

Solving Cybersecurity Skills Shortage With Apprenticeships and Certifications

NDIA

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Topics

- Why We Are Here
- Ubiquitous Software Defects, “Patch and Pray”, What is at Stake
- Swiss/German Dual Track “Learn and Earn” Model
- DoL Registered Apprenticeships
- Community Initiative Center of Excellence for Secure Software (CICESS)
- Takeaways and “ASKs”

Takeaways

- **Sense of urgency** to address unsustainable trends and exploit rare economic development opportunity to create hundreds of thousands of middle class jobs
- Industry/government/academic coalition led by industry to address “**skills gap**” and talent pipeline
- Connect education directly to a job through a dual learn and earn **registered apprenticeship program (Because “Nothing Else Works”)**
- Develop **skilled workforce** based on validated competencies and industry standard certifications
- Apprenticeships are good for business with **positive return on investment**

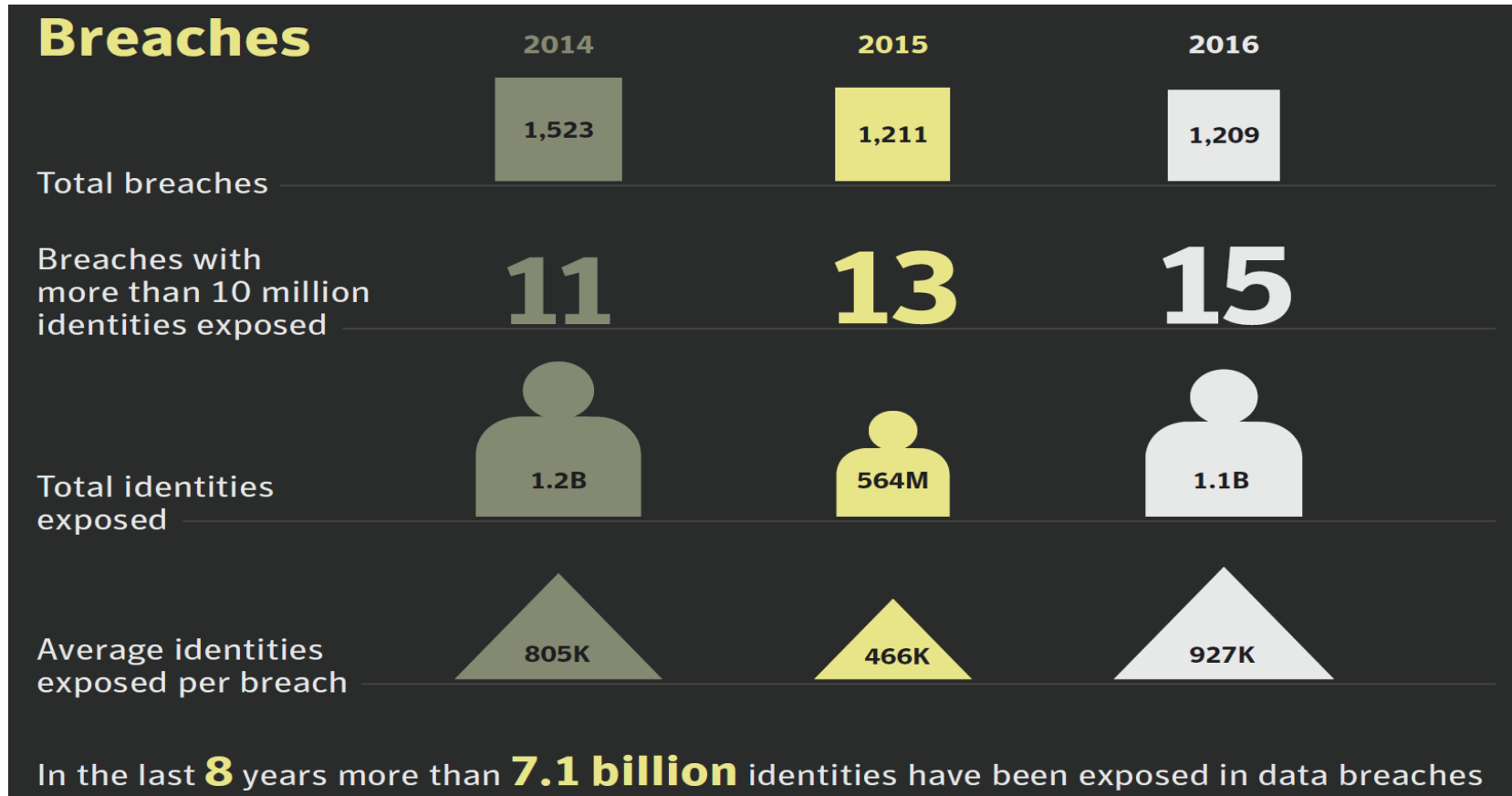


Why We Are Here

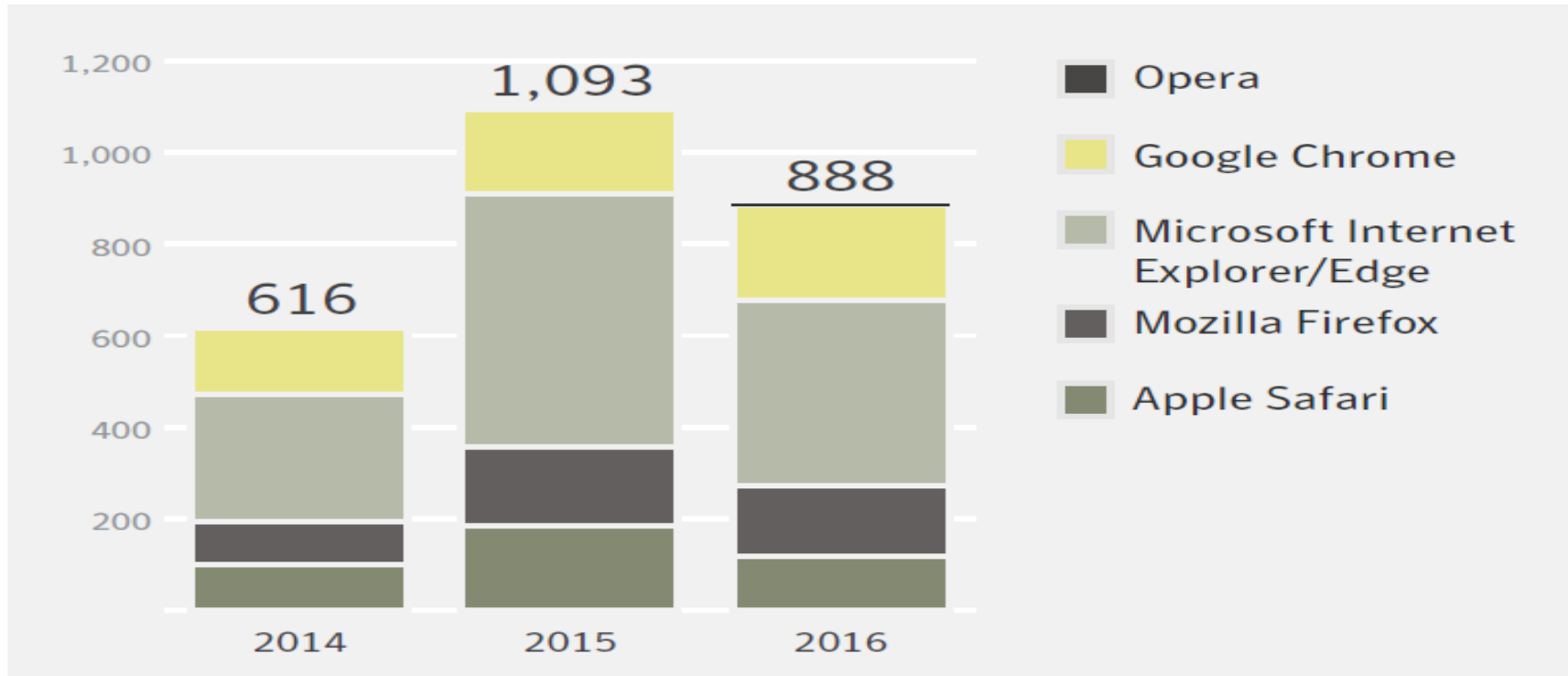
- Increasing number of cyber attacks against critical infrastructure
- 90% of attacks are successful by exploiting defects in software
- Software developers not trained to deliver software with fewer vulnerabilities
- 1.5 million cybersecurity jobs currently unfilled
- High youth unemployment and large number of under-employed people
- Student debt > 1.0 trillion
- Cost of status quo



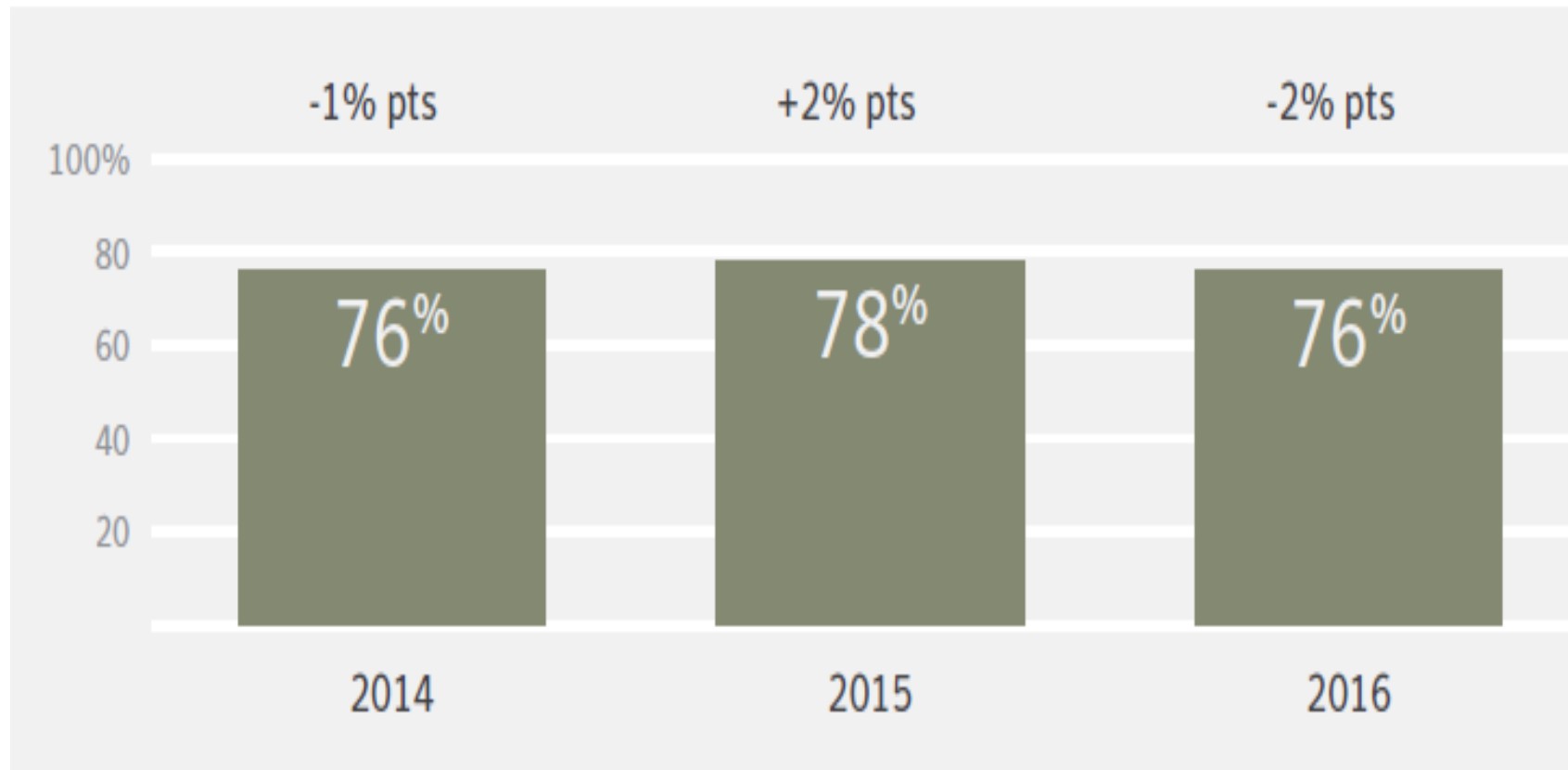
Personal Identity Breaches



Browser Vulnerabilities



Websites with Vulnerabilities



Patch and Pray - 1

Microsoft Patch Tuesday

On Tuesday, September 12, Microsoft released fixes for more than 80 security issues in multiple products, including Windows, Office, Microsoft .NET Framework, Flash, Internet Explorer, and Edge.



Patch and Pray - 2

Apache Struts Vulnerability Exploited in Equifax Breach

Equifax has acknowledged that the massive breach that exposed personal information of as many as 143 million people was due to a failure to apply a patch for a vulnerability in Apache Struts. A patch for the flaw was released on March 6, 2017. The Equifax breach occurred in "mid-May" 2017.



Patch and Pray - 3

Adobe Security Updates

Adobe has released updates to address security issues in Flash Player, ColdFusion, and RoboHelp for Windows. The Flash updates, available for Windows, Mac, Linux, and Chrome OS, address two critical memory corruption flaws. The ColdFusion update includes fixes for four flaws, and the RoboHelp update fixes two flaws

Patch and Pray - 4

Patches dominate the Top of the News this week.

Bill Murray speaks for many when he writes: "The cost to tolerate or remediate a design, recording, or coding error goes up exponentially with the time to its discovery. **There is something fundamentally wrong with an industry in which the toleration, indeed the institutionalization, of late discovery and remediation of error is as it is in ours.**"

And John Pescatore offers a path toward fixing that fundamental flaw in the software industry, describing a future where larger buyers of software (government, for example, along with the Business Roundtable) set a much higher bar for application security testing at multiple stages of the development life cycle, both for custom software they develop and for every package they buy, with **substantial contractual penalties for vendors who fail.**



What is at Stake - 1

Some US States Are Going Back to Paper Ballots

In the wake of rising concerns about the security of electronic voting systems, several US states are returning to the use of paper ballots for their elections. Georgia will pilot a paper-ballot system in elections this fall.

FDA Approves Pacemaker Patch, Announces Recall of Abbott/St. Jude Medical Devices

The US Food and Drug Administration (FDA) has announced a recall of more than 450,000 pacemakers because they require a firmware update to address several security issues. The recall applies to several models of pacemakers manufactured by Abbott, formerly known as St. Jude Medical. Patients must visit their doctor's office where the update can be installed while the device is in backup mode. The flaws could be exploited to gain unauthorized access to vulnerable devices and issue commands to modify the pacemaker's settings and functionality.

What is at Stake - 2

Car Safety Vulnerability Lies in the Way CAN Handles Error Messages

A vulnerability in the Controller Area Network (CAN) that exists in most new automobiles could be exploited to shut down components of the car, including safety systems. Any component connected to the car's CAN bus could be affected. The issue is not one that can simply be patched because it lies in the CAN bus messaging protocol standard. Components that send too many error messages are disconnected from the CAN, so if attackers can spoof error messages to appear to be coming from a targeted component, that component could be shut off from the CAN.

What is at Stake -3

National Infrastructure Advisory Council Report - A Pre 9-11 Moment

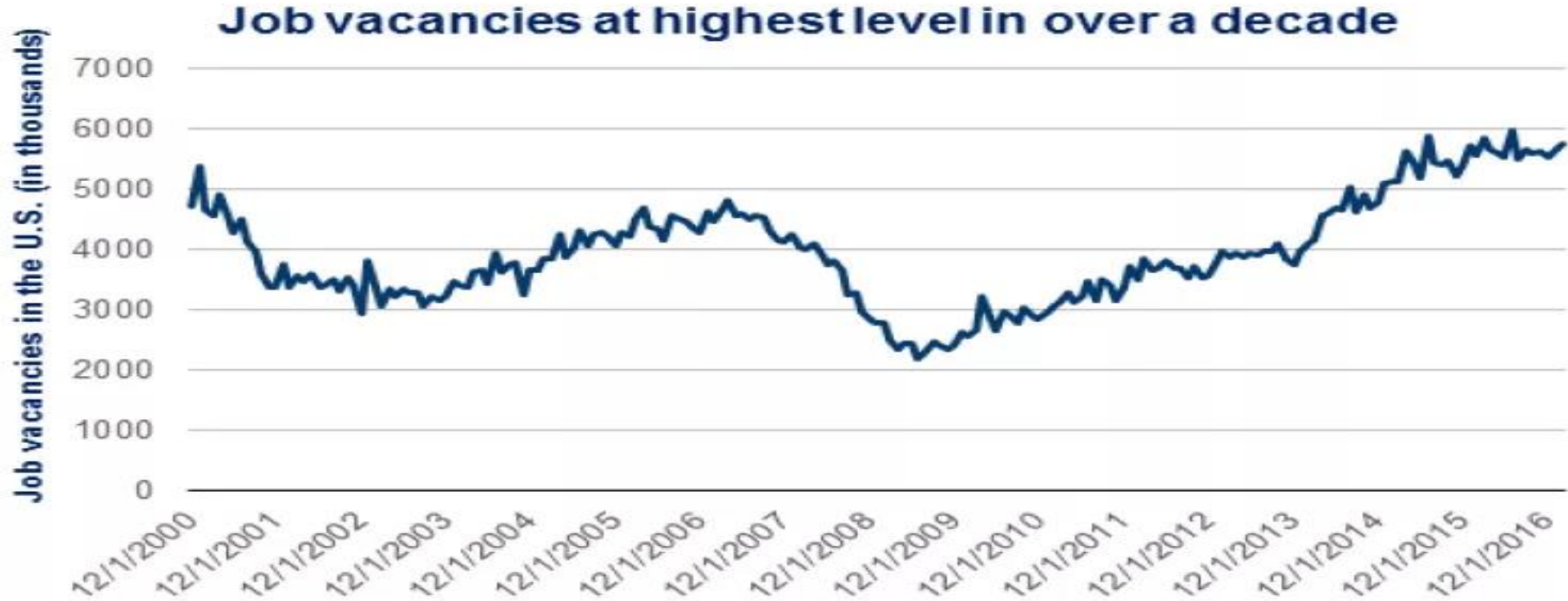
"There is a narrow and fleeting window of opportunity before a watershed, 9/11-level cyber attack, [for the nation] to organize effectively and take bold action," said the US National Infrastructure Advisory Council report. The report lists 11 recommendations, including "establish separate, secure communications networks specifically designated for the most critical cyber networks; ... identify best-in-class scanning tools and assessment practices; ... [and] establish clear protocols to rapidly declassify cyber threat information."



What is at Stake - 4 IoT Risks



Total Number of Unfilled Jobs



Source: Organization for Economic Co-operation and Development, Total Unfilled Job Vacancies for the United States® [LMJVTTUVUSM647S], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/LMJVTTUVUSM647S>, June 28, 2017.

BROOKINGS



Cybersecurity Skills Shortage

1.5 Million
MORE cybersecurity professionals will be needed to accommodate the predicted global shortfall by 2020

Source: (ISC)² 2015 Global Information Security Workforce Study

On average, **52%** of IT professionals surveyed stated fewer than **25%** of all applicants were qualified

Source: State of Cybersecurity: Implications for 2015: An ISACA and RSA Conference Survey

The biggest skill gaps of today's cybersecurity professionals

	72%	Ability to Understand the Business
	46%	Technical Skills
	42%	Communication Skills

Source: State of Cybersecurity: Implications for 2015 An ISACA and RSA Conference Survey

Fastest cybersecurity demand sectors are in industries managing consumer data

Source: Job Market Intelligence: Cybersecurity Jobs, 2015-2016 Burning Glass Technologies

Cybersecurity job postings took **8%** longer to fill than IT job postings overall

Source: (ISC)² 2015 Global Information Security Workforce Study

Expertise required for various cybersecurity roles in demand

- Information Security
- Network Setup
- Auditing
- Network Protocols
- Core Database, Coding and Scripting
- Systems Administration

Source: Job Market Intelligence: Cybersecurity Jobs, 2015

Approximately **10%** of the current cybersecurity workforce are comprised of women

Source: (ISC)² 2015 Women in Security: Wisely Positioned for the Future of InfoSec

18% Growth

Computer and mathematical occupations will grow much faster than the average job during 2012-2024

Source: Bureau of Labor Statistics, U.S. Department of Labor

Fastest growing skills in cybersecurity job postings

- Python
- HIPAA
- Risk Management
- Internal Auditing
- Audit Planning

Source: Partnership for Public Service

Hardest to fill skills in cybersecurity job postings

Source: Job Market Intelligence: Cybersecurity Jobs, 2015-2016 Burning Glass Technologies

- Software Architecture
- Network Attached Storage (NAS)
- Software Issue Resolution
- Internet Security
- Legal Compliance
- Data Communications
- Platform as a Service (PaaS)
- Computer Forensics
- Internal Auditing
- Apache Hadoop

Cybersecurity: the Hottest New Major In College

Large numbers of US colleges have added undergraduate cybersecurity majors, cybersecurity concentrations to other majors, and master's degree programs in cybersecurity. Most colleges, however, do not know what to teach, and **many are teaching students only how to admire the cybersecurity problem, but not how to fix it.** Further, computer science graduates don't learn secure coding or other technical cybersecurity topics. None of the top ten undergraduate computer science and engineering programs at American universities (as ranked by the U.S. News & World Report) required its students to take a cybersecurity course in order to graduate.

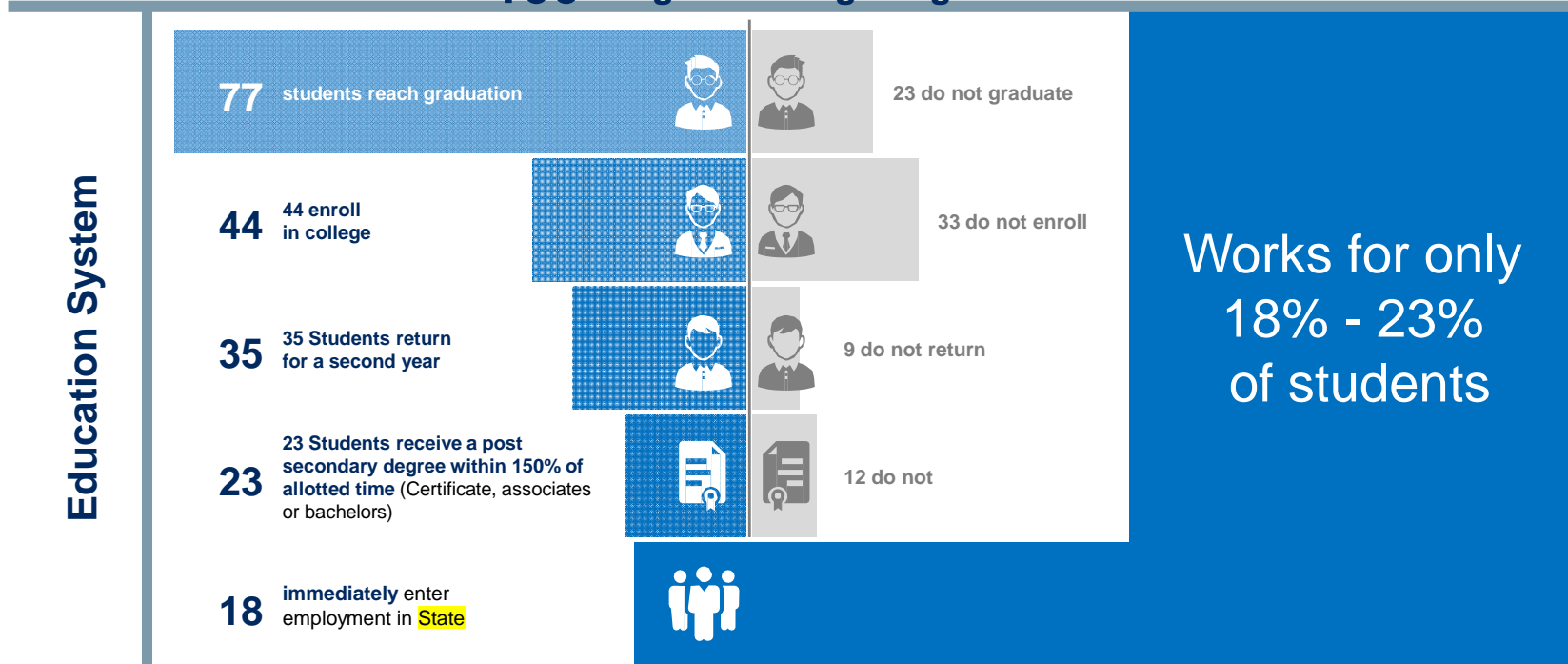
Read more in:

- www.villagevoice.com: How Cybersecurity Became 2017's Hot New Major



Educational System's Challenge

100 9th graders begin high school



The challenge: How do we prepare the talent needed by business to be globally competitive

Cost of Status Quo

Item	Cost
Two-year and four-year college	\$400 billion per year
Post-secondary workforce education and training	\$600 billion per year
Skills gap	\$160 billion per year
Time for new employees to reach full productivity	> Five months on average
Replacing an employee	Ranges from 6 to 24 months of the position's salary

Source: Georgetown University Center on Education and the Workforce



Swiss Dual Track Vocational Education and Training Model

STUDENTS GIVE APPRENTICESHIPS AN A+

They join the workforce prepared thanks to a *top-notch* education

- ✓ A prestigious education pathway
- ✓ Flexibility regarding future career options
- ✓ Skills & knowledge align with labor market demands
- ✓ No student debt
Tuition paid by cantons (states)
Apprentices earn a progressive wage

Gross Investment in Apprenticeships by Companies → **\$5.2 Billion**

Productive Apprentice Output → **\$5.65 Billion**

COMPANIES SEE A DIRECT NET BENEFIT → **\$450 Million**

Who benefits? Everyone.

AMONG SWISS HIGH SCHOOL GRADUATES

- 2/3 choose vocational education & training
- 1/3 choose a general education

YOU'RE HIRED

Switzerland has one of the lowest youth unemployment rates among European countries

APPRENTICESHIPS

Switzerland's business-driven & labor market-oriented training system

230 TYPES OF APPRENTICESHIPS TO CHOOSE FROM

- #1 MOST POPULAR: BUSINESS
- #2 MOST POPULAR: RETAIL
- #3 MOST POPULAR: HEALTH CARE

SWITZERLAND

NUMBER 1

GLOBAL INNOVATION INDEX

2011 • 2012 • 2013 • 2014 • 2015

How does the system work?

FUNDING SOURCES

- 10% FEDERAL GOVT
- 30% CANTONS (STATES)
- 60% PRIVATE SECTOR

AGE 14

CAREER COUNSELING

AGE 16

HIGH SCHOOL GRADUATION

APPRENTICESHIP (3-4 YEARS)

- Dual-track approach
- Work-based learning at host company
- Classes at local school

AGE 19-20

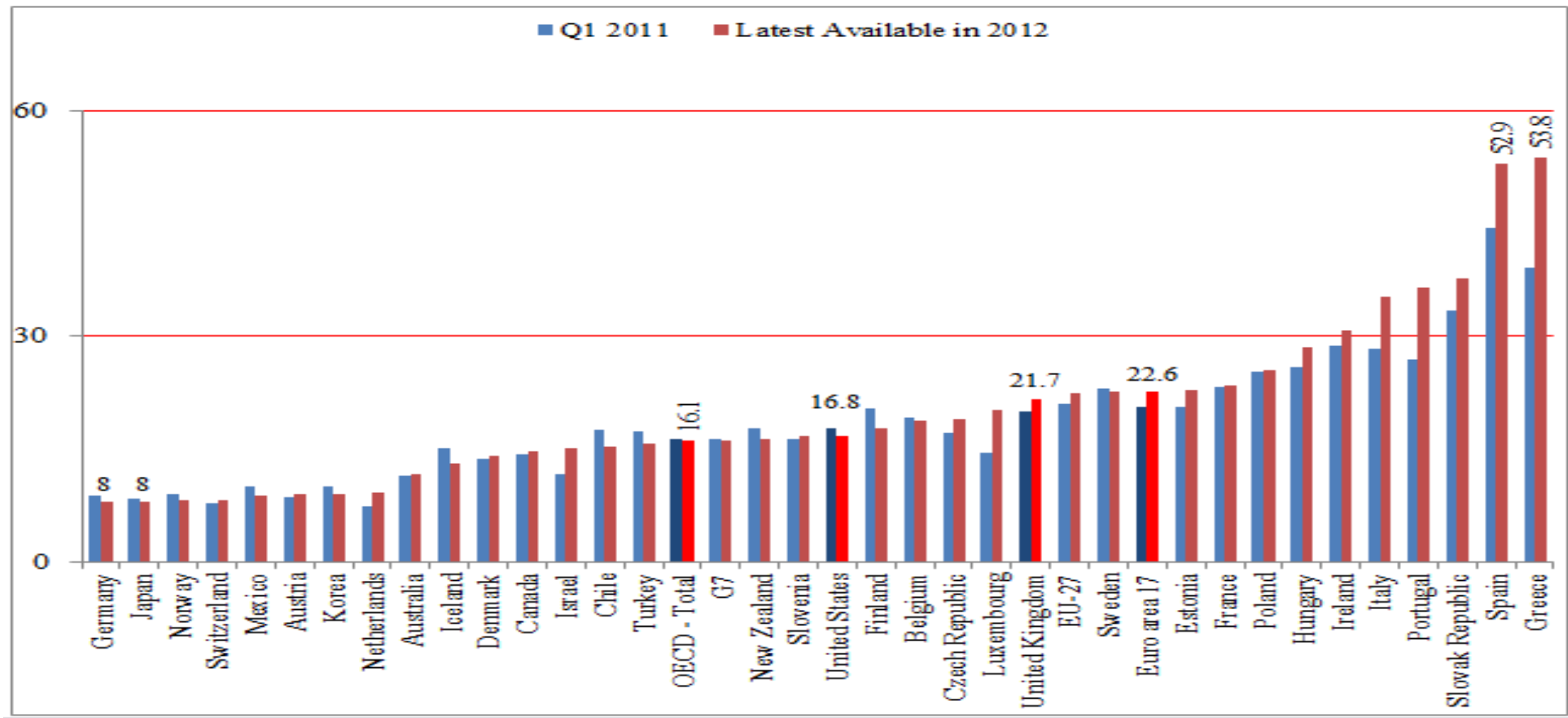
APPRENTICESHIP GRADUATION

EARN FEDERAL DIPLOMA

THE FUTURE AWAITS

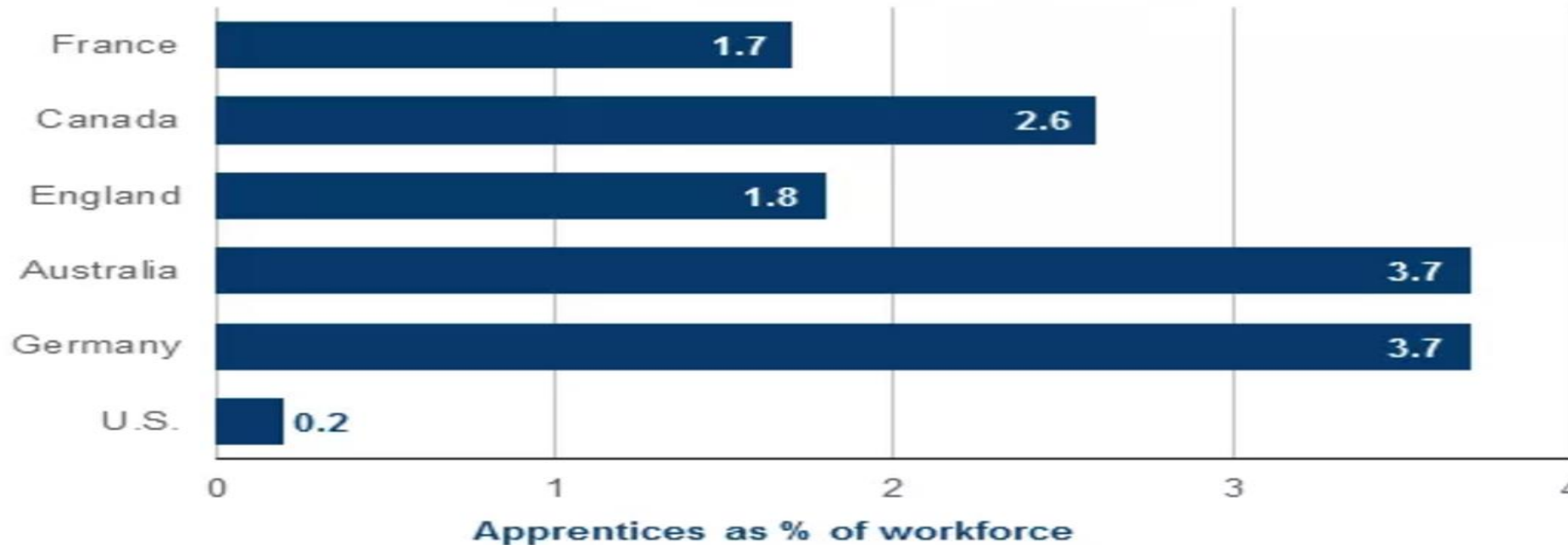
- A wealth of job prospects
- Maximum mobility in the labor market
- Further education

Youth Unemployment



Apprenticeships in the U.S.

Apprentices: not big in the U.S.



Source: Robert Lerman, "Are Employers Providing Enough Training? Theory, Evidence and Policy Implications," prepared for National Academy of Sciences, 2015

BROOKINGS



US Department of Labor Initiative




- An exciting national renewal and reimagining of registered apprenticeship
- Learn, borrow and steal from Europe
- Expand in new, non-traditional industries and occupations
- \$165 million in new funding for Registered Apprenticeship


DoL Registered Apprenticeship Requirement


5 Core Components of Registered Apprenticeship

- 
Employer Involvement Is Integral

Employer is the foundation for the RA program and must be directly involved and provider of OJT
- 
Structured On-the-Job Training with Mentoring

Minimum of 2,000 hours Structured and Supervised
- 
Related Training and Instruction

144 hours recommended per year
Parallel | Front-loaded | Segmented Options
- 
Rewards for Skill Gains

Increases in skills brings about increases in earnings
- 
National Occupational Credential

Nationally recognized credential showing job proficiency. Sponsor certifies individual is fully competent for career.

Employer-Led Collaborative Design



Why Apprenticeships?

Because Nothing Else Works



CICSS

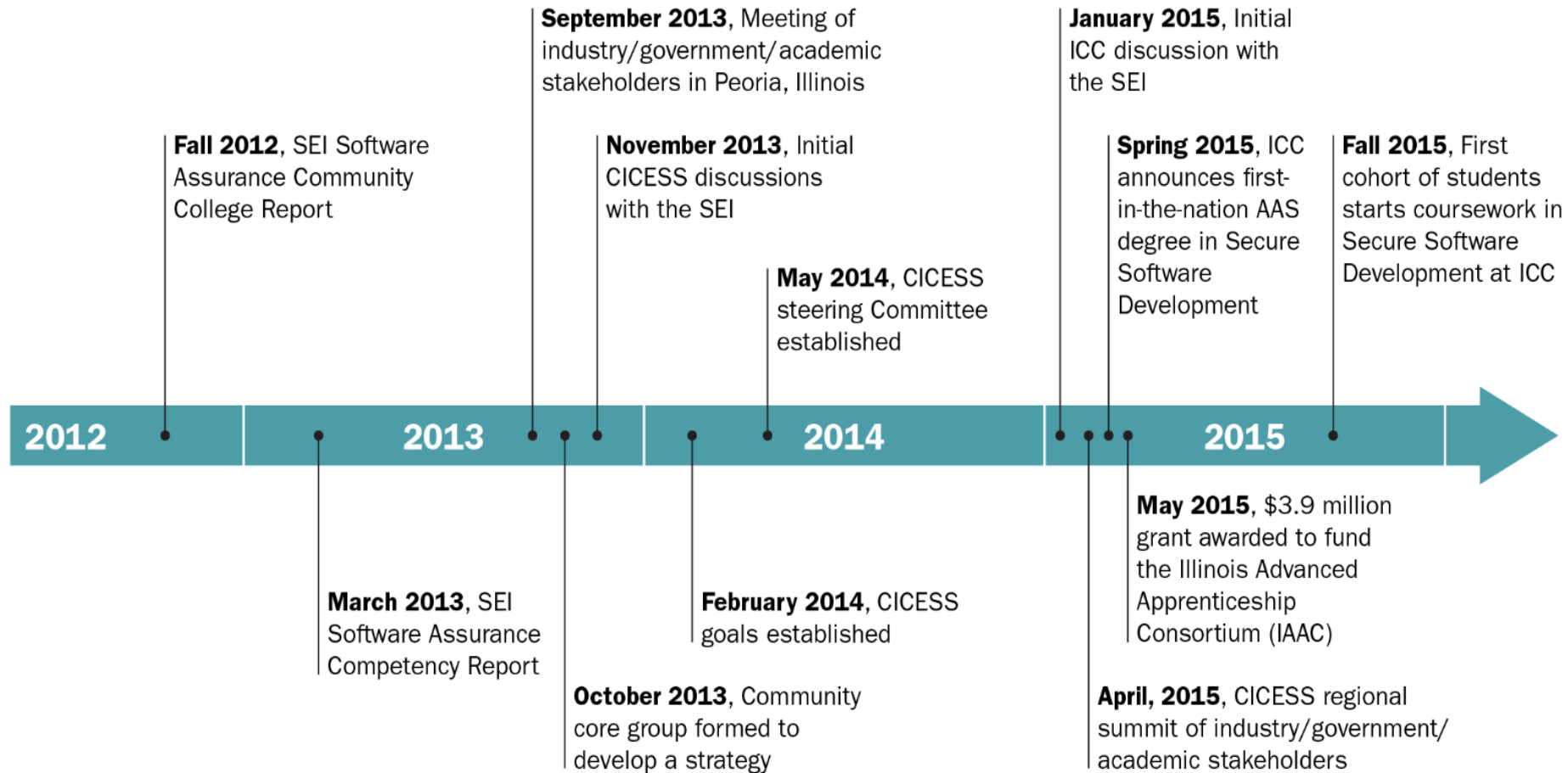
- Community Initiative Center of Excellence for Secure Software
- Solving Cybersecurity Skills Shortage With Apprenticeships and Certifications
- Launched successfully in Fall 2015, partnering with Illinois Central College and the Peoria Public Schools



A Unique Collaboration – Industry, Government, Academe



Timeline for the Community College and Industry Apprenticeship Program



CICISS Design – 1

- Standard academic curriculum leading to first-in-the-nation AAS Degree in Secure Software Development
- Berger Aptitude Test (B-Apt) for Computer Programming for entry to the apprenticeship program
- Standard apprenticeship curriculum based on Carnegie Mellon University Software Engineering Institute (CMU/SEI) process models
- Validate secure software development competencies – (ISC)² CSSLP, SEI PSP Developer certifications



CICISS Design – 2

- Alternating blocks of weeks of academic instruction and apprenticeship on-the-job training in the dual model
- Recurring and one-time-only fees from participating employers for ongoing program administration, apprenticeship curriculum development, and train-the-trainer materials
- Guidelines for minimum hourly wages for the apprentices with flexibility to meet varied human resources practices of participating employers

Apprenticeship Dual Model Computer Programing (Secure Software)

2-3-year dual model “learn and earn” program	
On the job training	Class room instruction
<p>Employment contract executed between company and apprentice</p> <p>Dual work study model with increasing hours under company supervision and mentorship as training progresses</p> <p>Standard apprenticeship topics defined by industry and aligned with Carnegie Mellon University / Software Engineering Institute</p>	<p>Full time student AAS degree in Secure Software Development at local community college</p> <p>Dual work study model with more classroom hours at the beginning</p> <p>Curriculum created by Carnegie Mellon University and adopted to meet industry requirements</p>
Practicum examination and standard industry certifications to validate competency	

Secure Software Development AAS Degree

CS I: Programming in Java

CS II: Programming in Java

CS III: Advanced Programming in Java

Structured Query Language

Introduction to Relational Database

C# Programming

Mobile Application Programming

Introduction to Computer Security

Secure Coding

Introduction to Assured Software Engineering

Database Administration

Structured System Analysis

Two electives in computer programming, web, or networking, depending on employer needs

Students must also take 19 credit hours in general education courses.



Alignment with Federal Initiatives

- DHS Cybersecurity Workforce Framework
- NSA Centers of Academic Excellence
- NIST Cybersecurity Education
- DoL American Apprenticeship Initiative
- DoL Registered Apprenticeship standards



CICISS Value Proposition

- Augmentation of your current workforce development methods
- Ability to plan for and satisfy future needs for hard-to-fill secure software developers
- Ability to build a secure software talent pipeline that includes women and minorities who are trained, mentored, and certified
- A cost-effective solution to training and retaining new workers in secure software development
- High retention rates when apprentices become full-time employees



Takeaways/“ASKs”

- Act with a **sense of urgency** to address unsustainable trends and exploit rare economic development opportunity to create hundreds of thousands of middle class jobs
- Develop industry/government/academic coalition led by industry to address cybersecurity **“skills gap”** and talent pipeline
- Take immediate steps to connect education directly to a job through a dual learn and earn **registered apprenticeship program**
- In your community, develop **skilled workforce** based on validated competencies and industry standard certifications
- Stay on the message: Apprenticeships are good for business with **positive return on investment**



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