CYBERSECURITY LEADERS: KNOWLEDGE DRIVING HUMAN CAPITAL DEVELOPMENT

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ABSTRACT

Cybersecurity leaders must be able to use critical reading and thinking skills, exercise judgment when policies are not distinct and precise, and have the knowledge, skills, and abilities to tailor technical and planning data to diverse customers' levels of understanding. Ninety-three percent of cybersecurity leaders do not report directly to the chief operating officer. While status differences influence interactions amid groups, attackers are smarter. With the aim of protecting organizations and reducing risk, knowledge about security must increase. Understanding voids are costly and increased breach chances are imminent. Burning questions exist. What are needed technological learnings for cybersecurity leaders to become smarter and remain ahead of attackers? How might these technologies hasten the understanding of the 'what,' 'how,' and 'why' reasons and key drivers for organizational behaviors. This article offers comparative analyses for cybersecurity leaders to engage in the questioning of practices, scrutinize entrenched assumptions about technology, customary practices, and query technology's outputs by pursuing to comprehend all assumptions that could influence operations. Because understanding continues to rely upon progressively multifaceted epistemic technologies, outcomes of the research suggest that the salience of status distinctions is of central significance to the development of ongoing and proactive technological learning and up scaling solutions.

KEYWORDS:

Artificial intelligence, augmented reality, cybersecurity leadership, hype cycles, human capital development

1. Introduction

Building an interdisciplinary learning system for cybersecurity leaders to continually sharpen their knowledge, skills, and ability (Burton, 2014; HIMSS, 2021a) is required to thwart even the most sophisticated hackers and attackers

(Burrell, 2021). Namely, interruptions subsist for advancing suitable cybersecurity training and controls within the critical infrastructure sectors; such concerns, forebodings, and failures leave the United States and others subjected to cyberattacks that could leave caustic, crushing, and damaging effects on

security (Dawson et al., 2021; Muller, 2021; Olsen, 2020). This text posits that organizations, to include healthcare facilities, must investigate and infuse human capital development aspects for cybersecurity leadership instead of applying only a focus on increasing knowledge in cybersecurity and its intricacies as they relate to a technical, planning, and response operational standpoint (Burrell, 2021). Human capital development is people development. Applying the interdisciplinary approach to cybersecurity mindfulness is needed as the action references issue-driven concerns. However, having a seat at the table and a voice at the C-suite level can establish increased security mindfulness throughout every organizational function. As personnel status differences continue to influence and derail interactions amid cybersecurity groups, attackers are becoming smarter.

The salient coordinates of the research are learnt from copious databases. Academic fee-based databases utilized are ABI Inform Complete (ProQuest), MEDLINE, Academic Search Premier (EBSCO), Business Source Premier (EBSCO), ProQuest Dissertation Database, PubMed, Ebook Collection (EBSCO), Education Research Complete (EBSCO), and ERIC (EBSCO) Research. Association fee-based databases utilized are American Telemedicine Association (ATA). Internet searches useful include Telehealth Resource Centers.org, Department of Health and Human Services (telehealth, rural health), Healthcare.gov, Google Scholar, and recent peer reviewed literature. Additional literature data searches include the US National Library of Medicine, and the National Institutes of Health (NIH). Using the given databases and systems supported this researcher's faith in the sources of data scrutinized plus in the exactitude and influence of the data. The usage of the given subscription-based and examined databases reinforced recognition that the investigation and data underwent strict, painstaking, careful, and controlled evaluation systems, that define scholarly work (Saldaña, 2018).

Applying the interdisciplinary approach to human capital development means that no one learning and development action or sector can supply a response to the particulars of cybersecurity difficulty (Waltner-Toews, 2017). Applying transdisciplinary leadership learning can be challenging due to this leadership demanding knowledge fusion that directs obscurities, strictness, pieced interactions, and risk sharing (Burton, 2014). With the aim of protecting organizations and reducing risk, overall cybersecurity knowledge must increase. Also, cybersecurity and organizational priorities must align. Cybersecurity leaders and risk management leaders must employ needed technologies where their organizational infrastructure could be at risk of compromise whether by external or internal threats (Shoard, 2020). Delimitations of this text includes the tool, hype cycles, and technologies artificial intelligence and augmented reality. A graphical presentation to understand the technology is the hype cycle.

2. Comprehending hype cycles

Hype cycles are frequently employed as reference points in technology and marketing reporting (Wigmore, 2021). Gartner: Global Research and Advisory Company stands as the global leading research and advisory company that offers leadership essential organization insights, information, and tools necessary to for organizations to realize their individual enterprise obligatory priorities for the purpose of shaping tomorrow's needs (Gartner, 2021a). The Gartner hype cycle, a graphical exemplification of the perceived worth of an individual technology trend or innovation to include the technology trend or innovation comparative market promotion. The hype cycle supports leaders to comprehend the manner and perceived worth of how a given technology progresses over the course of its maturity lifecycle (Gartner, 2021b). The maturity lifecycle is composed of five cycles that are noted on the x-axis. See Figure no. 1 to understand the stages of the hype cycle.

Figure no. 1: Hype cycle for emerging technologies, 2020
(Source: Adapted from Gartner 2021)

The data shows that Gartner's 2020 hype cycle for emerging technologies gleaned more than 1,700 distinctive technologies into

a list of critical to understand technologies and trends (Panetta, 2020). See Table no. 1 for the five unique technologies are highlighted.

Table no. 1
Gartner's 2020 Five Unique Emerging Technologies

Composite Architectures	Provides enhanced increased business resilience.
Algorithmic Trust	Confirms assets on the blockchain and safeguards the assets authenticity
Beyond Silicon	Applies DNA and biochemistry in place of silicon or quantum architectures to perform computation or store data Data is encoded into synthetic DNA strands for storage and enzymes offer the processing capabilities through chemical reactions
Formative Artificial Intelligence (AI)	A type of AI that can produce fresh original content (e.g., images, video etc.) or alter existing content.
Digital Me	Bidirectional brain-machine interfaces (BMIs) - brain-altering wearables that permit two-way communication amid a human brain and a computer or machine interface BMIs are as wearables or implants that monitor EEGs (electrical activity in the brain) and persons' mental states

Adapted from Gartner 2021

Composite Architectures, Algorithmic Trust, Beyond Silicon, Formative Artificial Intelligence (AI), and Digital Me (Panetta, 2020). Of these technologies, this text points out AI and AR as significant technologies that are expected to lead in emerging developments (Anderson & Rainie, 2018; Karasinski et al., 2021). Also, reviewed is the need for both technologies as stand-alone, plus both as integrated technologies. Further reading offers more information for human capital development of cybersecurity leaders to be able to engage in the questioning of practices, scrutinize entrenched assumptions about technology, customary practices, and query technology's outputs by pursuing to comprehend all assumptions that could influence operations. Further, this text considers the gained knowledge of this review on the freshness of knowledge outcomes.

3. Comprehending Artificial Intelligence (AI)

What cybersecurity leaders should know about AI? AI is being incorporated into innumerable industries – organizations, IT companies, financial services, healthcare, automotive, education, journalism, and others. This form of technology imitates the computational processes of the human brain (Burton, 2019). In other words, it is the simulation of what is known to be human intelligence processes; however, by machines (Dimiduk et al., 2018). How is this done? AI performs via a digital circuitry with the goal to create an authentic mindfulness within a system that is not biologically fixed. AI is a form of IT system intelligence that runs algorithms supported by past recorded data to calculate the best possible and most probable outcomes (Radziwill, 2019). Also, AI is termed as the imitation of human intelligence practices by machines, particularly computer systems. AI has particular applications – expert systems, natural language processing (NLP), speech recognition and machine vision (UiPath, 2018).

The programming of AI focuses on three cognitive skills – learning, reasoning, and self-correction. Learning references AI programming concentrated on obtaining information and establishing rules (algorithms) for how to turn the information into actionable data (Burt et al., 2018; Lu & Burton, 2017). The rules offer step-by-step directives on how to fulfil a peculiar task. Even though machine learning is based on the notion that machines should be able to learn and adjust via involvement, AI denotes a wider idea such that machines can complete tasks cleverly (Dawson & Szakonyi, 2021). AI applies various types of learning – machine learning, deep learning, plus additional methods to resolve definite concerns. Let's review reasoning.

For AI, reasoning references the functionality to draw conclusions suitable to the condition. Reasoning is vital in order for the machine to also think rationally akin to a human brain. In other words, the machine is expected to accomplish like a human, a trend of technology fast-forwarding along a path of no return (Fazzi, 2018). Conclusions of reasoning are termed as deductive, inductive, abductive, common sense, monotonic, and non-monotonic. According to Wang (2021) reasoning through AI programming centers on selecting the correct algorithm to determine a preferred conclusion. Last is machine vision.

Since the 1950s, machine learning references computers making sense of enormous amounts of data (AI Timeline, 2018; Cowan & Nelson, 2010; Tsidulko, 2016). Over the years, programmers have progressively advanced the ability of machines to analyze data for the purpose of identifying patterns that permit computers to then systematize data, recognize relationships, make predictions and distinguish irregularities. Current technology, using AI has allowed the development of autonomous-driving vehicles (Lauterbach, 2019), enabled virtual assistants (Dash et al., 2019), supported the uncovering of fraud (Suresh & Rani, 2020), and has directed resources such as electricity being more cost-effective (Ercan & Samet, 2020).

4. Comprehending Augmented Reality (AR)

What cybersecurity leaders should know about AR? Akin to AI, AR is being fused into countless industries – business, IT companies, financial services, healthcare, automotive, and others. This technology, which overlays representative looking objects onto the background setting of viewers presenting the impression that the computer-generated object is really a part of the real scene (Greenwald, 2018). Simply put, AR is an enriched account of the real physical world. This change is achieved via the application of digital visual elements, sound, or other sensory inducements produced by technology (Greenwald, 2018). AR signifies seeing actuality, however with other simulated things on top of the actuality (Gäthke, 2020). This technology is an intensification of actual images by offering more data about images/objects users may point their AR devices to (Dimiduk et al., 2018). Devices must be registered plus grounded on the GPS location and direction of the compass entering data about the images / object from the web, and shown on visual displays such as glass/computer displays. Essentially, the experience is reality but amplified by digital data (Brenngman et al., 2019). For example, an AR experience can be looking into the lower windshield of a vehicle and seeing not only the speed travelled but the speed of the road and how close the driver's vehicle is to the surrounding vehicles. Noting Brenngman et al., 2019, AR technology enable organizations' customers to position products in their own environments to determine how the products might fit, and then add the products to carts for purchase. The engineering, technology, and healthcare industries are using AR for training professionals who can see, through augmented vision, actual step-by-steps procedures.

5. Linking Artificial Intelligence (AI) and Augmented Reality (AR)

AI and AR are two distinct technologies that can stand alone. On the other hand, the bridging of the two technologies permits mobile app developers to create more interactive and interesting applications (Gäthke, 2020). What is the significant distinction? As posited by Gäthke, (2020), AI comprises algorithms and statistical models proficient to carrying out tasks minus precise instructions. Fundamentally, AR is an involvement that merges physical and cybernated environments. Through AR, viewers experience a heightened version of the real physical world (Gäthke, 2020). Although AI promises to improve the access and quality of industries such as engineering, technology, and healthcare, the expenses of image digitization in certain areas continue as barriers to real-life application. An example of an expense area is pathology, as well as snags in deploying AI solutions. Examples of AI and AR cost effective connections exist (Gudoniene & Rutkauskiene, 2019).

Human capital development of cybersecurity leaders should include knowledge that the field of technology is applying AI and AR for image recognition and image tracking in robotics. Next-generation robotics, with the utilization of computer vision and machine learning, are more complex and cutting-edge with their proficiencies to detect their surroundings, examine dynamic scenarios or changing conditions, and then ascertain a conclusion. As this technology advances, developers must continue to remain exceedingly educated in higher-level robotic vision functionality and tools for object detection and classification, and object tracking and navigation. Similar to engineering and technology, AI and AR overly is used in healthcare.

As given by Wimalasena and Clements (2019), the field of healthcare is applying AI and AR overlay to propel widespread medical advances that are helping a myriad of patients. For example, HoloLens augmented reality (AR) glasses with clear lenses are used during surgery for the purpose of escalating the correctness of incisions during lower limb, and back procedures (Wimalasena & Clements, 2019). Further significant to understand, according to Wimalasena and Clements (2019), is that a devoted AI chip is required for the HoloLens that has to be built to realize enormous amounts of complex data congregated by its depth and camera sensors void of latency.

Data from sources such as Pew Research, Brookings Institution, and other organizations show that the demand for AI and AR applications are positioned to sky-rocket (Anderson & Rainie, 2018; Glaser & Gerald, 2018; West & Allen, 2018). For this reason, and to remain current in the technological sphere, the fields of engineering, technology, and healthcare should continue to seek the most up-to-date and appropriate software development kits (SDK) and application program interfaces (API). Maintaining current knowledge is significant for cyber leaders.

6. 5G Technology on Artificial Intelligence (AI), and Augmented Reality (AR)

Ascending from innovation and computational power is the fifth industrial revolution (Ericsson, 2019), an innovative era of intelligent and super-intelligent machines. 5G, the 5th generation mobile network, a wireless technology (Burton, 2019), an advancement from 4G (Muir, 2019), and a progression of AI and humanity, denoted as Industry 5.0 (Rossi, 2018) is being deployed around the world (Burton, 2019). This technology, permitting a new kind of network, is expected to significantly change the manner in that

people live and work by meeting significant growth in data and connectivity due to the establishment of faster broadband speeds, which are one hundred times faster than 4G in terms of traffic capacity and network efficiency, decreased latency, along with amplified dependability and capacity (Ericsson, 2019).

The consequence of industry 5.0 on people is that organizations have higher-valued jobs allowing employees the autonomy of design responsibility versus manufacturing processes (Rossi, 2018). 5G is changing the way we work and live. Human resource professionals are increasingly able to complete strategic tasks while AI handles on boarding solutions (Muir, 2019). More organizations are using human-robot collaboration (Nahavandi, 2019). Industries such as healthcare and automotive are applying AR overlays on computer-generated impressions, sounds, and texts which changes what a person would normally see (Joda et al., 2020; Skorenkyy et al., 2021).

Significant for the operation of the 5G technology on AI and AR applications is cybersecurity (Dawson & Szakonyi, 2021; Radziwill, 2019). Across the board, organizations continue to struggle to avert increasingly intricate cybersecurity attacks (Muller, 2020). In order to make well-informed decisions and function as vital performers, cybersecurity leaders, across the board, must gain and maintain an understanding of the workings of AI and AR technology (Bhatia, 2018). While technicians handle programming and the daily working of the technology, cybersecurity leaders must understand this technology enough to ask the right questions and guide their respective organizations toward the best solutions (Burton, 2021). Due to the changes enabled by 5G, disruptive technology development is expected to continue into the next decade (Glaser & Gerald, 2018).

7. Implications for future research

Through constant research and learning cybersecurity leaders can remain well-informed of technological metamorphosis as digital transformation trends continue to disrupt the actions of people, the formation of processes, and the functioning of technologies. This developing knowledge can support cybersecurity leaders to become forward-thinking and become better at hindering direct and indirect cyberattacks. This article has reviewed evidence-based information listing, noting, specifying, and particularizing disruptions in the technological space so that cybersecurity leaders can better understand how to meet strategic technological requirements, plus better support ever-evolving knowledge changes in this digitized world. Learning has to endue to reflect and support novel methods for evolved threats. Adding to this comparative analysis, other research is needed to maintain a full range of technological understanding.

The first area needing more research is the use and application of AI technology. Organizational leaders need more understanding of AI such as scaling analytics and automation, as well as the data that energizes the connections to embolden all cybersecurity leaders to understand diverse technological processes. This enhanced knowledge can support decisions regarding the application of AI to alter the fundamental functions of what organizations do plus how and why they perform work in a specific manner. Also this knowledge can help cybersecurity leaders better understand how to remain competitive and to remain a viable organization. New knowledge should include understanding AI strategy, the need for diverse teams, as well as the look and feel of ethical frameworks fabricated within the AI.

The second area needing more research and comparative analysis is machine learning vs. deep learning vs. natural language processing. Leaders might believe the technology is needed; however, not understand that each area is a part of the AI backdrop is progressing the length of its

own path. What needs to be detailed is how can the combination of these functions through data, analytics, and automation support cybersecurity leaders' knowledge banks to accomplish goals such as enhancing customer service and augmenting the overall supply chain. Through increased and significant understanding, professionals lacking AI understanding become equipped to discover vital data to improve organizational efficiency (Murawski, 2019).

A third and final area needing more research and comparison is AR, a collaborative three dimensional (3D) involvement that joins a view of the real world with computer-generated components. Cybersecurity leaders need to understand this technology's value, specifically the manner in which AR can decipher, manipulate, and enrich the belief of the real world in real time. Through advanced learning cybersecurity leaders can learn to enhance customer experiences, increase revenue, gain sustainability, and drive forward competitiveness. The knowledge of these four points have the potential for cybersecurity leaders to learn more about using technology for customers to try on products, determine how products may appear in their homes and offices, overlay navigation information on vehicle windshields, view 3D information in books to gain better comprehension, or overlaying information on a person's field of view to learn or perform a task. Significant is the present need for cybersecurity leaders to increase their knowledge, skills, and abilities to successfully guide organizations through the pitfalls of cyberattacks, being effective players in their perspective industries (Anderson & Rainie, 2018; Murawski, 2019; Muller, 2020; West & Allen, 2018).

To be significant leaders, cybersecurity leaders must be knowledgeable and have a seat at the table for all aspects touching the industries' futures (Burton, 2019). The benefits to be gained from cross-technology research include a wider comprehension of other technologies and of their application processes.

8. Conclusion

What do cybersecurity leaders need to understand regarding human capital development? Despite the fact that AI and AR are individual technologies, these technologies can sync with one another on a diversity of applications. One can influence the other's best physiognomies, and components forming unconceivable mobile experiences. AI enables AR to have pluridimensional relations with the physical environment. The interaction permits the manipulation of 2D and 3D virtual objects with words, eyes, and the hands. AI and AR are being integrated in numerous ways. Examples include but are not limited to the following: learning and education; human pose estimation; image recognition and image tracking; object recognition; speech recognition; recognizing and labelling; and vehicle recognition. These interactions are driving change in fields such as engineering, technology, journalism, and healthcare, as well as for overall organizational operations such as analyzing

demographics of applicant pools, assembly, filtering resumes, maintenance, repair, security, stocking, surgery, warehousing, etc.

The result of this delimited cybersecurity human capital development reveals that information exists for cybersecurity leaders to understand and continue to build skillsets regarding AI and AR. Because of 5G, these technologies are revolutionizing the manner in which the world functions. Ubiquitous technology is striking most every field; therefore, new information is continuously required to fill knowledge gaps (Uzialko, 2019). Technology continues to assimilate into every single aspect of human life. The comprehension as to if the assimilation is entirely beneficial and gainful remains an indefinite. An unquestionable point is that the world is dependent upon technology. Whether separate or through overlay, the budding anytime and anyplace usage of AI and AR can be credited to increased processing power and the diminishing cost of realizing such tasks at amplified paces.

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