

BILT Meeting Minutes
("Face to Face" KSA validation)
Tuesday, May 2, 2017

In attendance:

BILT	Mercedes Adams, NetApp Tom Boehmer, Juniper Susan Coefield, VMware Lucas Figg, Dell EMC Anne Frailey, retired Cody Hooper, Cisco Yang Lai, Juniper Candy Slocum, Interlink Bob Thomas, SEC Kim Yohannan, Dell EMC	Phil Andrews, Biz Smarter Chelsea Bray, Catalyst Corp Vincente D'Ingianni, Raytheon Ivor Flannery, Redline Matt Glover, Le-Vel Tu Huynh, Comerica Lynn Mortensen, retired, Raytheon Brian Smith, NTT Data Glenn Wintrich, retired, Dell
Educators	Suzy Ames, Lake Washington Ann Beheler, CTC Trevor Chandler, Houston Tricia Conner, CTC Charles Desassure, Tarrant County Ernie Friend, Florida State College Stephanie Gray, Gallatin Mike Harsh, Collin Mark Highum, Bay College Jimmie Joseph, Ferris State Manzurul Khan, Houston Xintao Liu, Herzing CyndiKaye Medved, Waukesha Debbie Miller, CTC Kay O'Dell, Workforce Solutions Jeff Palmer, Collin Jackie Porter, El Centro Adam Rocke, Seminole State Beth Stall, El Centro Anna Tanguma-Gallegos, Science AZ Sheacy Thompson, Workf Solutions Dan Tuuri, Kirkwood Donnie Willis, NCTC	Judy Archer, NCTC Pam Betts, San Jacinto Michael Coffman, Collin Mark Dempsey, CTC Kathy Fant, Collin Amy Garrison, CTC Elizabeth Halweg, Fox Valley Julie Hietschold, Collin Toni Jenkins, Collin Chris Kadlec, Georgia Southern Ray Koukari, Gateway Technical Patrick Logue, South Plains Jim Meeks, San Jacinto Brian Nelson, Lansing Sean Otmishi, Houston Lenny Portelli, Seminole State Susan Randall, Cleveland William Sanderson, Renton Susan Svane, NCTC Greg Teets, Clark State Christina Titus, CCTA Dwight Watt, Georgia NW Solomon Zewde, Houston

National Business and Industry Leadership Team (BILT) Meeting for Networking and Convergence Technology

Ann Beheler – Welcome. The Business and Industry Leadership Team face to face meeting is held once a year to discuss the knowledge skills and abilities (KSA).

Agenda



Business and Industry Leadership Team (BILT) meeting
Networking and Convergence Technology
Tuesday, May 2, 2017 (8:30am-2:00pm Central)

AGENDA

8:30am Light networking breakfast
8:45am CTC grant update
9:00am KSA/job skills discussion
10:45am Break
11:00am KSA/job skills discussion
11:45am Working lunch – Manufacturing/IT and Biotech/IT KSA meetings
12:30pm KSA/job skills discussion
1:50pm Conclusion and next steps
2:00pm Adjourn

Rules of Engagement - Mark Dempsey



Rules of Engagement

BILT members – phone

- * **Mute your phone** if you're not talking – on WebEx, that's *6.
- * You have to **pick an audio channel** – you can't listen on your phone and also listen through your computer. That creates an echo and you will be muted.
- * **Do not put us on hold** – we prefer to not hear your hold music.
- * Feel free to speak up, but always **say your name** so everyone knows who's speaking.

CCN educators – chat box

- * We'll be monitoring the WebEx **“Chat” tool** for questions. Send your chat comments and questions to the Host. Do not send messages to us via e-mail.
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Ann Beheler - National CTC grant update (charts enclosed)

- Renewal grant funded – July 1, 2016 to June 30, 2022



BILT meeting CTC
grant update.pptx

Ann - The BILT model and the KSA Process



BILT Model and
process.pptx

Ann – We rely on the BILT to lead CTC/CCN work.

- What do we need to teach?
- Must also demonstrate to the BILT that we are designing curriculum to fit their suggestions.
- The BILT works with us four meetings a year (three virtual and one face-to-face).
- **History of the KSA process** – KSA (Knowledge, Skills, and Abilities) process was developed by the US Air Force – simplified into clusters of particular knowledge areas.
- **National BILT sets the stage** – 60 partners in our Convergence College Network (CCN)
 - ✓ The faculty takes the BILT’s requests and cross-references them against curriculum identifies the gaps. Then they implement new curriculums or new models to address the gaps.
 - ✓ Faculty is limited by the number of semester hours per degree, with many states now limited to 60 semester hours.
 - ✓ Faculty cannot do a 120-hour associate degree so choices have to be made.
 - If we add hours, then we have to take away hours.
 - Or we have to get someone else to do it, which is our strategy for working with the high schools and the colleges.
 - ✓ All of the colleges are expected to have a local BILT.
 - We expect the CCN schools to take the national BILT suggestions.

Reminder of Roles / Ground Rules



Roles & Ground
Rules.pptx

Knowledge/Skills Validation Process



KSA Validation
Process.pptx

Questions?

KSA/Job Skills Discussion

Ann - Students want to do cybersecurity. But sometimes there is so much specialized cybersecurity involved that unless the student has foundational knowledge of IT, they do not have enough of the basics to be successful for the long term.

Edge Computing is involved. How much scripting? How much programming do we need to have people to know in this program?

Ann - What do you see in terms of Internet of Things/SDN/edge computing? How important are they? What are we going to do with it?

Glenn

- SDN is no longer a future item; it's moving down from extremely large global enterprises and mid-size enterprises. The small enterprises are most likely not going to adopt it. They're probably going to move to the cloud and SDN will be adopted by their provider.
- A company of 50 employees is not going to hire five IT people.
- No one IT person can handle all the technical issues for all the devices.
- When we talk IoT (Internet of Things), we're really talking about a software defined enterprise incorporating IoT.
- Network Function Virtualization is an initiative to virtualize network services that are now being carried out by proprietary, dedicated hardware. The concept of replacing dedicated network appliances (such as routers and firewalls) with software running on commercial off-the-shelf servers optimizes service creation, activation, and assurance by bringing the benefits of the cloud to the metro edge.

Lucas

- In general, there's a large push towards hybrid cloud, defined as a "same to same architecture" – VMware to VMware, Azure to Azure, OpenStack. There's also a push as well to Multi-Cloud, which is a healthy mixture of Azure, AWS, *VMware (reference: <https://www.rackspace.com/en-us/cloud/multi-cloud>)*. Hybrid cloud moved out of the infrastructure as a service layer and into software as a service and that is the focus. They want to move higher up the value chain and assume the services for providers similar to AWS, who developed their own in relation to IoT. Every public cloud has very specific offerings and capabilities developed for IoT. It's generally in partnerships with AWS and Azure because the criteria requirements are vast and you get a level of distribution with those providers that most can't provide on their own.
- Two data centers trying to compile millions of devices into the centers, plus their typical traffic patterns, create challenges. So they rely on the providers to compile the devices for them and extend that data back into their private enterprise.
- The focus has been on how to put workloads into these public providers –
 - Manage them
 - Govern them
 - Understand who's doing what
 - What's the cost associated with it?
 - How do they expect value from the data collected from IoT?

Glenn - The basis of SDN is the abstraction away from the hardware. You can manipulate it. You can do anything like a router change from anywhere in the world. And you can do it globally. Ten years ago if you had 100 routers in your system someone had to go in and change 100 individual routers. You may write a script to do it faster, but you had to touch every single router, every single switch. When you extract it out of the hardware, you can do that in a centralized fashion. And, from the curriculum perspective, if a network guy isn't the guy plugging in probes and twisting screws, he's writing scripts to do things. He is working with the scripts given to him and validating that they can work across the

enterprise. What is the change from hands-on to virtualized work, and what does that involve for a future graduate that is entering that field of work?

Matt – It’s also very important to understand how big of an impact it has on the industry that you’re in.

Glenn – Are any of the companies that are represented here moving away from peer review of being a senior human to being some form of artificial intelligence to check the humans’ work? So you don’t have an AWS failure, because it recognizes that it was wrong.

Lucas – There are some early software out there. I think StackStorm is one where network automation platform can run test changes and do roll backs. They’re highly focused on taking control of broad networks and then treating it no different than you would any other part of DevOps scenario. You actually have test-driven network configuration, which is pretty rare. Usually you just press the button.

- *StackStorm is a powerful open-source automation platform that wires together all of your apps, services, and workflows. It’s extendable, flexible, and built for DevOps and ChatOps (<https://stackstorm.com/>).*

Ann – Jeff Wacker, the futurist who retired from Hewlett Packard, says that they’re using robots to do all of their maintenance in the data centers. Those used to be jobs for entry-level people. The robots do the racking and stacking. Either these jobs are becoming obsolete or they are obsolete.

Glenn – Lucas mentioned to me recently about remote configuration. You install equipment, you choose the number of processors and servers, and then all that work is done from a centralized location.

Lucas – “Hyper-converged” is an infrastructure platform. All vendors have it at some level. You go in and fill out a number of questions and it will fill in clusters. Or, you can actually have something called “down stack” – as more containers are needed and the workload increases, the container orchestration would reach down into the infrastructure and indicates “I need four more servers that look like this.” They’re provisioned, they’re attached to the network, and they get their firewall and ACL software by networking. Once that’s done, the application is automatically pushed, tested, validated, and added to a virtual IP so additional servers can handle the workloads that have been brought forth. They will also retract once the workload has diminished and decommission themselves to be used in other areas.

- *A hyper-converged system allows the integrated technologies to be managed as a single system through a common toolset. Hyper-converged systems can be expanded through the addition of nodes to the base unit. Common use cases include virtualized workloads. (Google researched) <http://searchconvergedinfrastructure.techtarget.com/definition/hyper-convergence>*

Glenn – Another entry-level job is racking and stacking and all the scripting you do on the router and switches. If all an employee knows is networking, they’re in trouble. Dramatic shift is part of the change in the curriculum.

Lucas – If you’re single skilled, you’re going to have a limited job-life.

Chelsea – I work for a small business that's making sure my skills are broadened. I'm currently working on servers, serving as network engineering, project managing, and making sure my team and I know the processes to get from point A to point B.

Matt – The single skill really has to do with the person's attitude. If they're skilled and they want to learn new things and they're eager to learn, there is no end to where that employee can go.

Tom – We all agree that we're in this digital disruptive era from a business perspective regardless of the industry you're in. At Juniper, we see four areas that are critical design elements inside the business at a high level that plays a role into all the technology being discussed:

1. Automation
2. Interoperability
3. Trust
4. Performance

It doesn't matter what industry you are in. If you don't have a business that supports those four attributes, you may not remain sustainable due to the changes in technology. Technology is enabling things that are far beyond our comprehension from a human perspective. Business models have adapted and will continue to adapt and people, processes and compliances will have to catch up.

- Automation – It's all about enabling technology, we have a concept called the "self-driving" network. We do believe that networks could be self-driving and self-healing. In IT, 90% of the resources are focused on keeping the lights on. That is not healthy to the business. A lot of people are concerned that automation removes jobs. Quite the contrary, it moves people into strategic roles that are actually more important to the institutional organization.
- Interoperability – IT infrastructure (real business interoperability) is moving beyond the negotiated federation that we're currently in. There are IT skills that will have to be developed.
- Trust is about building security and to trust in everything that's connected to the business – There are models out there that establish trust.
- Performance – Technology provides agility. It's all about performance: scale in or scale out. Those enabling technologies create performance. Everyone's going to move to the cloud, but those applications that are latency sensitive aren't going to be cloud-appropriate.

We have multiple industry advisory boards and across the industry the top problems are:

- Security
- Staff – Attracting, retaining, sustaining staff.
- Those that have staff want to know how to transform who they have to develop the skills to take advantage of the evolving technology.

Glenn

- We haven't even got in the peak of digital transformation. This change is going to shift jobs.
- What do you do if you have system administrators and there is no longer a need for them? Do you terminate these qualified employees? Companies will have to start using futurists and say, "I won't need system administrator in four or five years. What am I going to do with those quality people?"
- Most companies are going to have to look to a third party to train their staff and a community college is cost-efficient and equipped. I think that's going to be a changing role for community colleges over the next five years. This change may not be effective for the KSAs, but it can be

applied as double duty by creating courses for the students and the same courses for the Continuing Education program. Consider Raytheon and Dell as examples: they welcomed community colleges to come teach in their conference room. There was a partnership between Dell and Raytheon to create those classes.

- There are so many things that are first-level troubleshooting that you no longer need that first-level person. How many companies do a password reset with a human?

Matt

- We have small businesses and medium- size businesses that do leverage the “gig economy.” They look for someone specifically skilled in an area that they can hire for a short period of time to get the job done, and then get their on-premises staff trained to do the same job.
- If you’re tech savvy and capable of learning new things, that is where people are going to want to pivot.
- If you’re in a technical space and you would like to stay in a technical space, you’re going to want to move to a new technology paradigm so that you can keep your skills highly-tuned and be viable in the marketplace.
- Community colleges are the mechanisms for getting those retrained capabilities and that’s why this KSA process is so important.

Vincente – I’ve been contrarian about certificates and the need for extra certification. I’ve been working in this industry for years. Specific vendors, specific certifications often come and go and change, but recently I got an e-mail from a very high-level employee who needs to go get his CISSP. There is a very high value placed upon certification now. It was shocking to me. It’s something that’s occurring quite a bit now.

Glenn – I can tell you from my experience if you had a job opening for an entry-level network engineer, how many applicants do you think you would get if you posted that on all the different websites? A thousand? You can’t interview that many people. So what’s the first thing HR does? “Do they have a CCNA?” “No? Then take them off the list.” How do you get the applicant list down to ten for interviews? They’re using the certifications as a hurdle. It’s not the hiring manager saying “If they don’t have a CCNP, I don’t want to even talk to them.” It has nothing to do with the hiring manager.

Vincente - The Department of Defense requires a certain level of certification to be able to work on the premises and that is becoming the certification of highest value.

Morning break

Cody – Speaking of retraining, I’d done phones my whole career. But I’d heard about openings in other departments. And so at 41, I changed from phones which I knew to now I’m security. Yes, Cisco loved certifications but they also love learning. They’ll bend over backwards for you. I don’t work there for the money; I work there for the education.

Lucas

- Careers are made by filling in the gap. When VMWare first came out, people popped into it and they had a skill and became highly employable. This is still happening in all directions and in all levels of the stack.

- Teach your students to be forever learners. Reinvent themselves every 6-8 months. You have to develop your skill set continually.
- When you see something on the rise, be the person hungry enough to go after it. Don't wait for someone to send you to training.
- The ones who stagnate will be unemployed.
- Career management is really important – this is not something you're exposed to early in your career unless you have a mentor. If there's anything we can do to help student understand what that means, it would be important to them.

Ann – When I was in industry, my resume was my responsibility, not my employer's. Keeping it up to date was my responsibility. We need to train students about this skill.

Kathy F - Our BILT is pushing DevOps. How do we teach that?

Lucas

- There is no one way. You'd be teaching framework and ideology, not execution. It is a way of thinking, not a way of doing something.
- There are DevOps tools that you can teach them use to be part of a DevOps team.
- Most of the customers I talk to – no one does it the same way. Generally, what we see are developers enabling to become ops.
- Beyond DevOps there's SRE (site recovery engineers). Your whole goal is to eliminate unplanned outages by prioritizing bug fixes and infrastructure improvements over new widgets in coding.
- DevOps and SRE are interrelated, but teaching your students to think and work in an agile framework is what you can do. It's not "This is DevOps and how you do it is step one, step two, step three."
- Company to company it's done very differently; few do it properly because most customers are still very siloed into teams.
- The biggest hindrance in the corporate world is their standards book – "This is what we do and these are my processes and we will not deviate." If you can teach students how to evaluate standards and processes and look for ways to improve and automate and streamline, they will have high value.

Ann - We find that people are going into infrastructure because they don't like programming. More and more, they at least have to like scripting. Scripting by another name is programming. How do we convince faculty that this is the case?

Vincente – Python, Java, and C++. I have seen Python used for so many things. It's become the de facto language.

Tom – Python and PHP will replace Java.

Lucas

- Scripting is important, but most medium and up enterprises are focused on the tooling like Puppet and Chef. That's the way DevOps works. I can go in and create a Puppet manifest that will provision and control a server or storage platform or network and if someone changes it, it will put it back. It won't allow you to deviate from the manifest.
- That's what customers are asking for. Not just to configure, but also to control.

- Puppet and Chef are engrained in any effective DevOps team unless they're writing their own system.
- There is an open source option for Puppet. You can download and use it to manage your laptop as a way to self-teach.
- If you have a large cloud environment, the rule used to be 50 servers for every admin. Today it's a thousand per admin. Now they're making changes using these types of tools. They can't have someone working on 500 servers. You can't manually control these things anymore. You have to automate it. So the option is write your own scripting or use a Configure Management Tool. And usually it's a blend of both.

Glenn – You might want to look at the open source element. If you're teaching Python, the students could download Puppet and do some self-learning.

Tom

- The foundation of a portfolio since its inception is open APIs. It's required. The whole concept of a self-driving network relies on all of the automation predicting what's going to happen. You can't pay someone to look at logs fast enough to address a vulnerability. There has to be a leveraging tool.
- The more versatile someone is, the more marketable they'll be.
- Maybe one piece of the curriculum is helping a student entering the workforce understand how to use their skills and pursue what they want. What do they want to do? You can work for enterprise (government or industry), you can work for a service provider, you can work as a freelancer (entrepreneurial skills). The needed skills will be different for each career option. The point is to help the students see that each business model is different.

Matt

- I don't want people to think that for DevOps you have to know things like Puppet and other technologies. It's just the process.
- With the cloud, we started making it easier for the development teams to integrate with the operations team for seamless deployment and delivery. Then someone came up with the term "DevOps." We've been doing this for a long time.
- As the cloud allows deeper levels of integration, there are incredibly powerful new tools to allow for the transactions. And everything is getting thrown into the DevOps term. It's a big mechanism that's transforming employment and transforming the way developers and ops teams operate. But, if you're a very small business you won't have the integration capabilities that a large business would. We're crafting the KSAs to serve the largest population possible and DevOps is a part of that mix.
- Rather than get wrapped up in the styles of technology, look more at the DevOps view and the DevOps "tool chain." It's about reducing the silos and increasing the deployment capabilities.

KSA/Job Skills Discussion/Voting begins

Working lunch – Manufacturing/IT and Biotech/future IT KSA meetings

Ann - This was requested by the National Visiting Committee and included in the CTC grant renewal proposal. We agreed to come up with this KSA analysis involving manufacturers and IT experts as a

response to expanding IT systems in manufacturing and biotech. Industries need IT support, but don't have a full-time IT administrator.

Can job skills be identified for a worker who understands IT as well as manufacturing or biotech?

Manufacturing floor and assembly lines have to keep operating. If any technical issues arise due to the network, someone has to repair it. And, if the manufacturer has a gig economy-type person or a contractor in general, that contractor may not be on-site and may not be available. Even if the contractor is onsite, they could support it virtually. But, that is assuming your contractor has a cloud setup and that you can get to the right person at the right time to restore network operations.

I will invite all of you to this KSA analysis for manufacturing possibly six or eight months from now, because we have to get the new grant underway. We have two new partners – Lone Star College (Houston) is going to focus on secure coding and data virtualization. Biotechnology focuses on a massive amount of data. Some of the devices are networks, but that is not the big issue. It's when you're mapping the genome – and there's a massive amount of data to turn it into information – that's the big deal. There was another National IT Center with the NSF that focused on the computational and programming side of IT. That center was not renewed. The NSF is pushing more and more to streamlining the number of centers that they have. For four million dollars for five years, they can fund four-and-a-half projects. They could fund more projects with fewer centers. Therefore, we will possibly have to take over the computational side. I will monitor that as we go.

In terms of biotech, I know that is going to be big data – programming and figuring out the capacity around big data. We're not focusing on that at this time.

Glenn – Will these be separate tracks for an associate degree?

Ann – We're not even close to that decision. We want to see if there is going to be a need for it first. I think there is. When we started talking about putting the intersection between manufacturing and IT into our proposal, I had very little interest from the small and medium manufacturing firms. But a year later, they're demanding it. On the biotechnology side, they're asking the biotechnologist to have enough knowledge about big data to manage their own. There is a regional center in Austin, Texas and we may work with them.

Glenn – There's an extreme shortage of business analysts, but they're not at the bachelor level. If you would have asked me a year ago, I would have said you need a PhD. A lot of companies are scaling back saying they really don't need PhDs. They can bring in cognitive computing to do a lot of the work, and we can use people with master's degrees to do the analysis of what's being processed by the computers. What would someone with an associate degree do in that area? If you could do the work with a two-year degree, most likely it can be automated.

Ann – What we have learned so far, and it changes rapidly, there appears to be an area called "data technician" that is a support assistant for the master's degree or the PhD person to help identify the integrity of the data. The hackers are not always hacking and stealing data, they're hacking and changing data. Companies are identifying different hacker approaches and find comfort knowing their data has not been compromised due to the service of data technicians. That's one thing emerging as a popular task that an associate degree graduate can do. However, it's not going to be an end-type job. They call these career and technical educational programs "terminal degrees" – after two years, you get a job and

you never have to learn anything again. We know that is not true. I've encouraged students to at least get a bachelor's degree. The fact that you can get a bachelor's degree is good.

Self-Learning

Lucas – If you want to move into management, a bachelor's degree is required. But, individual contributors – highly technical, focused people – after a few years in the industry, stand upon their experience and their ability to demonstrate what they can do versus certification and credentials. That doesn't mean you have to go back to formal school. However, to stop learning will destroy your career.

Ann – Something I discovered over the years while I was teaching is that there are distractions – children, parents, etc. You can do self-learning, but it is challenging to have that kind of focus while managing a family and life in general.

There are a plethora of MOOCs (Massive Online Open Courses) available to everybody. Someone along the way said that we could use MOOCs and we wouldn't have to teach a whole lot. The problem is the assessment assigned to a MOOC. How are you going to prove that you know what's been taught? When are you going to use it? And are you going to be self-motivated enough to continue taking the courses? And, usually, there's no one to tutor you.

Lucas – They've pulled some of these (MOOCs) courses. You can still get to them, but it's a little different than it was before. You can go on YouTube and watch them.

Mercedes – NetApp has a MOOC and we partnered with IEEE. It's delivered through edX, but its vendor-neutral and it's foundational. It's a four-week program. You can print the certificate if you would like one for \$50. Otherwise, it's free. It's not going to make you an expert, but it will help you if you need some knowledge on certain subjects. When you think about all the learning options, this is one of the opportunities to say that students are learning on the job and on YouTube. We have "knowledge bite" videos that take a little over ten minutes. So when we look at this curriculum of what we really want to invest, I think we have to look at the backdrop of all the different ways you can learn.

Ann – No disagreement on that. My point was that this group (BILT), when we met in the past, saw MOOCs as a lifesaver. Instead of putting in 60 hours, the BILT wanted to substitute some of the hours with a MOOC. It wasn't quite that simple.

Lucas question to Mercedes – Do your courses integrate some of these alternative online learning resources like YouTube videos? Are they integrated into the course? Where you say, "Here's what I want you to go learn." And then students will know how to sort out what's good content and apply that in some way?

Mercedes – Yes, they are integrated into the course.

KSA/Job Skills Discussion/Voting resumes

KSA/job skills analysis ranking 1-4

Reminder: all of these rankings and votes include a consideration of what would be most valuable for an entry-level person. A “4” vote means that skill is more important; a “1” means that skill is less important.

The items in red on the KSA grid are additions, comments, and questions posed during the May 2017 KSA discussion in comparison to the May 2016 KSA grid. The Excel grid was amended and updated in the room in real-time.

The KSA list is scheduled to be finalized in a late summer “Tiger Team” follow up meeting.

Certificate voting will be handled via a short online survey.

KSA	Knowledge, Skill, Ability	Topics	# votes (4 = most important)				
			4	3	2	1	Avg
K1	Unix / Linux Linux/ Unix OS	Current within 3 years, as of now the operating system of the IoT	13	2			3.9
K2	Windows Server OS	Current within 3 years, need this background for AWS and Azure	2	12	1		3.1
K3	Operating System Maintenance	Includes topics such as account mgmt, installing apps, command line, directory, file structures, os scripting, config modification, backup/restore, os admin, scheduler, stopping/starting services, change control, documentation, awareness of KPI and SLA/OLA, log files and patches, ACL .		15			3.0
K4	OSI Model	Layer 1: physical layer Layer 2: data link layer Layer 3: network layer Layer 4: transport layer Layer 5: session layer Layer 6: presentation layer Layer 7: application layer Provide basic framework for how it all works, including how cloud computing has impacted the conceptualization of the seven layers. Plus and awareness of IP multimedia services. Understand that OSI is the framework for all problem solving and troubleshooting	15	1			3.9
K5	Collaboration Technologies	Includes such topics as * PSTN and telecommunications basics as well as computer networking/telephone integration * voice over IP protocols and details of protocols and implementation * video telepresence * presence * instant messaging and text messaging * mobility * IMS overview * SDN/OpenFlow					#DIV/0!
K6	Network Devices-Connectivity Components	Includes such topics as NICs, Switches, Routers, Gateways, Cables and connectors, WAPs, DTE, CTE, modems, sensors, wireless LAN controllers (includes teaching MAC and ARP). * Note: this runs on K5 "Collaboration Technologies" above - K6, K7, and K8 will be merging together over time.	15	1			3.9
K7	WAN Technologies	Includes such topics as packet and circuit switching, T and E carrier systems for data communication, multiplexing and concentrating, Serial Synchronous Digital Hierarchy, ISDN , etc., SDN/ open flow , PRI ISDN, MPLS; SIP and Web RTC protocols. Add mobility? * Note: this runs on K5 "Collaboration Technologies" above - K6, K7, and K8 will be merging together over time.	5	8	2		3.2
K8	Wireless Infrastructure and WLANs	Includes such topics as cellular telephone, Personal area networks, Satellite data communications, microwave point to point, Broadband Mobile access/LTE, Wireless spectrum, Wireless IEEE 802 standards, near-field communications , WiFi, Bluetooth Do we need near-field and Bluetooth? * Note: this runs on K5 "Collaboration Technologies" above - K6, K7, and K8 will be merging together over time.	4	8	2		3.1
K9	Troubleshooting and Equipment Repair	May include use of diagnostic software (such as cloud-based monitoring, listening, and remediating systems - e.g. Data Dog and New Relic and VictorOps) and use of hardware including hand tools as well as knowledge of troubleshooting methodology, critical thinking, situation assessment, documentation, inspection routines, fiber and fiber splicing awareness Understand the scope and details of the problem (and how to gather/analyze that data), understand error messages (and how to research them), use correct data for decision-making, apply the OSI model to troubleshoot (to apply the right tools to the right layer), employ communication and collaboration "soft skills" to resolve problem in a stressful, high-pressure environment, and demonstrate openness and transparency (i.e. don't hide mistakes).	13	1			3.9
K10	Infrastructure Monitoring and Restoration	Includes such topics as backup and recovery, centralized log monitoring and correlation, types of alarms, network monitoring and provisioning software, fault tolerance, mass storage and backup devices, network and computer system redundancy including storage, power, connectivity and hot swapping, disaster recovery planning, business continuity, MDM (mobile device management) exposure but not required, sensors, automated tools (e.g. HP OpenView, SolarWinds, SystemCenter), optimizing performance. Add Wireshark? This should cover both physical and virtual infrastructures - students need hands-on in either physical or virtual or their education is incomplete	6	8			3.4

KSA	Knowledge, Skill, Ability	Topics	# votes (4 = most important)				
			4	3	2	1	Avg
K11	Network Security	Includes at least overview knowledge of topics such as knowledge of firewalls, password practices and procedures, encryptions, network virus protection, anti-theft and tamper proof devices, biometrics, security protocols, SSL, IPSEC, WPA2, SSH, Security tools, Trojan horses, DMZ, Hack attacks, social engineering, public, private, symmetric, and secret keys, virus, worm, honey pot, and backdoor concepts, digital certificates, physical security, authentication, vulnerability scanners, intrusion detection systems, ACL, risk analysis, information security, data security, VPN	14				4.0
		Basic hardening do's and don'ts					
		Certificate management					
		DNS					
		Application interactions					
		Managing environments at scale					
		Configuration management					
		Password management					
K12	Virtualization Technologies (Network Function Virtualization NFV)	Change control process					
		Staying current with security advisories (how/where to find them)					
K12	Virtualization Technologies (Network Function Virtualization NFV)	Concept of network security should be woven into all other IT courses; take a moment at key points in all curriculum to ask "Is this secure? Why or why not?" and "What would you do you make it more secure?"; add to the class tests these questions, concepts, and elements - build it up, open it up, secure it					
		Includes Conversational awareness (non vendor specific) of such topics as installation/configuration of server and desktop virtualization solutions, management of virtualization solutions, administer/install/patch/recovery, virtual network and hypervisor configuration and optimization, identify solution. This should also include a high level of cloud. Understand difference between server virtualiation and network virtualization. May fade over time with the rise of automation.	12	2			3.9
K13	Storage-Management / Data Management (or Data Protection and Integrity?)	Includes such topics as evaluation of storage architectures such as DAS, SAN, NAS, CAS; understanding backup, recovery, disaster recovery, business continuity, and replication; understanding logical and physical components of an information storage infrastructure, tiered storage Include cloud topics? continuity vs data recovery vs backup recovery plans?	9	3	1		3.6
K14	Cloud and Cloud Services	Understanding what the cloud is, what are public/private cloud services, what is in a hybrid cloud, and what are the challenges and difficulties of using the cloud (including business requirements). Plus also awareness of mashups and API (application programming interface). Understanding of role of cloud architect; architects must master fundamentals that sit "below" the cloud. Includes such topics as server virtualization as a services desktop virtualization as a services, storage virtualization as a services, I/O virtualization as a services, security in the cloud, awareness of and exposure to different "X as a service"aaS types (differences between them). Consider a hybrid cloud solution as a capstone project.	14				4.0
K15	Soft Skills	Oral Communication, written communication, leadership, teamwork and collaboration, appreciation of diversity, conflict management, customer service, work ethic, professionalism, integrity, attention to detail, adaptability, organization, stress management, multi-tasking, problem solving, decision-making, intellectual risk-taking, thoughtful reflection, initiative, creativity, dedication, perseverance, pride in work, numerical and arithmetic application, following directions, information gathering, resource allocation, time management, technology and tool usage, critical thinking, willingness to continue learning, technical writing, presentation Soft skills should be threaded into every course and perhaps called out on the syllabus for emphasis.	14				4.0
K16	Basic Project Management	Basic understanding of principles including the individual's role in the process, accountability. Specifically, PMLC, ITIL, and SDLC as a framework of understanding	8	2	1		3.6
K17	Script Automation and Application Programming Interfaces	Global automation in a single push; writing, executing and debugging (Python, Java, etc). This can be a differentiator: understanding the basics/benefits of combining scripting and API will help students. Open source is one cost/free approach. This is used throughout all of the Ks above. Team building, project management, and time management concepts interwoven into classes likely through projects - ideally, each student has a different job working toward a common goal. (Don't wait until the final capstone to address these.)	11				4.0