Designing a Defense M&S Workforce Pipeline to Promote National Readiness

Dr. JJ Walcutt
jjvogelwalcutt@yahoo.com

COL Robert Epstein, USAF
robert.h.epstein.mil@mail.mil

COL (Ret) James Torgler, Army
james.r.torgler.ctr@mail.mil

ABSTRACT

As technology matures and becomes more affordable for adversaries of every size, our global advantage begins to erode. It means the currency of tomorrow will not only include our financial and technological capabilities but also our ability to ensure a deep bench of qualified civilian and military workers. Accordingly, the National Defense Strategy notes significant concerns about the workforce pipeline of the future. While many programs have been developed from youth competitions to university and innovation research, the strategic connections across these programs are lacking or non-existent.

Accordingly, the National Defense Industry Association (NDIA) has identified the workforce readiness pipeline issue as a key priority and is taking action to consider solutions that may help improve strategic planning. Of particular focus is the Modeling and Simulation (M&S) pipeline. As the military increasingly relies on distributed training opportunities, M&S will correspondingly increase in importance. To accomplish this distributed training goal, the M&S pipeline of the future will need to marry the strategic and policy goals of the Defense Department with the capabilities available across the workforce, both existing capabilities and those needing to be developed. It will also need to recognize and address evolving expectations of future workers, and use a digital backbone to capture, connect, and match skilled workers across all ages, experience, and education. Most notably this strategic connectivity will need to support personalized learning to progress professionals through the pipeline more efficiently and identify individuals closely aligned to future jobs, assess the additional skills needed, and train complementary skills. To accomplish this goal, training efficiency and workforce connectivity will need to be substantially enhanced to meet the constantly evolving defense workforce needs. Thus, this paper explores current policy directives, education programs, and workforce needs and provides recommendations for organizing strategic plans that can fill the expected workforce gaps.

ABOUT THE AUTHOR

JJ Walcutt, Ph.D. is a strategic designer for large-scale military, education, and government systems. She is the former Director of Innovation for the Advanced Distributed Learning (ADL) Initiative under the Office of the Secretary of Defense. She is also a former Human Innovation Fellow under the Office of Personnel Management focused on using design thinking to promote Federal Government transformation. Dr. Vogel-Walcutt has 20 years of experience in research and development for training and education with specific interests in applying instructional techniques to improve the effectiveness and efficiency of cognition and educational development.

Colonel Robert H. Epstein is commander of the Air Force Agency for Modeling and Simulation (AFAMS), the lead USAF Field Operating Agency in charge of enabling Enterprise Solutions for Readiness across warfighting domains through the application of Technology Innovation Management (TIM). As commander, Colonel Epstein oversees Air Force Modeling and Simulation initiatives that drive innovation and interoperability, allowing warfighters to maximize performance, decision-making, and help build a more lethal force to win any fight, any time.

Colonel James Torgler (Ret.) has over 30 years of diversified experience operating at the highest levels of the U.S. military. Most recently, he was the editor and a primary writer for the development of the AFAMS-led Joint TACAIR Synthetic Training (JTST) Analysis of Alternatives (AoA), which studied the complex and disparate combat training systems and live range infrastructure/airspace that precludes realistic 5th Generation and advanced 4th Generation aircraft training across the Services. This AoA assessed system requirements such as the need to employ sensitive non-kinetic and kinetic weapons systems, developmental timelines and associated costs with enhancing Air Force and Navy simulation infrastructure to provide secure connectivity between their respective networks, analysis and applicability of available and emerging technologies.

MODELING AND SIMULATION

The modeling and simulation (M&S) community plays an integral role in achieving joint mission goals across the Department of Defense (DoD). It creates the environment in which learning can occur in context and aids trainees in applying lessons learned to the real world. Advancements in complementary systems, such as neuro-physiological apparatus, augmented, virtual, and mixed reality, and Live, Virtual, Constructive systems, further support representation of real-world experiences and help determine how to vary training and education to meet individual needs. Interoperability standards and cross-branch collaboration also help by enabling an All Domain simulation environment and creating the opportunity for trainees and leadership to more deeply comprehend a holistic battlespace. Most important is the benefit of a possible future vision that modeling and simulation techniques can provide to decision makers. However, the collective capabilities provided by the M&S community can only create the opportunity for a faster, better, cheaper strategic advantage if information, knowledge, innovation, research, and tactical data are organized, accessible, and synthesized for leadership use. In other words, a significant variety of scientists, engineers, innovators, data analysts, technologists, cybersecurity professionals, learning experts, and strategists are needed to ensure the longevity and quality of the M&S enterprise. However, a national shortage of skilled individuals mixed with competition from outside the defense community threatens the ability to maintain and grow this pipeline. Further hindering expansion of this discipline is the lack of recognition of the multi-disciplinary requirements of the field and a lack of coordination from youth experiences to full-time employment and career growth. Stated another way, the path to becoming an M&S professional is varied, unclear, and lacks a coordinated pipeline of experiences.

Creating an intentional trajectory with M&S is particularly important because the opportunities afforded by this community. While M&S is not the answer to everything, it makes possibilities tangible, observable, and experiential and in doing so, aids decision makers and trainees in finding answers to substantially challenging tasks and problems. There is a reason Gen. Mattis (Ret.) wanted every trainee to experience 25 bloodless battles before entering theater and while reading is one of his favorite ways to vicariously attain the wisdom of others, M&S offers the opportunity for personnel to widely gain the experience needed to maintain readiness during a pandemic, increase lethality, and maintain consistency in non-co-located allied forces training. But it can do so much more than that. Modeling capabilities, mixed with the next generation of interoperable knowledge management, training, and tracking systems will make it possible for artificial intelligence (AI) to find connections across data silos, synthesize and translate that information, and provide it to personnel at every level to enhance decision superiority at the rate of necessity. Recruiting can be enhanced through distributed access, inspiration, and the ability to assess qualifications beyond what can currently be tested on paper. Advancements in distributed learning, xAPI, and interoperable technological architectures will allow DoD to not only identify future military personnel but will also be able to match neuro-physiological devices, decision support tools, and physical and cognitive accelerator apparatus to warfighters creating human-technology hybrid trainees who experience a significantly reduced perceptual change from garrison to theater. These capabilities are not the future, they are the present.

But like a metaphorical car building challenge, in spite of having experts building pistons and steering wheels and exhaust pipes, and more, without the blueprint for the car, we lack the entire capability of transportation. It is time for the field of M&S to design that blueprint so it can be elevated, expanded, and shared across the DoD and our allied forces in order to optimize the strategic advantage this field offers. Specifically, the vision and strategy for M&S (2007) needs to be updated and from that the best practices, workforce, and outreach plans require updates. It is imperative that we gain thought leadership and vision at the DoD level to ensure that our warfighters have the opportunity to benefit from the capabilities M&S can provide to promote readiness at a more efficient rate and enhanced effectiveness. Modeling and simulation will affect so many industries in the future that having a cohesive and connected body of science complemented by programs, policy, and workforce options is imperative for national security and a skilled workforce.

Call to Action: Strategies and Policies

An in-depth review of the strategies and policies that influence the Modeling and Simulation (M&S) enterprise was conducted to develop a cohesive understanding of the impact of that guidance. The review included national level strategies as well as the Department of Defense (DoD) strategies and policies.

DoD-specific strategies define the strategic pathways that, collectively, clarify the expectations and steps to achieve the missions set forth by the national strategy documents. Seven of these strategies focus on areas relevant to M&S, including the M&S Strategic Vision (2007) as well as the Cloud (2018), Cyber (2018), Data (in development), Digital Modernization (2019), Net-centric Services (2007) strategies, and the Initial Plan for Reforming the Business Operations of the DoD for Efficiency & Effectiveness (2019). Though dated, the DoD M&S Strategic Vision outlines the key focus areas for the M&S enterprise including standards, architectures, networks, environments, policies, management processes for models, simulations, and data, tools, simulations, authorities, and workforce development.

Combined, these strategies indicate a requirement for M&S to provide insight into the focus areas within the M&S Strategy while meeting the forward-thinking goals of interoperability, security, and data transparency that can inform decisions to ultimately improve warfighter readiness and lethality in the field. Policies provide the rules, directives, and requirements that ensure M&S content and focus areas are represented and leveraged as needed, security protocols are followed, interoperability standards and architectures are utilized, and business processes are efficient and optimized. As delineated in the M&S Vision, M&S activities fall into two key areas: Making better decisions and developing better skills. Additional supporting policies include DoDD 5000.59 DoD M&S Management (2018) and DoDI 5000.70 Management of DoD M&S Activities (2018) which focus on management of M&S systems and capabilities as well as Military Standard 3022 Documentation of VV&A for M&S (2012) and DoDI 5000.61 DoD Modeling & Simulation Verification, Validation, & Accreditation (VV&A, 2018), which define VV&A processes.

Complementary DoD policy related to M&S personnel needs and enterprise goals is also extensive and provides requirements, instruction, or mandates focused in several key areas including roles and responsibility (DoDD 5134.01 USD AT&L, 2008; DoDD 5101.1 DoD Executive Agent, 2003; DoDD 5141.02 Director of Operational Test and Evaluation, 2009; DASD Memo Establishing the OUSD for Research and Engineering and the OUSD for Acquisition & Sustainment, 2018; DoDD 5144.02 DoD Chief Information Officer, 2017), training (DoDD 1322.18 Military Training, 2019; DoDI 1322.26 Distributed Learning, 2017; DoDI 1322.31 Common Military Training, 2020), information and data management (DoDD 8000.01 Management of the Department of Defense Information Enterprise, 2017; DoDI 5015.02 DoD Records Management Program, 2017; DoDI 5025.01 Office of the Chief Management Officer of the DoD, 2019; DoDI 8170.01 Online Information Management), privacy (DoDD 5400.11DoD Privacy and Civil Liberties Programs, 2019), and data sharing and interoperability (DoDI 8320.02 Sharing Data, Info, & IT Svcs in a Net-Centric Department of Defense, 2013; DoDI 8320.07 Implementing the Sharing of Data, Info, & IT Svcs in the DoD, 2017; DoD 8910.1-M DoD Information Collections Manual: Procedures for DoD Internal Information Collections, 2017; DoDI 8330.01 Interoperability of IT Including National Security Systems, 2019).

To summarize, training doctrine and instructions recognize the benefits of M&S for providing necessary training opportunities to improve readiness and lethality at a lower cost and reduced safety risk. Information and data management policies clarify how that data is shared and used to drive training decisions. Privacy, data sharing, and interoperability policies require that future technology tools connect to data accessible across the DoD enterprise and follow DoD security regulations based on the defined clearance levels. Finally, roles and responsibilities for M&S at the DoD level lie within OUSD R&E in the M&S Coordination Office. However, given the extensive vacancy in the Director position, associated policies have become outdated, creating a chain-of-command break in planning, organizing, and advising. Taken together, these strategies and policies require a workforce enterprise that enables and promotes efficient, near-realistic training, data analysis, and connectivity to realize and implement the extensive possibilities the M&S community can provide. Specifically, it requires a wide variety of professionals to be identified, encouraged to join the M&S community, and have access to continual educational options to evolve with the dynamic changes and speed of the varied discipline. To date, the primary source for this guidance is included in the M&S Book of Knowledge (BOK, 2007). However, given the 13-year lapse since it was written, updated recommendations for workforce needs, development, and how data and technological advances can be exploited to maximize the impact of the M&S community is warranted.

DoD M&S BOK

> *"The DoD M&S Workforce Body of Knowledge (BOK) comprises the core knowledge and skills that an M&S professional obtains at different levels throughout his or her career within any Service or functional community—analysis, acquisition, training, planning, experimentation, operations or testing." (DoD M&S BOK, 2007).*

The motivation to create this document was derived from the recognition that each of the services were using different definitions, descriptions, and associated Knowledge, Skills and Abilities (KSAs) for their personnel. This led to key differences in "organizational structure, procedures and policies and functional requirements." Accordingly, it was decided that a core set of agreed upon terms was needed at the awareness, management, and executive levels of the M&S workforce. This action resulted in 9 BOKs being consolidated into one that highlighted over 400 individual content items grouped by topic area. Based on these data, a framework was devised that organized M&S professionals into four layers of position focus, eight areas of skills, twenty-two tasks and capabilities, and twenty fields of knowledge or study. Key areas of focus relevant to M&S workforce development to promote strategic advantage across DoD are listed below.

Table 1. M&S BOK Summary

Position Focus			
Awareness	Application	Management	Executive
Skill Areas			
Historical perspectives	Design and build models	Modeling	Journeyman (contracting)
Modeling concepts	Simulation concepts	Leadership and Organizational Management	Supervisor, Manager, Sr. Tech. Specialist
Tasks and Capabilities			
Develop Simulation Requirements	Developing the training environment	Management	Soft computing
New M&S Applications	Simulation in the training environment	Evaluation design	Assessment of change to a simulation
Technical development of the simulation	Observation in the training environment	Execution of evaluation	M&S development and use life cycle
Prepare to use the simulation	M&S related assets	Assessment of evaluation	M&S related concepts
Specific simulations and attributes	M&S related perspectives	M&S modification	
Specific simulation applications	M&S related disciplines	Technical changes of the simulation	
Fields of Knowledge or Study			
Engineering	Content Specialties (e.g., medical)	Learning Science/Education	Contracting
Military Training	Psychology	Research/Experimentation	Design
Ethics and Legal	Mathematics	Business	Marketing and Knowledge Sharing
Computer Science	Statistics	Economics	Cybersecurity
Data Science	Logistics and Systems Analysis	Enterprise Management	Technical Writing

The BOK was a good starting point as it consolidated an enormous amount of information about the M&S enterprise and made clear how expansive this field is. Specifically, the skills needed to work in even one of these key areas listed could take decades of research or experience but the work at the executive level would require an understanding of not just one, or even several, fields of study but rather, requires the incorporation and meta-knowledge of at least twenty different areas. Also of note is the lack of focus on how to progress the field forward. There was no reference to skills or support for innovation, strategic vision, strategic planning, or coordination across fields of study. Stated another way, the BOK provides the foundational information needed to define and clarify the elements needed for the

M&S community to thrive but does not provide actionable guidance regarding workforce, research, or strategic development. Specific to this paper is the need to better define those relationships and pathways but also to understand the expectations of workers who will be needed to fill future positions.

VISION

Ultimately, the stated goal of the DoD M&S enterprise is to "Empower DoD with M&S capabilities that effectively and efficiently support the spectrum of the Department's activities and operations." (DoD M&S Vision, 2007). Though dated, this document further outlines the key areas of focus including: "(1) Standards, architectures, networks and environments, (2) Policies at the enterprise level, (3) Management processes for models, simulations, and data, (4) Tools in the form of models, simulations, and authoritative data, (5) People that are well-trained, employ existing models, simulation, and data to support departmental objectives, and advance M&S to support emerging departmental challenge". The expansive areas of focus make the management and continuous growth of the M&S ecosystem demanding. Regarding workforce development, procurement, and growth, the need for coordination and continuous nurturing of the system increases.

Thus, workforce pipeline development and support for the M&S ecosystem of talent requires special consideration. It is necessary to first understand what is needed by this multi-disciplinary field but it is also necessary to consider the expectations of current and future workers. Substantial competition outside the government and military space now exists in every field that contributes to the M&S enterprise. Between government and military and the private sector, researchers estimate a 50% pay gap (Katz, 2020). Work-life integration expectations are also evolving requiring more flexibility, personal interest and growth, and development compared to previous generations (Pomerleau, 2019). It is necessary to consider all elements when designing a workforce pipeline that will evolve and sustain into the future. Otherwise, task-based hires will continue an inefficient cycle of disconnected workers who technically complete requirements but fail to evolve the discipline and more importantly, fail to help the military realize the deep and expansive benefits that can be garnered from a well-organized multi-disciplinary workforce machine.

General Workforce Expectations

The workforce of the future will enter the public sector at a variety of levels, for a variety of reasons, remain for unique lengths of time, and view their work as a service to America (OPM, 2018). However, they will also expect an experience that adds to their personal growth. Accordingly, workforce development in the future will not only focus on technical job skills and requirements but also on a variety of personal interests, life experiences, social interactions, and soft skill development spanning from emotional resilience to strategic design. In the future, jobs will be viewed as part of a person's life journey rather than a means to an end. As such, those employers that offer the most personalized, engaging, and meaningful opportunities will attract the best talent.

Flexibility, interest, and meaning will drive engagement and productivity in the future workforce. Individuals will work when they want, where they want, and how they want. Work goals will be project-based rather than time-based and as such, individuals will achieve success through a variety of pathways. Collaboration will be key because it will not matter who or how the task is completed, only that it is finished on time and effective. Accordingly, teams of complementary people and systems will naturally develop in order to make workers' time spent on a project more efficient. When completion is the goal and workers have the freedom and trust to problem solve without roadblocks, collaboration will be maximized. When project interest and meaning are high, workers will be driven to create optimized, holistic solutions that help them feel valued not only in the workplace but also in life. Meaningful and interesting projects will attract the most driven talent. Allowing flexibility of thought, time, and structure will result in the most optimized solutions.

In support of this future workspace, learning needs, expectations, and opportunities must be re-imagined. For example, introduction to the public sector may not be a linear learning experience. Instead, new hires may construct their own understanding of the federal space through a series of exploratory experiences. Their mobile devices may push to them key terms that need to be memorized throughout the day. Longer or deeper learning materials may be accessible anywhere using an actionable ebook. This tablet could be fully automated and personalized, providing high level topics to first determine a person's interests but then cuing the individual to videos, further reading, and accessible experts as they progress. Simulations and gaming environments will be able to provide contextual practice, the ability to develop a library of "unlived" experiences, and vicarious learning opportunities through virtual social connections.

Job tasking can naturally follow as talent management analytics will aid the development of optimized teams of individuals with complementary skills. In other words, in the future, individuals may not be hired at a specific rank or for a specific job. They may instead be hired for their talents and personal goals. Their tasking will be defined along their personalized journey and their learning experiences can be seamlessly interwoven throughout their work journey, being accessed at the point of need rather than when pre-defined. Overarchingly, hiring, learning, and worktime of the future is expected to be a centralized, seamless, social, engaging, personalized, experience optimized for the individual in order to optimize work products for the collective system.

M&S Personnel Expectations

"We've always been able to out-innovate our enemies, because we have our people – the builders, the operators, the innovators from our military and civilian force as well as our contractors and our nation's overall technology base – people who think creatively, who are flexible, and who've always been able to combine our advanced technology with creative practices to solve the problem at hand. In order for our people to continue accelerating the breakthroughs and progress that ensure our continued dominance, we must back them up with the freedom to innovate and take risks, and with a stable and secure funding environment."
-Ash Carter, Former Secretary of Defense

Professionals working in the M&S community are comprised of a specialized, highly educated group ranging from engineers, psychologists, computer scientists, and military training experts to lawyers, doctors, data analysts, cybersecurity specialists, and more. Expected shortages in all of these disciplines is rising with as many as 60% of companies in some specialty areas reporting they cannot find the talent they need (Lapedus, 2019). Accordingly, competition for talent will only continue to rise. Further, given the multi-disciplinary requirements of this work, shortages across each division are multiplied by shortages in others.

"The Department of Defense has a talent management problem. The Pentagon is struggling to attract and retain talent for technology-centric jobs" "The DoD must identify personnel for high-tech positions, train them and allow them to use their skills in rotational opportunities, otherwise they'll walk out." – Josh Marcuse, Former Director, Defense Innovation Board, Defense News Roundtable, 2019

Within the DoD sector, M&S professionals will expect a level of intellectual freedom to create, innovate, build, and address complex, or "wicked", problem sets. Yet budget-line constraints, hiring for tasking versus talent, and the inadvertent promotion of one-off solutions is likely to not only reduce productivity and increase solution redundancy but also reduce interest in future generations desiring in long-term employment in this industry space. Pay differentials and flexible work environments as well as personal gratification may also have an effect (Gregg, 2018).

"Leaders in the defense and intelligence communities must learn from the tech sector and leverage cultural practices to keep pace with the bleeding edge of technology—a necessity to adequately defend against emerging adversaries." - Foerch, 2018

Current System

Today's model for talent identification and workforce development is largely random or created based on specific needs. This leads to a series of possible opportunities but no clear development or growth plan for the industry that ensures the skills needed for the future will be available. Specifically, workforce development for the M&S enterprise falls into four specific areas: Youth programs, University programs, Specialty degrees and certificates, and Work experience. Unlike other disciplines, however, M&S is extensively multi-disciplinary so the pathway of every individual will vary considerably. This unintentional personalization of formal, informal, and work experience makes it challenging for the Department to identify the best talent for each M&S billet, assign appropriate duties to M&S professionals who may have experience in a field that technically falls under the umbrella of M&S fields but that does not have the expertise needed to complete a given task, and challenges individuals within the working world to determine where they fit into the M&S enterprise. It is likely that many professionals whose skills would benefit this industry are unaware of how they can best support or get involved. Talent may be inadvertently lost due simply to a lack of clarity.

Youth Programs

Military-sponsored and related youth programs are extensive. Some examples include Civil Air Patrol, Naval Sea Cadet Corps, Young Marines, Cyber Patriot, Sea Perch, First Robotics, and the DoD Science, Technology, Engineering, and Math (STEM) Programs which boast upwards of 65 program areas across all military branches and security sector. These programs focus on developing experiences for young children to graduate students in areas such as cyber security, research across several areas, and health promotion and wellness. Yet, while nearly every program listed could lead a student to an M&S job in the future, no M&S-specific opportunities are listed. However, the National Center for Simulation (NCS) is connecting with the K-12 and university communities through their certificate program. A 4-year curriculum, study guide, and free test are provided. After passing the test, students are awarded an "industry-accredited certification aligned with the M&S framework and standards" (NCS, 2020). More organizing programs like this area needed.

University Programs, Specialty Degrees and Certificates

At the university level, a significant number of M&S graduate programs are also now available both at the masters and doctoral levels including Georgia Institute of Technology, Arizona State University, the University of Central Florida (UCF), Old Dominion University, Nava Postgraduate School, and many more. Yet, again, the curricula are highly variable with some focused more on mathematical modeling, others on training and education, still others on engineering principles. Without curriculum clarity and uniformity, entering the field can be challenging for potential employees but equally challenging is the difficulty of employers to determine appropriate qualifications. Some universities have begun to recognize and therefore formalize multi-disciplinary M&S education tracks. For example, UCF's M&S program includes eight different tracks: Behavioral Cybersecurity, Human Systems, Computer Visualization, Simulation Modeling and Analysis, Simulation in Healthcare, Interactive Simulation and Intelligent Systems, Simulation Infrastructure, and Simulation Management (UCF Institute for Simulation and Training, 2020). Still, as this is not a widespread practice, the workforce pipeline retains gaps between learning opportunities and employment.

Work Experience

Within the workplace, there are many entrance points. Some individuals will intern with companies and begin contracting work after college. Others will be indoctrinated into the M&S community while serving active duty and upon retirement or separation continue within this enterprise. The last group involves those professionals and experts in areas related to M&S but who did not intend to work in this sector. These are the engineers, lawyers, learning scientists, and others whose skills and expertise are needed to help grow the community. Haphazard entry points for professionals creates several issues. First, it means that a formalized understanding of how all the components of the M&S ecosystem can collaborate is not an intentionally managed system. In other words, those experts that find themselves working with the M&S community are lending their services and viewpoints but to only one area of the extensive enterprise. It necessarily limits their ability to productively guide, advise, enhance, or participate. Stated another way, the M&S community receives only a fraction of what could be provided. Additionally, it means that talent that is needed is unlikely to simply find the M&S community independently. Accordingly, we rely on those who are seeking employment to find available positions that are defined and funded by specific tasking rather than seeking talent to help drive the entire system. These issues raise two key questions. (1) If funding is allocated solely for individual research, projects, or tasking, then who is designing the vision for the future and connecting the possibilities of M&S to programs needing these capabilities? (2) Who is in charge of planning the intentional organization and structure of the entire enterprise from workforce management to technological advancements and interoperability? Without putting structures in place and providing the authorities needed to operate, the field of M&S will fail to provide the needed readiness support to our troops at the pace of relevancy. Rather, it will react to stated needs.

> *"While usage of human capital flexibilities has increased, DOD's Office of Human Capital Initiatives (HCI)…does not regularly monitor or assess how the department uses these flexibilities…Without efforts to gain such insights through monitoring, HCI may be missing opportunities to identify challenges, inconsistencies, or needed improvements in using these tools…According to DOD officials, this analysis can begin following development of a plan to ensure that defense components consistently collect data on hiring timeframes."*
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> *- Government Accountability Office, Defense Acquisition Workforce, 2019*

PATHWAY

The significant technological development that has occurred in our nation over the last 20 years has not just allowed the field of M&S to evolve but has also created the ability to collect, store, analyze, and use data to manage the enterprise itself. These advancements allow workforce data to be accessible anywhere, anytime, and define personnel skills as well as project, program, or DoD needs. They create the possibility to refine and optimize workforce pathways in ways not previously possible. Individualized experiences based on extensive data analysis of information beyond traditional reporting capabilities to include worker traits, tendencies, competencies, and experiences can enable us to create more actionable and effective interventions for optimizing the future workforce. In short, these advances create the synergy needed to develop an optimized workforce pipeline that maximizes efficiency with heightened effectiveness.

Tactical Planning for Optimized Development

This technological maturity not only enables us to create significant changes in organizing the workforce, it also changes our access to information and data and affects the way potential employees think, interact, develop, and seek jobs. Consequently, expectations for what a job will provide, how and where work will occur, and what their career trajectory will look like has also changed dramatically. In response, the military and government must find new ways to accommodate these workers of the future so we can maintain a world class workforce for the M&S community.

Several key trends have been noted that will change the way we identify and manage talent in the future. First, education is variable. No longer will employers value formal degrees as necessary or sufficient for job success. Experience matters. Second, competency-based badges will measure more than formal learning. They will measure and communicate traits, talents, skills, knowledge, preferences, and experience across employers, educators, and military. Finally, age will not necessarily be considered correlated with skill, rank, needs, knowledge, or capabilities. We must therefore redefine ways for our workforce to measure personal success that reflects this developmental shift. Since it cannot be assumed that age is correlated with income, rank, ideas, or leadership, we must reimagine the definition of worker value and how we communicate and satisfy the need to be seen as a useful contributor in our future workforce. Extensive research in technology development, psychology, and learning science has created a repository of complementary recommendations that when combined create an optimized framework for future worker development.

Thus, the following framework for the optimization of the future M&S workforce pipeline marks a pivotal augmentation to the way the M&S enterprise employs professionals and it can create a fundamental acceleration and improved flow in the way we identify, develop, and utilize M&S personnel. It creates the structure needed to optimize talent development, management, and maximize personnel capability at an unprecedented pace.

Proposed Framework

Across DoD, digital modernization is occurring and with these changes, comes the ability to capture data of all types, store it in the cloud, make it accessible anywhere, anytime, and allow for analyses, tracking, training, and prediction. Thus, any framework developed for the M&S community needs to adhere to the DoD technological structures being designed and focus first on data capture as well as assessment. Currently, no processes exist to capture, store, or assess information about potential employees or employers. Further, to date, individuals within the federal government and military have been hired into specific positions at specific pay rates based on a combination of availability, work experience, time in government, and formal degrees. These will not continue to be the primary markers of capability. Accordingly, a six-element initial framework that outlines what data to capture, how to tag it, store it, analyze it to inform hiring, professional development training and experiences, and capability needs is provided. Strategic outreach, the sixth element, is included because given the multi-disciplinary necessity of this field, it is a requirement that continuous connection to youth and university programs as well as across expert fields and the M&S community be intentionally maintained.

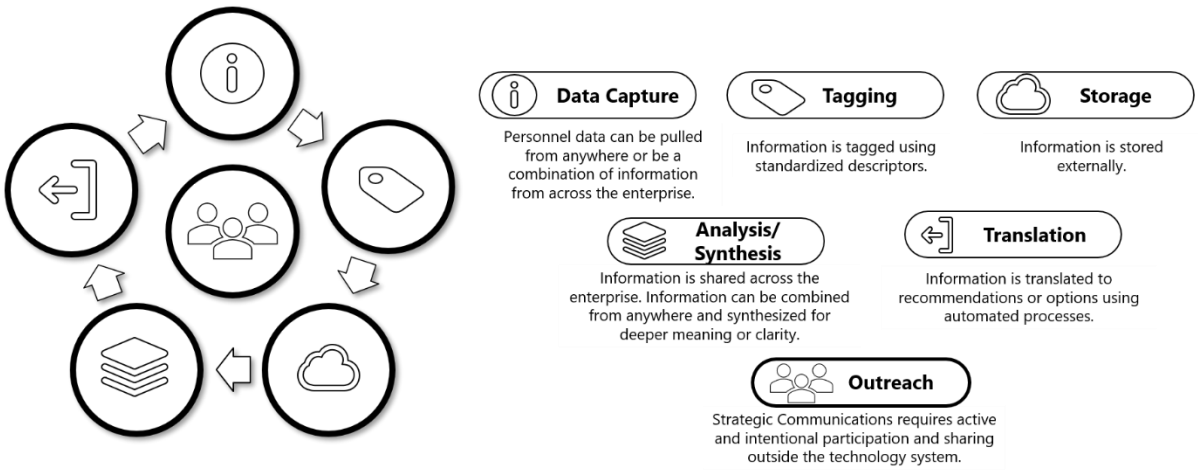

Figure 1. Proposed Workforce Pipeline Framework

Data Capture

To date, requests for resumes or curriculum vitae plus a cover letter and references are the key elements used for hiring. The system relies on individuals to find the employment opportunities across a variety of online sites and initiate the application process themselves. Billets are predefined with general requirements that can exclude capable individuals if they do not fit a specific billet series and hiring decisions are generally task or position based. However, variables to capture in the future could include competencies, experience, personality traits, and personal goals and expectations. When a multi-dimensional, whole-person analysis on this variety of data is conducted, the ability of companies, the military, or government to identify qualified employees increases. If that same data is analyzed to drive professional development and work experiences, the ability to retain that individual increases. And given that employee turn-over costs are estimated at 33% of each individual's annual salary, the fiscal savings could be substantial (Hall, 2019).

Tagging

Once the data is captured, tagging the data appropriately is necessary to be able to automate analysis. Specifically, given the goal to drive identification, growth, and retention rates, tagging data will need to fall into those three categories. For identification, job-specific skills (e.g., degrees, resume/CV, certifications, and competency badges), knowledge demonstrated by testing where possible, and personal preferences (e.g., Group work, travel, work hours, learning interests, personal goals) can help target appropriate individuals beyond the current system. Professional development, or growth, will need to tag current capabilities and expected needs for the department in the future and connect that information to determine individuals most closely aligned with future needs and the training needed to address gaps in knowledge or experience. Tagging personnel data in these ways allow for continuous consideration of the needs of both the departments and the employees and is expected to increase retention rates.

Storage

It is already a requirement within the DoD to move all data storage to the cloud (DoD Cloud Strategy, 2018). However, it is not enough to simply store data individually and separately from data across multiple areas of interest. Rather, data efficiency standards are being transformed from being single repositories to becoming streaming architectures that allow for real-time assessment of data across multiple entities and allowing management of knowledge, whether it be about personnel, learning, or operational needs, to be coordinated across a wider scope of data (e.g., Army University's Universal Transcript, OUSD(i)'s Learning Architecture, ADL Initiative's Total Learning Architecture, ADL Initiative's Future Learning Ecosystem framework). Accordingly, storage of personnel data in the future needs to be incorporated into these developing systems in order to allow departments to seek out talent, manage internal and personnel needs, and better predict which skills are needed for which efforts. A more optimized ecosystem can be achieved.

Analysis/Synthesis

Once the data is captured, tagged, and stored, the analysis and synthesis phase would involve determining not only which projects need M&S professionals and which professionals have the skills needed to complete the projects, but

it also allows for knowledgeable personnel across the spectrum to drive future planning of needed billets and changes to billet series descriptions (or additions), the department to better define youth experiences and connect them to university education, colleges and universities to continuously evolve their curricula to ensure they are preparing students for future expectations, and design, align, and improve professional development training, experiences, and meet personal needs. In short, once a system-wide data streaming architecture is designed, the ability to holistically improve the flow of personnel can be achieved.

Translation

Once it is understood what needs to occur based on the data, it is then necessary to translate that information into actionable tasks, recommendations, and guidance. Translating data into application can involve humans making decisions or artificial intelligence and other machine learning techniques can be used (Blake-Plock, 2019). For example, training available and appropriate for employees' professional development can be automatically pushed to individuals. Position availabilities and matches to these billets can also be provided. Certainly, these elements are already being executed in pockets but a defense-wide talent management program has not been implemented and expanding this to that scale requires a different technological architecture than when all variables such as billets, tasking, and programs are known. Expanding to an unlimited set of variables and possibilities for action changes the way systems need to be integrated.

Outreach

Finally, a somewhat independent element, Strategic Outreach, needs to be added to this ecosystem. Too often, the research-practice gap ensures that great ideas drive the design of great products that meet the needs of the few providing input. As a result, usage is limited and eventually, the project is no longer sustained. Rather, it is necessary to create a living ecosystem of personnel data that meets the needs of a very wide variety of department programs, offices, and especially those that focus on providing the cross-project vision currently lacking in the M&S executive leadership space. While there are many individuals across the enterprise capable of this work and designing the future, the structure of budgets, billets, tasks, and focus, by nature at least deter and perhaps prohibit any person or entity from driving the innovation and forward-thinking goals that need to be achieved. Independent innovation programs exist in every military branch but an intentional organization and harnessing of that talent and findings is limited at best. Creating a sustaining outreach plan to manage the M&S talent pipeline will be imperative to the success of not only a management system but also to the enterprise's ability to support the readiness needs of the US DoD.

RECOMMENDATIONS

Tomorrow's talent management system is likely to be entirely competency-based with professional growth experiences being recommended based on data analysis, personal need, and interest. Rank and age will decreasingly define tasking, team organization, or learning recommendations. Rather, the future federal and civilian military work environment will need to identify top talent in the United States and will need to develop flexible options for how to enter and how to engage within the government. Employment options will be more flexible in time, location, and focus. Project-based activities will be the norm and learning, working, and living will be intertwined. Value-reward metrics will be defined by the individual and could include anything from pay increases to travel opportunities to project flexibility. Cross-departmental, cross-state, cross-nation experience will be common. The greatest benefits to the government and military will be realized when creativity and diversity are maximized. The greatest fulfillment to the individual will be realized when interest, meaning, and value are maximized.

Thus, the intent to create an interoperable system that takes advantage of cloud technology, artificial intelligence, and streaming architectures has been noted for nearly a decade across reports, strategic guidance, and policy. However, the definitive steps to align current systems to the next generation vision for talent management has not yet been realized. Accordingly, the six-element proposed framework in this paper elucidates how talent can be harnessed across the M&S community to achieve the highest-level readiness for military personnel. To accomplish this goal, three recommendations are provided in the areas of personnel support, research, and outreach.

(1) Treat personnel as human assets

Current flexibility allowances to support employee retention are limited to signing and relocation bonuses, personal support (e.g., drug and alcohol abuse programs), student loan payoffs, and teleworking (GAO, 2019). Substantially more options can be provided that would not only support employees but would also add to the knowledge and

capability base afforded to the department. Specifically, allowing for optional work location, focus, experience, and length (e.g., project based) can create a more efficient and effective workforce that costs the department less but capitalizes on the talents and interests of future workers. This level of flexibility, however, is only reasonably attainable with a technology-enable talent management system such as the one described in this paper.

(2) Research

Workforce development is often limited to determining how to manage human assets across a system. However, humans are not widgets and accordingly, effective "management" requires a focus on the personal, emotional, professional, and overall growth and development of people. As the working world of tomorrow evolves, the US Government's Office of Personnel Management is already recognizing that individuals will not likely enter government and remain in a position for 20-30 years. Military also recognizes that all personnel who separate or retire will enter the civilian workforce. And the civilian workforce expects to transition not only within one field but instead expects to experience three to six full careers across their lifetime (Dede & Richards, 2020). Accordingly, research needs to be supported in the areas of life-long learning, technical advancements that can connect learning experiences across the lifetime, competency-based assessments, and standardizing communication between industry, education institutions, government, and military. More specifically, research needs to be sponsored to continuously determine the workforce needs of the future, connect workforce needs to skill and competency development across the lifetime, and provide recommendations to the federal government and military regarding resource expenditures and policy updates.

(3) Outreach

To ensure the development, sustainment, and continuous evolution and effectiveness of the future M&S workforce pipeline, the initial design must represent a living system and be tested in first a contained location with the idea of building to scale in mind. Recommended building and testing activities include sponsorship of: (a) Strategic planning for how to connect learning, enrichment, and on the job training programs across the lifetime to promote a workforce ecosystem ready for our future needs, (b) Designing a Model Pipeline to create a replicable model for how to connect learning experiences across the lifetime to promote a ready workforce, and (c) Information Sharing through published papers, keynote speeches, social media presence, strategic partnerships, and promoting awareness of the need for strategic planning to ensure a healthy industrial base for the government and military M&S workforce of the future.

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