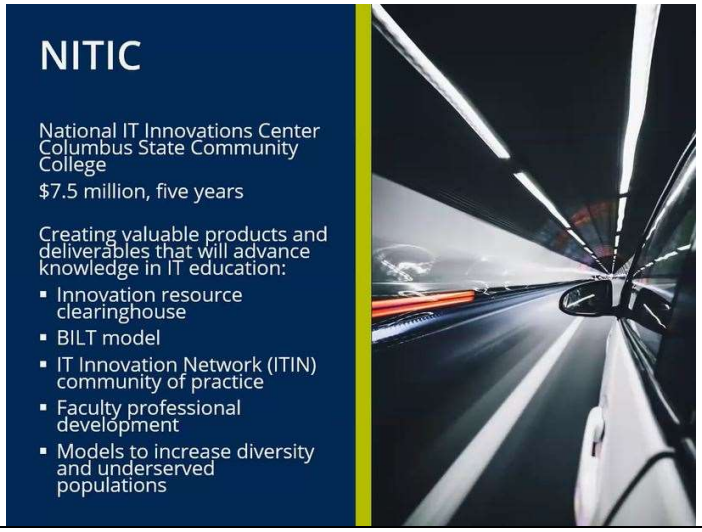
National BILT Meeting Minutes
"Networking Infrastructure" KSA Vote and Discussion

MEETING DATE: **Tuesday, May 7, 2024**	MEETING TIME: 9:30am-12noon Eastern	MEETING PLACE: Zoom
RECORDER: Mark Dempsey	RECORDING: Available upon request	PREVIOUS MEETING: Data management KSA vote meeting – March 8, 2024

MEMBERS PRESENT

BILT:		
Scott Andersen	Sean McBride, Idaho State University	Shane Stailey, Idaho National Laboratory
Stacy Brandenberg, Hye Tech Network and Security Solutions	Kimberlee Millikan, Ascension	Dan Tuuri, Involta
Craig Cocciola, Cogent Cyber Workforce SKills	Susan Morris, Cogent Cyber Range	Kim Yohannan, Alteryx
Carolyn Corbin, Center for the 21st Century	Robert Packer, Converged Technology Group	Plus 1 more employer
Devin Jones, Wiley Edge	Mark Richter, Hitachi Digital Services	
NITIC staff: Ann Beheler, Mark Dempsey, Christina Titus, Stephanie Schuler, Larry McWherter, Leah Palmer, Diane Meza		

Agenda items	Discussion
Introductions and KSA overview	Ann explained she was principal investigator (PI) for the National Convergence Technology Center grant at Collin College; that grant ended last fall. Ann worked with Columbus State Community College in Ohio to develop an NSF proposal for a new national IT center to succeed the CTC. NITIC (National IT Innovation Center) was funded in summer 2023. Ann will lead the BILT meetings for NITIC. Ann introduced NITIC's PI Larry McWherter and assistant director Stephanie Schuler and asked each of the employer SMEs to briefly introduce themselves. Other NITIC team members said hello. 

	Larry discussed NITIC. He noted this is a time "built" for IT innovation. He's the cybersecurity coordinator at Columbus State, but he is setting that aside to work as NITIC's PI. The NITIC grant is $7.5 million for five years. There are five elements of NITIC's work and Larry said they're all connected and all equally important. The goal is to create as many resources as possible to help faculty prepare students to join the workforce. He noted that NITIC especially needs help from BILT member SMEs. Education sometimes moves slowly, but IT programs cannot afford to do so. Ann explained the meeting will update the KSAs (knowledge, skills, and abilities) prioritized in May 2023, the last time the CTC's BILT convened. The list will focus on networking infrastructure which includes cloud. Cybersecurity is a part of networking, though Ann noted there are major NSF cybersecurity centers like NCyTE (https://www.ncyte.net/) that focus solely on cybersecurity. She reminded everyone to cast votes based on what will be needed 12-36 months in the future for entry-level IT workers. "Everyone has to start somewhere." The goal is to fill entry-level pipelines with qualified candidates to save businesses money and time on on-the-job training. Consensus is not the goal; the votes and needs won't be the same for everyone. Only employers vote – educators do not vote. Ann noted also that abstention is okay if there's an item on which a BILT member doesn't feel qualified to vote. This BILT KSA voting process is based on one developed by the U.S. Air Force. Ann explained the 1-4 voting scale. Each KSA item will receive its own separate vote. * "4" means absolutely must be in curriculum * "3" means should be in curriculum * "2" means it's a "nice to have" * "1" essentially means delete Because semester hours in a program are limited, it's important to know (via the 1s and 2s votes) what content can be dropped to make room for new. Using a QR code, the SMEs voted electronically. Ann reminded them that we would not discuss the KSA items until after the voting ended. She also noted that items with an average of 2.6 or less (which the spreadsheet formula automatically turns pink) typically will get left out of curriculum, acknowledging that certificate and degree programs have limited hours. Ann will discuss those KSA items with the BILT. She also often discusses items with a "wide" vote spread (e.g., an item with six 4s and four 2s). The BILT members can also ask to discuss any KSA item of interest.
Knowledge	Ann started by defining "knowledge" as conceptual. Students won't have the skill, but they will know about it. *K18 - Knowledge of Voice over IP (VoIP), 2.60 average* One SME voted this high because most communications (including this Zoom call) are VoIP. He said network engineers need to know what video looks like on VoIP and how to fix it if it breaks. Another SME noted that this information can be provided by an AI tool; understanding troubleshooting best practices is more important. VoIP is too complex now for entry-level workers. VoIP is so commoditized and cloud-based; the days of troubleshooting "phones on desks" are over. Look at how AT&T is pulling out of the phone landline business. Another SME agreed – soon you will log into VoIP and treat it like an app, rather than as an underlying technology. The SME who voted this KSA high reconsidered his vote given the discussion; he agreed that it's not an entry-level K. It's becoming more and more of a specialty. If students are

	really curious about VoIP, let them explore it on their own. One SME who also teaches suggested that he likely wouldn't include VoIP in his class. Another SME echoed the idea that he's more interested in whether a new hire understands how to solve a problem rather than understanding specific technology. The BILT seemed okay if K18 gets left out. From the chat box: "We do not deploy phones to users. Our requirements around using/supporting VoIP are ensuring that a smart phone through a *aaS tool is functional. When I hear VoIP knowledge I think PBX, switching, protocols, etc. We don't need the weeds on this." **ACTION: consider removing K18.** *K15 – Knowledge of concepts, terminology, and operations of a wide range of baseband and broadband communications transmission media and protocols (computer and telecommunications networks, satellite, fiber, wireless), 2.70 average* Ann noted that K15 will be kept as is, but wanted to talk about the wide vote distribution. One SME said that entry-level workers would not be involved in SDN solutions. This is something more suitable for a senior technician. He asked to remove it, suggesting some of this is common knowledge. Ann reminded everyone that community colleges students come from varied backgrounds – they all may not be tech savvy. Another SME said that this seemed to be the only KSA that mentioned satellite and fiber. He liked that; he said those will become more and more important and wants students to know it. Another SME marked this lower – to him, the WAN is like tires on a car. You know they're there and what they do, but you don't need to know the "granular" specifics. One SME agreed that it's important for entry-level workers to understand these transmissions are different so when they're with their peers and teams, they understand the conversation and can contribute. Ann remined the BILT of the difference between "knowledge areas" (Ks) and "skills" (Ss) - "knowledge" is awareness; "skill" is being able to do it. She admitted that the level of understanding needed may vary based on the employer's needs. Someone asked how a student can develop a "skill" S without also getting the foundational "knowledge" K? One SME noted that 70%+ of business are small businesses that would potentially hire entry-level network engineers, though another argued that many small businesses would likely hire a third party to do this sort of work. Another SME noted again his need is for students to know how to learn fast and troubleshoot rather than understand these items. He believed that in 36 months, much of this work will be handled by expert systems (https://en.wikipedia.org/wiki/Expert_system). "Anything with a K is irrelevant if it's not teaching someone how to learn." *K23 – Knowledge of where to find details on wired and wireless transmission standards (e.g. Ethernet, Bluetooth, Radio Frequency Identification (RFID), Infrared Networking (IR), Wireless Fidelity (Wi-Fi). paging, cellular, and satellite communications.), 3.40 average* One SME pointed K23 out – he liked that K23 pushes the need to know "where to find." He thought that's a valuable element for all of the Ks. "Do you need to have it memorized? No, but I need you to know how to go get it." *K30 - Knowledge of file system implementations (e.g., New Technology File System [NTFS], File Allocation Table [FAT], File Extension [EXT]) including network storage and servers with emphasis on extensions, 2.50 average* Ann noted this one has a wide vote distribution: "Maybe we want it in, maybe we don't." One SME would not have an entry-level person do this. Another noted that it's a matter of what you

	want your infrastructure people to do; it also depends on the OS you choose. He also said that this starts to involve security topics and file systems, not just the infrastructure. The BILT was okay if this were removed. **ACTION: consider removing K30.** *K42 - Knowledge of infrastructure data storage capabilities and storage clusters, 2.60 average* Again, one SME noted that this depends on what your infrastructure definition is. He saw this this as an application layer item like for database administration. DBAs need to be skilled in that. The infrastructure people just need to know how to put it together. Another SME agreed. A different SME noted that there is a need for understanding and knowledge of infrastructure storage capabilities, even though entry-level workers won't be working in these areas. **ACTION: consider removing K42.** *K59 - Knowledge of Web Services technologies, 2.70 average* One SME considered this an application layer item. What are you defining as infrastructure? Is this on the app side or not? Ann replied that with so many different kinds of companies, it's hard to know for sure. Another SME found this to be a very broad, sweeping category. He knows web developers who don't understand web technologies. He would rather a student learn what it means when someone tells you, for example, they're going to implement an Apache engine in building a web app. Something like that would be more descriptive and finite. K59 as is seems very broad to him. Another SME agreed, but wasn't sure how to fix it. He wondered how this sort of thing is being taught in classrooms now. One SME who also teaches suggested this is something students would know about on a general level without getting into the details. While one SME wondered about removing it, another noted it's important for students to know what "web services" means, especially as it relates to network traffic and making apps available. If you understand those concepts, you can do basic analysis. Another SME was looking at it from a troubleshooting angle – "I've been hit serval times by web services updates that got very chatty and got into the network; it looked like a network problem but it was really coming from app layer." Students need to know web services from a troubleshooting angle. Another SME agreed that the definition of "entry level" is subjective, he didn't think workers will know enough about web services without experience and time in troubleshooting. The BILT seemed reluctant to remove it all together, but when Ann suggested an alternative "awareness of web services and their impact on the network" no one seemed enthusiastic. Other things are more important. One SME wondered if K11 "Knowledge of measures or indicators of system performance and availability" and/or K21 "Knowledge of network and systems management principles, models, methods (e.g., end-to-end systems performance monitoring), and tools (NOC and SOC)" might cover some of this. From the chat box: "The distinction I see is layer 4 vs layer 7... web services are at layer 7." **ACTION: consider removing K59.** *K61 – Knowledge of the different Cloud computing database types (RDS), 2.60 average* *K62 – Knowledge of how to scale a Cloud database, 2.30 average* Ann noted that over the years, more and more cloud Ks have been added to the list. One SME noted that he would not expect an entry-level worker to understand these. It's not an entry-level job duty. Another agreed that the database-related items would not be suitable for entry-level workers. But he agreed that general knowledge of the cloud is important, but not specifics. **ACTION: consider removing K61 and K62.**

K64 - Knowledge of the differences between SQL and Non-SQL Databases, 2.30 average
BILT okay removing this item.

ACTION: consider removing K64.

K65 - Knowledge of Cloud IAM (Identity and Access Management) - cloud and hybrid, 2.90
One SME said that IAM "makes me nervous." He'd never have an entry-level person do any of this. But he noted that his huge enterprise might use IAM differently than other companies that might use it more "generic." Another SME agreed – knowledge is important, but it's highly dependent on the company's policies and procedures. Another SME voted this lower because it seemed so specific; if they know IAM they'll get the cloud stuff later. The BILT liked the idea of changing "knowledge of" to "awareness of." They suggested doing the same for K66 "Knowledge of Cloud IAM users, groups, roles and policies - cloud and hybrid."

ACTION: change "knowledge of" to "awareness of" for K65 and K66.

K73 – Knowledge of microservices and containerization (e.g. Kubernetes and Docker), 2.70 average
One SME was "nervous" seeing Kubernetes score so low. In his world, it's what makes the move to public cloud "make sense." (Ann noted that at 2.70 this KSA is in the green and will likely make the cut.) Another SME agreed that microservices and containerization are the future. When asked if he would have an entry-level person do this sort of work, one SME said yes. Another SME found this too specific - he noted that Kubernetes and Docker are one of many such tools for this sort of work.

A side discussion emerged here regarding the difference between "knowledge" and "skills." One SME was casting his votes thinking a K to be "one step" away from being able to do it, which is not the definition the BILT process uses. Going forward, the BILT facilitators will work harder to clarify this distinction to avoid confusion. "Knowledge" K means a general, conceptual awareness of a concept or tool, while "skill" S means you have the know-how and hands-on experience to do the work. Knowing about something (K) doesn't mean you can do it (S).

K76 – Knowledge in preparing and deploying a cloud database solution that meets application requirements, 2.50 average
K77 – Knowledge of database management systems, query languages, table relationships, and views, 2.40 average
None of the BILT members lobbied to keep these low-prioritized items.

ACTION: consider removing K76 and K77.

K80 – Knowledge of Google Cloud, 2.60 average
None of the BILT seemed to want to remove this despite the low vote average. It's important to include all of the top three cloud providers in the K section. Ann noted that some colleges have trouble covering all three, but if they're in the Ks they can be covered broadly. One SME noted that AWS and Azure control 70% of the marketplace, but that doesn't mean Google can't become more widely used in the future. He also noted that which cloud service is taught will depend on a school's job market; some regions may need students to learn Google based on the needs of the local companies.

ACTION: consider keeping K80.

	K81 – Knowledge of emerging technology (e.g., blockchain, quantum computing), 2.60 average One SME didn't care if his entry-level workers knew about these technologies. Another SME wondered if the problem was the specific examples. Maybe there are better examples than blockchain and quantum. He brainstormed things like Jenkins (https://www.jenkins.io/), continuous integration and/or deployment (CI/CD) (https://about.gitlab.com/topics/ci-cd/), infrastructure as code (https://aws.amazon.com/what-is/iac/) that are emerging and growing. Those are some things students should be learning. Another SME wondered about students that might go work for a start-up learning about copyright and patents. The BILT was okay removing the specific examples. From the chat box: "Support change K-81. I would answer higher without the specific tech listed. I trust faculty to develop culture of innovation, environmental scanning, etc." **ACTION: consider removing the specific examples and keeping K81.** *K87 - Knowledge of assessing and evaluating the technical benefits of implementation of a cloud computing architecture, 2.40 average* BILT okay removing this item. **ACTION: consider removing K87.**
Skills	*S12 - Skill in configuring and basic optimizing software, 2.90 average* *S14 - Skill in maintaining directory services (e.g., Microsoft Active Directory, LDAP, etc.), 2.70 average* One SME stated he wouldn't have an entry-level person do this. He noted that both skills are "organization specific" and would be better suited to an employee that's been around for a while. Another SME suggested that smaller employers might take on entry-level workers and ask them to handle their active directory networks. 70% of the economy comes from small businesses. This could also be an issue of semantics in S14 – skill in "supporting" versus skill in "maintaining." "Maintaining" suggests more responsibilities for keeping it running. Entry-level workers help support but not maintain. One SME noted that in three years, with small companies embracing CaaS (https://www.redhat.com/en/topics/cloud-computing/what-is-caas) technologies, the maintenance will be done by providers and not the company. That is, you pay a monthly fee and a vendor provides the environment and the directory structure. All you do is add, remove, and change. Looking to the future, this won't be a skill to be taught. But for now it's appropriate. **ACTION: consider removing S14.** *S17 - Skills in using microservices and containers (e.g., Docker, Kubernetes, ECS) and understanding monitoring dashboards, 2.50 average* One SME noted that the two companies he manages don't have any physical infrastructure; it's all containerized and cloud enabled. If a job applicant didn't have these skills, then he'd have to spend time on on-the-job training to get them up to speed and he said that the point of the BILT and the KSA vote is to try and lessen OJT costs to business. But another SME believed that S17 is too specific. He wanted it to be broader. For enterprise, entry-level workers wouldn't do those jobs. He noted that the vast majority of employers are enterprise – Walmart employs more people than half of the country's small businesses. The BILT needs to strike a balance between small business and enterprise. He stated that the generic skill of how to do it is important, but not the specifics. When someone asked how would you teach S17 if it were taken out of curriculum, he responded that you can go to a search engine and get accurate step-by-step directions on setting up a container. Another SME countered that S17 is more than just following

	directions to set something up correctly. The SMEs weren't sure about the word "using." Should it be "administering"? There's a difference between using it and deploying and administering it. Ann noted there are many gradations to S17. One SME asked to remove the "e.g." examples. He thought the examples were too specific – there are many other orchestration tools. Another SME responded that it's Docker and Kubernetes that have the kind of market share that will be most useful on a resume. The point is to try and train as many students as possible for the widest number of technician jobs. There's little point in schools spending time and money teaching tools that no one is using. Another SME agreed – if you acquire the hands-on skill of using Docker and Kubernetes, then you can transfer those skills to other tools. As he mentioned with other skills, a SME noted that within three years these will evolve radically. That's why he's arguing to keep this as generic as possible. *S28 - Skill in applying Software Defined Networking concepts, 2.90 average* One SME noted that he would never have an entry-level person do that. He suggested making it a K so that students are aware of it, similar to K15 and broadband. Entry-level workers at small businesses might be asked to do this. Other SMEs agreed, but noted that applying SDN is an "advanced topic" that needs practice and experience in a precise and accurate way. Then again, the SMEs suggested that small businesses likely wouldn't use SDN anyway. Some questioned the word "apply." Ann wondered about making it a knowledge item K. One SME noted that SDN is covered in K44 "Knowledge of Software Defined Networking concepts" so maybe that's sufficient. He wasn't sure how a school can teach SDN as a skill – it would be experience. Ann suggested that some colleges have big equipment investments from Cisco. *S46 - Skill in analyzing and troubleshooting containers, 2.60 average* *S47 - Skill in using tools like Chef, Puppet, Ansible etc., 2.60 average* Ann asked if this should be removed since containers was previously covered. One SME argued for keeping it. He would not hire anyone who didn't have those skills; his company is cloud-based. Another SME was okay keeping it so long as there were knowledge item K that aligns with S46 and S47. **ACTION: consider adding a new K to cover containers.** *S51 - Skill in identifying areas where there are issues/gaps in a cloud implementation and develop a working solution, 2.50 average* The BILT agreed this is pretty advanced for an entry-level worker. **ACTION: consider removing S51.** *S53 - Skill in identifying appropriate cloud services that provide the compute power needed to solve a technical business problem while optimizing cost, 2.40 average* The BILT agreed with the SME who suggested an entry-level worker would not do this. BILT was okay removing this. **ACTION: consider removing S53.**
Abilities	Ann explained that this KSA list was last updated in May 2023. Since then, consideration of abilities have evolved. More and more, BILTs are converting some technical abilities into skills. That leaves only employability "soft" skills in the abilities section. The BILT seemed okay moving most of the "non-soft skill" abilities into the S section. Another SME noted that in most of the frameworks he's seeing, it's Ks, Ss, and Ts. The ability As are all soft skills.

	ACTION: move the technical abilities (e.g., A1 "Ability to install network equipment including routers, switches, servers, transmission media, and related hardware") into the S section and leave in the A section only employability skills (e.g., A16 "Ability to communicate effectively within and among team members and associated stakeholders").
Certifications	*Cert 4 – CCNA, 2.78 average* One SME asked to remove this, but Ann suggested there will be pushback from colleges. Another SME noted that many colleges graduate CCNAs through Cisco Academies. Even if employers wouldn't put new hires in a high-risk architecting or engineering role, there is still demand for CCNA certs. It helps provide vocabulary and knowledge of Cisco gear. Ann added that CCNA is an administrator cert. *Cert 5 - SSCP/CISSP, 2.56 average* One SME called CISSP a "paper tiger." Another noted that a CISSP isn't possible for a beginner. The BILT acknowledged that this requires additional experience. *Cert 6 – CWNP, 2.22 average* *Cert 7 – CWNA, 2.56 average* One SME called for these to both be removed along with CISSP. The BILT acknowledged that these certs require additional experience. **ACTION: consider removing Cert 5, 6, and 7.** *Cert 8 – AWS Cloud Practitioner, 2.60 average* The BILT found it odd that his was voted so low. They wanted this one kept. One SME noted that this is essentially Net+ with cloud. Another SME said that all of his developers went out and got this cert because it was helpful in their development role. **ACTION: consider keeping Cert 8.**
What's missing	Ann next asked the BILT for help identifying what KSAs were missing from the list. What should go on the list? One SME asked for the knowledge and skill in using **expert systems within a large language model**. That could be any one of 50 systems. It's not just how to use the systems, but how to intelligently look at the results and make sure the output isn't a "hallucination." Does what the LLM provided make sense? Other SMEs suggested adding a K related to AI ethics. He noted the infamous case of Samsung putting proprietary code into an LLM and thereby inadvertently giving away its IP. So not only do entry-level workers need to know about using expert system LLMs, but they need to understand the liabilities and risks involved. Others agreed – you cannot push into an LLM, you push into an expert system. This new K and S might include the verb "verifying and interpreting" the output. This would include knowing how to go to a known valid source to verify the data. Another SME listed these as "what's missing" – * Knowledge of **Infrastructure Recovery Methods** during a cyber-attack and also post-attack due diligence. He admitted this may not be entry level but it's critical to him. * Knowledge of identifying **Single Points of Failure**. That is, how to recognize critical dependencies in your network and what to do to mitigate. * Knowledge of **Infrastructure as Code (IaC)**. How to automate infrastructure provisioning and management using IaC tools like Terraform, AWS CloudFormation, or Azure Resource Manager templates. Another SME agreed, but noted that IaC should be a deeper conversation. He's

	curious especially with Hashicorp and IBM buyout (https://www.forbes.com/sites/rscottraynovich/2024/04/25/what-ibms-deal-for-hashicorp-means-for-the-cloud-infra-battle/?sh=1e31f33d6b75) * Knowledge and Skills of **Monitoring and Logging**. He noted that network engineer spend most of their time in logs). This should include understanding and using cloud monitoring and logging services such as AWS CloudWatch, Azure Monitor, or Google Cloud Logging. This also includes learning how to set up alerts, monitor performance metrics, and analyze logs for troubleshooting. Another SME suggested adding an understanding of log consolidation tools. In enterprise, you're reading Splunk not logs. If you're using AI ops, you don't need to read logs or Splunk; you're just reading the report from the AI ops. In three years, this will trickle down to the small businesses. But students need to be clear on the overall skill. Another SME noted that many companies are looking to community colleges for help with **operational technology (OT)**. He's curious what's being done to support that area that connects enterprise with utilities and infrastructure. The need for OT is growing. Ann reminded everyone that most programs are graduating IT generalists. But she's not yet familiar enough with how OT affects industry. Maricopa community colleges in Arizona are working with companies looking for entry-level OT engineers and technicians who have more knowledge than just traditional IT. Some programs are adding cloud-based digital twin training, for example. Ann wondered if there's any additional room in curriculum to add OT. She wants to talk to Maricopa to learn more.
Next Meeting: Tuesday August 27, 2024 – trends talk	