Identifying a Profile for Vulnerability Assessment Professionals:
Talent Identification to Support Career Assessment

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ABSTRACT:

An inter-collegiate research team completed initial research analysis of 166 professional cybersecurity workers from government and industry to identify talent profiles aligned four roles within the Protect and Defend (PD) NICE Workforce Framework: Cybersecurity Defense Analyst, Cybersecurity Defense Infrastructure Responder, Cybersecurity Incident Responder and Cybersecurity Vulnerability Assessment Analyst. Anonymized data collected from multiple teams with performance assessments to build a statistically validated profiles of high potential PD cybersecurity candidates. The World of Work Inventory (WOWI) a multi-dimensional on-line career tool, assesses career training potential, job satisfaction indicators and career interests. Anonymized, aggregated ranked data described profiles of existing high performing candidates working in the field. Utilization of a statistically validated methodology to identify cybersecurity talent at different phases of an individual's career life cycle supports recruitment of high potential talent from diverse backgrounds to increase the numbers of candidates entering cybersecurity education and training programs.

INTRODUCTION:

Early projections in "A Human Capital Crisis in Cybersecurity" [i] are overshadowed by current projections of national [ii] and global demands [iii],[iv] for cybersecurity workers at over 1 million people in the national cybersecurity workforce by 2024. [v] [vi] Societies reliant on the Internet of Things are vulnerable to cyber attacks on critical infrastructures and the internet based economies. Sufficient quantity of quality cybersecurity talent is a national and global concern. [vii] Discussions in academic and government circles include professionalization of the field leading to career occupations. Perhaps one day professional licensing based upon education, training and continuing education will be the standard. [viii] The question remains: How do we identify top talent, candidates suited to specific cybersecurity roles?

Multiple factors play into selection of cybersecurity talent search process. Is it a question of candidates with innate talent or can individuals be nurtured into the field. Secondary factors of this approach require candidates have an intense personal interest, open to coaching and mentoring, and nurtured by a well-structured pedagogical process. [ix] Strategies to fill cybersecurity talent pipelines acknowledge competitions "attract those already committed to the profession than interesting and developing those still exploring their interest." [x] Pipelines to cybersecurity professions traditionally rely on computer science, IT, engineering departments to educate students, and do not have capacity to address the short and long term demands for cybersecurity professionals. US initiatives, NICE/NIST and DHS/NSA partner to increase awareness of cybersecurity and represents the nation cultural shift to promote entry into

an emergent career field. Gaps exist in assessing the qualifications and potential of candidates including and beyond the technical skills generally associated with computer science/engineers. Cybersecurity requires professionals with strong communication and team skills to work across departments and disciplines.[xi] and through identification and career guidance for potential cybersecurity talent.

Benchmarking cybersecurity to medicine is a recurring theme within the cybersecurity research community. In 1910 Abraham Flexner funded by Carnegie Melon transformed American medical education[xii], ultimately leading to the standardization of curriculum [xiii]professionalization of occupations within medicine. Initiatives led by National Initiative Cybersecurity Education[xiv], NIST and the Centers of Academic Excellence network [xv]guided by NSA and DHS parallel Flexner work in the early 20th century. Educational institutions and systems collaborating with NSA/DHS curriculum standards grapple with identifying a curricular system reflective of licensed occupations which was addressed by the medical profession.[xvi] Stephanie Keith, Director, Cyber Workforce Management, Department of Veteran Affairs, benchmarked cybersecurity education to the medical career education during her panel presentation at the NSA Executive Leadership Forum in 2019. **(Will get her direct statement).**

The 2010 study "Psychological Profile of Surgeons and Surgical Residents" methodology informed our research team study NICE job roles, Cybersecurity Defense Analyst, Cybersecurity Defense Infrastructure Responder, Cybersecurity Incident Responder and Cybersecurity Vulnerability Assessment Analyst, within the Protect and Defend NICE Workforce Framework. The original methodology used two of the three components, Job Satisfaction Indicators (JSI) and Career Interests Activities (CIA) to build a profile for surgical burn residents. Acknowledging rigors of medical school, internship and residency administering the Career Training Potential (CTP) was unnecessary. Surgeons and residents ranked by leadership and a performance profile, based upon two of the three WOWI scales ensued. All three scales are described in Methods

Methods

Teams of cybersecurity workers from seven organizations spanned government: federal and state agencies, a national laboratory, the Washington Air National Guard, non-government entities included retail, telecommunications and transportation corporations. While twenty organizations were contacted and understood   their contribution would impact the professionalization and development of quality cybersecurity talent, the seven participating organizations had the management support, organizational culture, team size and availability to participate.

On-site administration of the WOWI occurred in proctored conference rooms. In addition to the anonymized assessment, human resource departments provided job descriptions and additional information on the individual's performance ranking within the team, their years in the job role and years within the organization was obtained through different methods depending upon the size and culture of the organization.   In compliance with the UW Institutional Review Board standards, individual assessments were anonymized and data was aggregated initially by site and by job roles. Research data was distributed to different computer networks isolating assessment results from managers' additional information. Aggregated data was analyzed and interpreted by team members.

 Instrument Structure: World of Work Inventory Structure

Three scales comprise the WOWI providing a comprehensive career profile measuring   xx categories.

The Career training potential (CTP)   measures six categories and three levels of motivation in a nomothetic approach across six categories inTable 3, ideographic assessments of Job Satisfaction Indicators (JSI) and Career Interest Activities (CIA) and are defined in Tables 4 & 5. [xvii]

Table 3	Measurement of Career Training Potential (CTP)
Verbal	Ability to read and comprehend words. Predictor along with the numerical score of ability to do school work.
Numerical	Ability to manipulate the language of numbers, indicates understanding and skill in performing basic mathematical functions
Abstraction	Potential in the area of figuring out problems through a logical procedure. Ability to solve problems by means of size, position, shape or quantity without assistance from words or numbers.
Spatial-Form	Ability to visualize and think in three dimensions. Ability to formulate a finished product from seeing the visual plans. Potential to sense forms and position of things in space.
Mechanical/ Electrical	Potential to construct, operate and repair machinery and understand physical forces. Also includes the influence of prior knowledge and understanding of electricity, electronics and electromagnetics.
Organizing	Ability to organize information, including the ability to perform sequential reasoning using letters, abbreviations, words and numbers.

Table 4		Characteristics of Job Satisfaction Indicators (JSI) subsets
Versatility	+	Likes variety and change; several things going on at once.
	-	Likes to concentrate on 1 task at a time; a linear approach to work.
Adaptable to Repetitive Work	+	Enjoys predictability; activities in a set order.
	-	Likes spontaneity; uncomfortable with tasks that repeat in a short time frame.
Adaptable to Performing Under Specific Instructions	+	Adjusts to being monitored; likes to follow set policies, procedures, recipes, instructions, blueprints, etc.
	-	Likes general direction/instruction; uncomfortable with close supervision
Dominant	+	Likes to lead; be responsible for decisions; is self-directed.
	-	Prefers to be in a support role; dislikes being responsible for others.
Gregarious Isolative	+/+	Likes to work with others, but also likes to be alone to focus on work and get it done.
	+/-	Likes people and does not like being alone; likes being a team player.
	-/+	Dislikes spontaneous interruption and likes being in control of when others see them.
	-/-	Not motivated by a traditional work environment.
Influencing	+	Likes to sell products, services or ideas; enjoys persuading, impressing, and motivating others.
	-	Likes to be in situations where there is no conflict; is uncomfortable having to persuade, motivate, or sell to others.
Self-controlled	+	Likes to work under pressure, deadlines, and in crisis situations; tends to procrastinate.
	-	Prefers calm atmosphere; dislikes constantly working under pressure, against tight deadlines, and meeting demanding quotas.
Values	+	Likes to make value judgments; has an intuitive approach to making decisions and solving problems.
	-	Dislikes making decisions using intuition or hunches.
Objective	+	Likes to problem-solve in a rational way; relies on facts and data.
	-	Does not like to rely on facts to make decisions.
Subjective	+	Enjoys being self expressive; likes to be creative; is uncomfortable conforming to others' standards of style.
	-	Does not have a strong drive to be self-expressive or creative.
Rigorous	+	Has integrity of workmanship; tendency toward perfectionism; likes to be detail-oriented.
	-	No need for exacting results, likes the big picture, the bottom line; dislikes focusing on details

Table 5
CIA Subscale
Public Service
The Sciences
Engineering and Related
Business Relations
Managerial
The Arts
Clerical
Sales
Service
Processing Machine Work Bench Work Structural Work Mechanical Work Graphic Arts Mining

**Curtis'
Section
: Data-**

Greg's Section: Interpretation of the data

CONCLUSIONS:

Martha, could you like to lead this section: notes below.
Refine another cybersecurity workforce category either in Analyze, Investigate, WOWI profile to several other specialties outside the PD category in either and focus on larger teams working in dedicated job roles. , Based upon Striving for Effective Workforce Development

Lessons Learned:

Conducting research in government and corporate settings present challenges. Whether union or non-union, organizational culture and workload set the tone for cooperation with the study. Cybersecurity pathways in this emerging field present a moving target impacted by technology, business and legal constraints. Industry work roles and job descriptions whether aligned to NIST 800-181 are subject to change.

1. My observations: cybersecurity teams in many organizations are smaller than anticipated. Major corporations capable of employing large teams were inaccessible. (major companies (ie.- unnamed- Microsoft/Boeing/Amazon were difficult to engage participate).
2. Top people are working at the organizations participating in the study. Low performers are circulated out to other departments. Thus, few low performers – they have been removed.
3. Other 'ahas'

Next steps – putting the model to work on students and in industry settings.

Martha: how many students would you like to assess using the WOWI coming into your next cycle of introductory cybersecurity courses? [CIAC assessment codes available]

Greg: application model for incumbent worker training – identifying existing workers have the highest likelihood of becoming a high performing cybersecurity defense analyst.

Additional Questions – opportunities for research:

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