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Military Operations

The Army Learning Concept for 2030-2040

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History. This publication is a major revision, resulting from publication of the revised TRADOC Pamphlet 525-3-1 (The U.S. Army in Multi-Domain Operations 2028). TRADOC Pamphlet 525-8-2 revision is detailed in the summary of change and executive summary.

Summary. This pamphlet describes the future of the Army as a learning organization that develops adaptable, thinking Soldiers and Army Civilian professionals with the knowledge, skills, and attitudes to generate and sustain trained teams. The Army learning Concept for 2030-2040 focuses on individual, tailored, and career-long learning integrated seamlessly along a learning continuum with unit training systems and processes to support the conduct of multi-domain operations. See the executive summary of this pamphlet for additional details.

Applicability. This pamphlet functions as a basis for Department of the Army activities that develop doctrine, organizations, training, materiel, leadership and education, personnel, facilities, and policy capabilities. The Army Learning Concept for 2030-2040 informs subsequent concepts and the Joint Capabilities Integration and Development System process. It supports Army capabilities development processes described in AR 71-9 and AR 71-32 and functions as a basis for developing concepts related to the future force. It also supports Army training and leader development described in AR 350-1 and TRADOC Regulation 350-70.

Proponent and exception authority. The proponent for this pamphlet is the Commander, U.S. Army Combined Arms Center. The proponent has the authority to approve exceptions or waivers to this pamphlet that are consistent with controlling laws and regulations.

*This publication supersedes TRADOC Pamphlet 525-8-2, dated 13 April 2017.

Suggested improvements. Submit proposed changes for improving this publication on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to the Provost, Army University, Vice Provost for Learning Systems, Policy and Governance Division (ATZL-AUL) at usarmy.leavenworth.tradoc.mbx.armyu-policy-and-governance@army.mil.

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Summary of Change

TRADOC Pamphlet 525-8-2

The Army Learning Concept for 2030-2040

This major revision, dated 12 February 2024 -

- o Changes proponentcy from the Director, Army Capabilities Integration Center to the Commander, U.S. Army Combined Arms Center (title page).
- o Updates title and concept timeframe (title and throughout).
- o Standardizes concept timeframes to align with the U.S. Army in Multi-Domain Operations 2028 concept (chap 1).
- o Addresses the training and education challenges from the future operating environment (chap 2).
- o Addresses the training and education required capabilities of the U.S. Army in Multi-Domain Operations 2028 concept (chap 3, app B and C).

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Executive Summary

The Army University produced TRADOC Pamphlet 525-8-2 over the course of two years in collaboration with leaders, trainers, educators, concept developers, training and education developers, researchers, and scientists from all Army major commands and centers of excellence. The concept was developed to meet the required capabilities of the U.S. Army in Multi-Domain Operations 2028 concept (see TRADOC Pamphlet 525-3-1) and anticipate the needs of the Army in 2040. The U.S. Army in Multi-Domain Operations 2028 concept includes several required capabilities that pertain to the future learning environment (see Executive Summary figure 1). Specifically, the U.S. Army in Multi-Domain Operations 2028 focuses on the need for "...new tools to more rapidly converge capabilities across the Joint Force, shifting training paradigms, and changes in personnel and talent management practices..." It also identifies the need that "Army formations be trained, manned, and equipped to leverage all available information..." and to "...attract, retain, and make maximum use of high-quality, physically fit, mentally tough Soldiers who have the skills and expertise to conduct [multi-domain operations (MDO)]." (TRADOC Pamphlet 525-3-1 excerpts).

A community of experts produced the Army Learning Concept for 2030-2040 in synchronization with the Army People Strategy.

Chapter 1 of the Army Learning Concept for 2030-2040 describes this pamphlet's purpose as follows: to provide a conceptual framework to build a learning organization that empowers learners to meet the total Army's readiness requirements and sustain intellectual overmatch of adversaries. Emerging technologies and talent management enable this strategic advantage with a culture of continuous improvement and increased proficiency at every echelon. This conceptual framework provides a basis for operational adaptability and expanding the competitive space within MDO to win.

Chapter 2 explains how the future operational environment, as described in TRADOC Pamphlet 525-92, will affect Army training and education across the operational, institutional, and self-development domains. The future operational environment will require the Army to innovate and adapt faster than peer and near-peer adversaries in constantly fluctuating social and information environments due in part to constantly advancing technologies across land, air, maritime, space, and cyberspace. Evolutions in the future operational environment will require the Army to incorporate new lessons, tools, and technologies rapidly into training and education to enable Army service members, at the time and point of need, to dominate in all forms of operations.

Chapter 3 describes the military problem facing future Army forces in training and education and the central idea that answers the challenge raised in the U.S. Army in Multi-Domain Operations 2028 concept's military problem. Namely, the Army, as a learning organization, will empower and enable learners through a culture of persistent and tailored development and behavioral assessment to optimize their knowledge, skills, and attitudes to serve as members of highly effective teams. The components of the solution describe how future Army forces implement the central idea during operations across five interrelated components: 1) the Army, as a learning organization, commits to a culture of continuous responsibility for the development of individuals and teams; 2) learning strategy design focused on learner centric activities for task

competency and ill-structured problem solving in high-tech, complex settings; 3) integration of learning science and enabling technologies promotes the right training and education for the right individuals at the right time and location; 4) a data informed learning infrastructure, integrated with the talent management enterprise, allows the tailoring of individual and unit learning to optimize individual and team performance; and 5) fostering human capital and workforce development ensures trainers, faculty, coaches, mentors, and developers capable of modernizing the Army as envisioned in the other components of the solution.

Chapter 4 concludes with a summary of the efforts needed to meet the learning challenges of the future operational environment.

Appendix B reflects required capabilities necessary to conduct training and education operations as described across the five components of the solution in chapter 3. Appendix C identifies the science and technology areas that can help achieve those required capabilities.

Operational Context:

- Technology innovations occur at rapid pace
- World connected through “Internet of Things”
- Cognitive enhancements, machine learning, and artificial intelligence are prevalent
- Constantly shifting information and influence environments create cognitive dissonance
- Social and cultural dynamics challenge status quo
- Increased potential for overmatch of U.S. forces

Military Problem: How does the Army, as a learning organization, empower and enable learners, operating as part of the Joint Force in ambiguous, complex, multi-domain environments, to fight and win our Nation’s wars?

Central Idea: The Army, as a learning organization, empowers and enables learners through a culture of persistent and tailored development and behavioral assessment to optimize their knowledge, skills, and attitudes to serve as members of highly effective teams.

Tenets:

- The Army promotes a culture of individual and organizational responsibility at all levels for continuous learning and behavioral performance improvement during multi-domain operations (MDO).
- The Army assesses and manages the development and employment of talent to maximize learner competencies, promote learner readiness, and optimize teams to conduct MDO.
- The Army improves its ability to adapt learning strategies and learning systems continuously to changes in the complex operational environment, changes to MDO operations, and training doctrine – in order to train as expected to fight in MDO and expertly employ the command-and-control system.
- The Army provides data-driven mechanisms to enable tailored learning and behavioral assessment across operational, institutional, and the self-development domains.
- The Army ensures learners, facilitators, leaders, coaches, and mentors have the capability, capacity, and commitment needed to support the learning environment and improve learner behavioral performance and task mastery.

Solution Synopsis (aligned to Tenets): To effectively implement an Army learning ecosystem, the Army modernizes learning technology infrastructure; invests in collecting and managing high-quality data across the enterprise; commits to the implementation of evidence-driven learning strategies; invests in preparing and supporting learning facilitators (namely, instructional designers, teachers, trainers, mentors); and appropriately revises organizational policies and processes across all areas of responsibility. Army leaders demonstrate a strong commitment to this organizational change or risk insufficient, incremental improvements that fail to meet the needs of the total force in 2040.

Components of the Solution:

1- The Army as a Learning Organization: committed to a culture of continuous responsibility for the development of individuals and teams for optimized performance.	2- Learning Strategy Design: focused on learner centric activities for task competency and ill-structured problem solving in high-tech, complex settings.	3- Integration of Learning Science and Enabling Technologies: balanced with assessment of uniquely human competencies in realistic environments.
4- A Data Informed Learning Infrastructure: crossing operational, institutional and self-development domains to enable assessment and development of individuals and teams.	5- Fostering Human Capital and Workforce Development: adapting and responding to the challenges of MDO by assessing, acquiring, and managing the talents of service members.	

Required Capabilities:

Organizational Learning Infrastructure	Persistent Learner Access	Pervasive Feedback/Change Mechanisms	Validated Socialized Learning Solutions	Customized Learner Pathways Developed
Learner Common Operating Picture for Leaders	Synthetic Environments	Customizable Learner Content	Shareable/Interoperable Secure Learner Data	Digital Literacy for Learners and Mentors
Learning Management / Talent Management Interface	Reach to Experts	Adaptive Proponent Competency Maps	Innovative Multi-disciplinary Workforce	Talent Managed Workforce Developed

Executive Summary Figure 1. The Army Learning Concept for 2030-2040 Logic Map

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Chapter 1

Introduction

1-1. Purpose

The Army Learning Concept (ALC) for 2030-2040 provides a conceptual framework to build a learning organization that empowers learners to meet the total Army's readiness requirements and sustain intellectual overmatch of adversaries. Emerging technologies and talent management enable this strategic advantage with a culture of continuous improvement and increased proficiency at every echelon. This conceptual framework provides a basis for operational adaptability and expanding the competitive space within multi-domain operations (MDO) to win.

1-2. References

Appendix A lists required and related publications.

1-3. Explanation of abbreviations and terms

The glossary explains abbreviations and special terms used in this pamphlet.

1-4. Records management requirements

The records management requirement for all record numbers, associated forms, and reports required by this pamphlet are addressed in the Army Records Retention Schedule-Army (RRS-A). Detailed information for all related record numbers, forms, and reports are located in Army Records Information Management System (ARIMS)/RRS-A at <https://www.arims.army.mil/>. If any record numbers, forms, and reports are not current, addressed, and/or published correctly in ARIMS/RRS-A, see DA Pamphlet 25-403 for guidance.

1-5. Background

a. The previous TRADOC Pamphlet (TP) 525-8-2, dated April 2017, was a leadership-directed concept that outlined key elements required to build the future Army learning environment. This revision of that concept describes how the Army, as a learning organization, ensures its members strengthen and develop the competencies needed to meet the Chief of Staff of the Army's four focus areas: 1) warfighting; 2) continuous transformation; 3) strengthening the profession; and 4) delivering ready combat formations.

b. According to TRADOC Regulation (TR) 350-70, Army learning is the act of acquiring, maintaining, or improving knowledge, skills, and attitudes to achieve required behavioral performance. Total Army learning results from a combination of training, education, and experience within the operational environment (OE) and across the operational, institutional, and self-development training domains. The Army deliberately uses learning products to address training and education requirements. Correspondingly, Army learning systems facilitate processes affecting personnel, resourcing, facilities, technology infrastructure, and acquisitions in support of lifelong learning. ALC 2030-2040 accommodates the Army's instructional systems design (ISD) process to produce Army learning products. ISD is the process of designing and developing materials that bring greater efficiency and effectiveness to acquiring knowledge, skills, and attitudes to achieve required behavioral performance from learners.

1-6. Assumptions

a. ALC 2030-2040 builds upon the efforts of the previous learning concept, now codified in TR 350-70, to establish the Army Learning Model and a career-long continuum of learning that provides operationally relevant learning experiences and outcome-oriented instructional strategies that extend learning beyond the institutional domain.

b. The Army will recruit, develop, and retain instructional system specialists who have specific instructional design backgrounds to address the complexity of an evolving learning ecosystem (see paragraph 3-4.b.) and who will provide solutions in a constrained resource environment.

c. Army governance sufficiently evaluates proponent progress toward ALC 2030-2040 required capabilities.

d. The Army's budget for training and education remains steady or decreases.

e. The demand for Army forces remains relatively consistent.

f. Modernization programs related to Army learning provide capabilities on their planned timelines.

g. Learning science and technologies exist, or soon will exist, to support the ALC. The Army adequately develops, acquires, and fields those learning technologies.

h. The Army continues to confront unexpected challenges from an adaptive enemy and responds rapidly in the development of doctrine, training, and education.

1-7. Linkage to other concepts

TP 525-3-1, The U.S. Army in Multi-Domain Operations 2028, identifies the need to rapidly converge organic and external capabilities across the Joint Force, shifting training paradigms and changing talent management practices, to make maximum use of high-quality, physically fit, mentally tough Soldiers who have the skills and expertise to conduct MDO. In support of TP 525-3-1, the ALC 2030-2040 identifies the required capabilities and proposed solutions that Soldiers and Army Civilian professionals need to support the future force.

Chapter 2

Operational Context

2-1. Introduction

a. Previous Army learning concepts drove the institutional Army to keep pace with changes in the OE and urged proactive adaptation. These concepts called for the use of instructional strategies that foster critical and creative thinking and that blend traditional brick-and-mortar

classrooms with state-of-the-art technology and simulations. The challenges of MDO require the ALC 2030-2040 to advance these same ideas further and faster.

b. Winning in MDO against peer and near-peer adversaries in a highly contested OE requires an Army learning ecosystem that can innovate and adapt even faster than the last decade. In pursuit of these goals, the total Army promotes a continuum of lifelong learning, adaptability, and innovation for Soldiers, Army Civilian professionals, and leaders.

2-2. The operational environment through 2040

a. Significant advances in science and technology continue at a rapid pace. Humans continue to interconnect increasingly to each other's ideas and opinions; through the Internet of Things¹, our human awareness and reach continue to extend. Technological innovations such as cognitive enhancements and artificial intelligence (AI) also augment human abilities. Meanwhile, access to an overabundance of information, misinformation, and disinformation, combined with each individual's increased reach and impact potential, creates the conditions for constantly changing social and cultural dynamics, and fluid—even chaotic—information and influence environments. Potential threats cheaply acquire advanced technological capabilities, increasing the potential for parity or overmatch of U.S. Armed Forces.

b. An ever-widening array of threats (pacing threats to hyper-empowered individuals) prepare to challenge the U.S. or to compete with the U.S. using economic, informational, and diplomatic instruments of national power. Such threat actors also challenge the U.S. across the continuum of competition, crisis, and armed conflict—and across all warfighting functions. Threats present the U.S. Army with challenges ranging from large-scale combat operations (LSCO) to continuous influence operations targeting the U.S. population.

c. Success in MDO requires Army leaders and service members to analyze, update, and adapt operational understanding throughout the full range of military operations and across all warfighting domains with integration of economic, informational, and diplomatic instruments of national power. Natural and man-made environmental challenges compound the MDO problem set and require rapid reconfiguration of forces (and learning requirements) as units respond to events ranging from humanitarian crises and support to civil authorities in addition to preparing for LSCO against peer and near-peer threats. The knowledge, skills, and attitudes required for these operations become more nuanced, sophisticated, and difficult to recruit, develop, and train.

2-3. The future operational environment and implications for the learning environment

a. The Army requires new learning and developing core competencies, technologies, and processes to mentally and emotionally prepare Soldiers and Army Civilian professionals for the ever-expanding array of threats and operations. These tools need to maximize explicit knowledge

¹ *Modernizing Learning: Building the Future Learning Ecosystem*. (2019). "Cloud computing...helped realize the Internet of Things..., the network of smart devices that can connect to networks and share data...researchers have only begun exploring its applications for learning. In the context of education and training, [the Internet of Things] helps bridge real and virtual contexts, allowing learners to interact with networked physical objects that also have digital footprints. These objects might include embedded RFID sensors, spatial beacons, or wearable technologies..."

through rote memorization aids, methods for increasing learning repetitions, and enhancing academic rigor. Additionally, learning tools and environments must improve tacit knowledge transfer between experts and novices to improve implicit learning utilizing both face-to-face and virtual educational methods in combination to enhance data-driven readiness. Further, schools and centers of excellence need tools to assess prerequisite competencies and ensure maximum proficiency development beyond rank or time served, providing experts in a timely manner at the point of need. Lastly, units need to have better ways to develop their social learning and rapidly form highly effective teams prepared for any unexpected and evolving challenges.

b. To achieve success, the Army must be a learning organization. As Army personnel engage in MDO with peer and near-peer adversaries, the advancement of the Army as a learning organization is of fundamental importance to avoid disruption of operations. As the Army actively facilitates learning and development to improve its proficiency and readiness at every echelon it grows as an organization, fostering a culture of knowledge sharing and continuous improvement. Simply maintaining today's standards of behavioral performance, whether for the individual or for the organization, will no longer suffice.

c. The Army trains and develops Soldiers and Army Civilian professionals to seize the initiative and maintain a competitive advantage when operating in a complex battlespace. When matched against adaptive adversaries, achieving decisive victory in future operating environments will require rapid, needs-based solutions that integrate across force modernization requirements for doctrine, organization, training, materiel, leadership and education, personnel, facilities, and policy. Soldiers and Army Civilian professionals need the capacity to innovate solutions under these conditions, as they prepare for rapid and sometimes unexpected changes in the environment. As part of this reality, the Army proactively and systematically identifies future core competencies, and assesses behavioral development and task mastery, to optimize and employ highly effective teams and MDO capabilities at every echelon.

d. In the future OE, the amount of information available influences cognitive load (or the amount of working memory resources) and motivation to learn. The Army develops individuals with the internal capacity to manage information overload as well as the technology and processes to mitigate cognitive overload or otherwise distribute the load among systems and teammates. Similarly, contested, degraded, and operationally limited information also complicates the information environment. Soldiers and Army Civilian professionals need the knowledge, skills, and attitudes to identify and evaluate the quality of information while actively addressing missing or unreliable data. Instructional designers consider human-machine interface to address cognitive burdens and address trust and confidence in rapidly evolving technology and resistance to those technologies.

e. The Army will continue to operate in a resource-constrained environment. The Army must use time and assets as effectively and efficiently as possible to have an advantage over adversaries. For learning and behavioral development, a careful mix of technologies and learning sciences help optimize outcomes. This includes leveraging distributed learning, data-driven learning analytics, personalized learning, social learning, and other technologies that support learning at scale. Additionally, optimizing learning outcomes includes the integration of principles that improve the design and delivery of learning experiences and assessments as well

as integration of advanced simulations that realistically replicate threats, environmental factors, and internal capabilities at every echelon.

2-4. Challenges for the learning environment

a. Replicating relevant aspects of the complex global environment within the learning context is critical to providing tough and realistic training and education. This environment involves operations among human populations, decentralized and networked threat organizations, information warfare, and true asymmetries stemming from unpredictable and unexpected use of weapons, tactics, and motivations. Adversaries employ information warfare to degrade command and control capabilities or conduct global perception management and influence campaigns. Adaptability is paramount; the learning system must provide training and education solutions to teams, Soldiers, and Army Civilian professionals synchronized to the operational tempo. The Army's training and education challenges are to optimize, synchronize, and sustain training and education across the operational, institutional, and self-development training domains to produce forces and leaders capable of responding across the range of military operations. To meet these challenges, Army training and education must do the following:

(1) Create situations allowing individuals and teams to master fundamental knowledge, skills, and attitudes, in conjunction with assessing their behavioral development and task mastery.

(2) Present complex dilemmas forcing leaders to think clearly about the use of lethal and non-lethal force and how to match tactical actions with operational and strategic objectives.

(3) Create situations allowing individuals and teams to experience, become comfortable in, and even thrive in, ambiguity and chaos – followed by timely and meaningful feedback on their behavioral performance.

(4) Provide the required repetition, understanding the importance of spacing and integration with previous knowledge, especially under the right conditions and with the right level of academic rigor, to build mastery of both fundamental and advanced warfighting skills combined with critical and creative thinking.

(5) Portray the complex environment to develop Soldiers, Army Civilian professionals, and teams that understand the situation, apply appropriate judgment, adapt to changing conditions, and transition effectively between operations. Army training and education prepare Soldiers and Army Civilian professionals to exercise mission command and influence key individuals, organizations, and institutions through cooperative and persuasive means.

b. Uncertain and complex OEs require continuous infusion of lessons learned and rapid adaptation of learning products, and the training support system, to provide increased academic rigor and improve relevance. Curricula, learning products, training aids, devices, simulators, and simulations will need to adapt to allow Soldiers, Army Civilian professionals, and teams to use emerging technologies that will improve social learning, distributed learning, interactive multimedia instruction, mobile applications, gaming, cognitive aiding tools, and embedded

training. Training physically dispersed teams collectively and supporting increased use of distributed learning at the point of need requires adaptation of the Army communications network on all security enclaves, information security, and policies and practices. Leaders of those dispersed teams require improved training management tools fully integrated with learning infrastructure to plan, prepare, execute, and assess learning using continuously evolving learning products more easily.

c. Learner-centric training and education require explicit and implicit learning unbound by location. Such support requires collaboration among trainers, faculty, coaches, and mentors pushing for greater system access and security specialists who ensure data use for specifically determined purposes. The ability to distribute learner-centric training and education that optimize human performance (such as through a cloud-based system to individuals at the point of need), while maximizing tacit knowledge transfer, must be commonplace.

d. Technology enables scalable, effective, and efficient training and education. Projected technological innovations allow the inclusion of a dynamic OE to challenge future Soldiers and Army Civilian professionals thereby maximizing their learning potential. Improved technology will allow leaders to train and educate individuals and teams at different levels of behavioral performance. Improving proficiency with sophisticated technology also enhances officer and noncommissioned officer's technical craft. Reflecting learning levels of students or teams will improve multi-echelon training within the same group of learners.

e. Investment in technology improves human dimension capabilities. Leaders must look to the future having a more capable, more technologically advanced force with further emphasis on operations across the land, air, maritime, space, and cyberspace domains in contested environments. This force must understand technologies are tools, only as effective and adaptable as the operators using them. Training development consideration and integration early in a new system's acquisition process will improve equipment and technology use during training and education, ultimately improving post-fielding operational readiness.

f. Chain of command involvement remains critical to increasing readiness. The chain of command, the learner, and training and education communities continue to share responsibility for learning management. The institution develops and delivers training tasks and education curricula and maintains the learning infrastructure. Unit leaders plan collective training, supervise its implementation, assess, and mentor subordinates in a career-long learning continuum. Therein, personnel gain experience and develop individually over time, acquiring and performing progressively higher skills and responsibilities as their careers advance. Individuals accept responsibility to become career-long learners through training, education, and experience.

g. Soldiers and Army Civilian professionals who develop training and education consider future learner capabilities and needs, recognizing that learning happens in different ways for different people over time. Training and education are interactive, engaging, and challenging at the individual level, while at the collective level emphasizing collaborative problem-solving events. Training and education engage learners to think about and understand the relevance and context of learned content, acquire and demonstrate ability to retrieve that knowledge, develop

skills through practice, and demonstrate desired behavioral performance and adaptive capability for the future. Army personnel acquire these knowledge, skills, and attitudes through a holistic approach to enhance both basic and advanced capabilities, developing from novices to experts rapidly and successfully.

Chapter 3

Military Problem and Components of the Solution

3-1. Military problem

How does the Army, as a learning organization, empower and enable learners, operating as part of the Joint Force in ambiguous, complex, multi-domain environments, to fight and win our Nation's wars?

3-2. Central idea

The Army, as a learning organization, empowers and enables learners through a culture of persistent and tailored development and behavioral assessment to optimize their knowledge, skills, and attitudes to serve as members of highly effective teams.

3-3. Tenets

All training and education planning should share the following features, including employment of this concept.

- a. The Army promotes a culture of individual and organizational responsibility at all levels for continuous learning and behavioral performance improvement during MDO.
- b. The Army assesses and manages the development and employment of talent to maximize learner competencies, promote learner readiness, and optimize teams to conduct MDO.
- c. The Army improves its ability to adapt learning strategies and learning systems continuously to changes in the complex OE and changes to MDO and training doctrine – in order to train as expected to fight in MDO and expertly employ the command and control system.
- d. The Army provides data-driven mechanisms to enable tailored learning and behavioral assessments across the operational, institutional, and self-development training domains.
- e. The Army ensures learners, facilitators, leaders, coaches, and mentors have the capability, capacity, and commitment needed to support the learning environment and improve learner behavioral performance and task mastery.

3-4. Solution synopsis

- a. Paragraphs 3-5 through 3-9 describe the five components of a solution designed to achieve the central idea (from paragraph 3-2) in the future operational context (chapter 2). This subsection summarizes those components within a unifying perspective, that is, under the concept of a “learning ecosystem” (see figure 3-1). The learning ecosystem exemplifies the

integrated methods and systems needed to support learning and behavioral development in the future.

b. A learning ecosystem is a system of systems, designed to support the diverse continuum of lifelong learning and behavioral development activities an individual or team may experience holistically. Varied learning delivery platforms establish a learning ecosystem enabled by interoperable common source software widely available to the user. This ecosystem functions as an integrated system through technology interoperability, data sharing, and associated business rules. Learning science principles guide the design and operation of the learning ecosystem to optimize its effectiveness and efficiency.

(1) The Army learning ecosystem will support the full range of formal to informal learning; for example, from formal brick-and-mortar professional military education and live training events to informal micro-learning² and mentorship. The ecosystem will support all Army learners, including military and civilian personnel as well as designated contractors and allies. The Army learning ecosystem will also incorporate the range of individual, team, collective, and Service-level learning and development equities, and it will integrate with the larger Department of Defense-wide learning ecosystem. Holistic integration across learning activities is key. All Army components and cohorts require appropriate ecosystem access.

(2) As it matures, the Army learning ecosystem will integrate Army training management tools with workforce and personnel systems, so that by 2040 the Army will realize the necessary infrastructure to support data-driven strategic talent management, with machine learning³ informing associated analyses, forecasts, and recommended actions across all phases of the talent management and learning management cycles.

(3) To effectively implement the Army learning ecosystem, the Army will need to:

- modernize its learning technology infrastructure,
- invest in collecting and managing high-quality data across the enterprise,
- commit to the implementation of evidence-driven learning strategies,
- invest in preparing and supporting learning facilitators (for example, instructional designers, teachers, trainers, mentors),
- appropriately revise organizational policies and processes across all functional areas of responsibility, and
- demonstrate a strong commitment to this organizational change or risk insufficient, incremental improvements that fail to meet the needs of the total force in 2040.

² A small learning event, focused to meet a specific learning outcome.

³ Machine learning is a method of producing an artificial intelligence system that relies upon rules learned empirically from large data sets rather than theoretically derived rules.

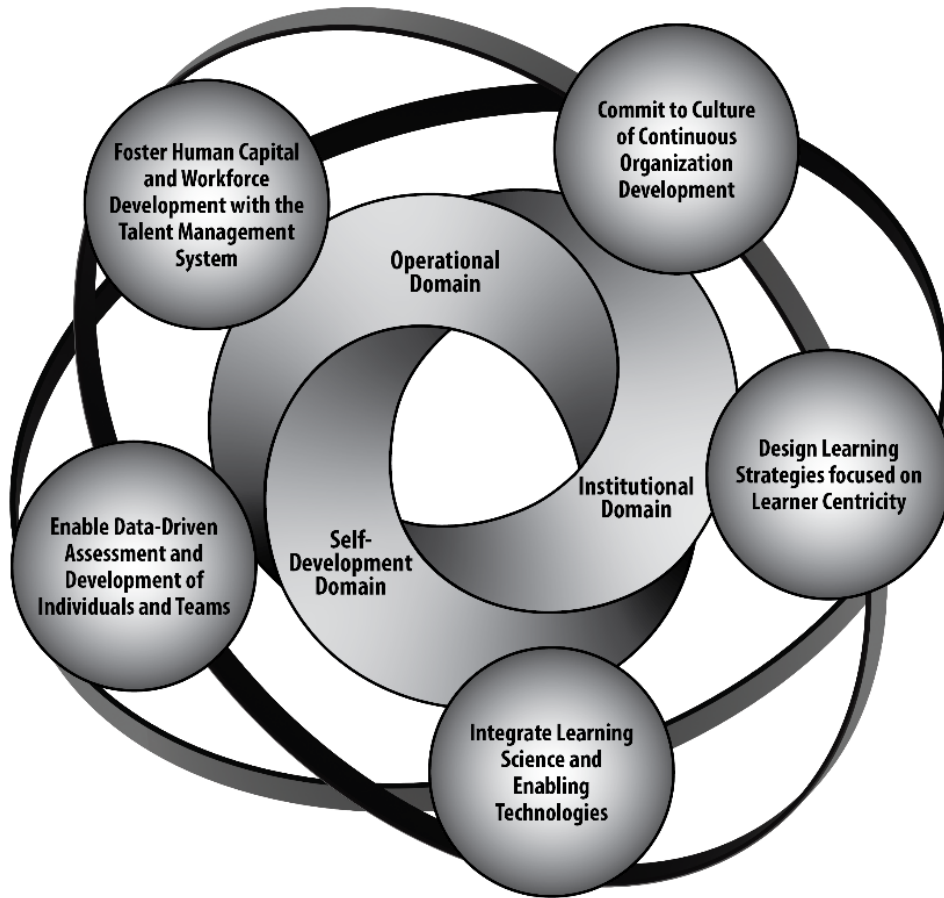


Figure 3-1. Solution Synopsis: The 2040 Army Learning Ecosystem

c. The first solution component is improving Army intra-organizational learning to meet operational readiness requirements (para 3-5). A learning organization is one that values and rewards individual learning and that has explicit mechanisms to support organizational learning. In other words, it has processes to enable knowledge sharing and continuous organizational behavioral adaptation. This component emphasizes culture change, empowering individuals through support systems and a culture of self-responsibility and improving accountability by enhancing measurement of both individual and organizational behavioral outcomes and task mastery. This component sets the foundation for all others.

d. The second solution component is investment in learning science and the use of evidence-based learning theory and instructional practices to adapt to learner conditions (para 3-6). Empirical evidence shows that proven learning science strategies yield better outcomes. However, employing quality learning science requires an organizational commitment. Part of strengthening the Army's stance as a learning organization includes implementation of these processes along with new mechanisms to hold Army components and cohorts accountable for using quality learning principles. Those principles include using a diverse set of validated learning strategies as well as employing modern methods for identifying the competencies Soldiers and Army Civilian professionals need, fostering self-directed learning abilities, using learner-centric approaches, and enhancing the learning and development workforce to support these advancements effectively.

e. The third solution component is using integrated learning technologies to share learner data across organizations (para 3-7), including the range of lightweight digital technologies, such as smartphone-based apps, to complex systems, such as the Synthetic Training Environment (STE). A considered mix of these technologies, connected into a cohesive learning ecosystem, yields the most efficient results— providing the right platforms, for the right individuals, at the right times. Traditional in-resident courses and live training also integrate within this continuum by augmenting those activities with technologies (for example, wearable sensors and performance monitors) and planning for a goal-directed mix of live, blended, and digital learning. The use of next generation constructive simulation capabilities will produce scalable representations of the battlefield combining multiple environmental and physical factors that will challenge students to think more completely about the operational environment. Students in 2040 resident classroom instruction will be well versed in using digital technology and fully versed in virtual and augmented reality (VR/AR). Resident training that once required hours of classroom instruction will migrate to micro-courses that augment reality during hands on training. This component of the solution focuses on the technical infrastructure needed to realize the learning ecosystem.

f. The fourth solution component is enterprise-wide data-driven learner competency development and behavioral assessment (para 3-8). If learning technologies are the engine of the learning ecosystem, then data is its fuel. The Army can realize massive advantages by leveraging common, standardized, shareable, and secure data to inform individual learning activities, organizational planning, and holistic system management. However, the Army must work to build the infrastructure and shift the learning culture to embrace data-driven processes. Data literacy must be improved for all Army personnel to ensure the effective and ethical use of data. Achieving this vision requires quality behavioral measurements (guided by learning science), diverse and pervasive technologies, and leadership commitment. As the Army builds the data infrastructure key to modernizing learning and development systems, it unlocks powerful opportunities for using machine learning and adaptive algorithms to enhance learning effectiveness and efficiency and contributes directly to the fifth component of the solution below.

g. The fifth solution component is an integrated talent management system that optimizes performance and processes in support of the other solution components (para 3-9). The Army learning and development workforce updates and properly defines roles, competencies, and responsibilities; in conjunction, this workforce trains in the skills necessary to meet the expanded requirements of the learning ecosystem. Achieving the Army Learning Concept for 2030-2040 will require challenging and, in some cases, wholly new efforts from teachers, trainers, instructional designers, material developers, and other contributors. The current training and education workforce must transform into an integrated learning engineering community supported by organizational systems aligned to the 2030-2040 model.⁴ The fifth component addresses the long-term sustainability of the other components of the solution by ensuring that

⁴ *Modernizing Learning: Building the Future Learning Ecosystem*. (2019). “Learning engineering, as conceived today, is an interdisciplinary approach based on an in-depth foundation and education in proven theoretical models and methods, educational paradigms and instructional approaches, and scientific and analytical methods. Learning engineers use data and knowledge of enterprise structures to help promote good decision-making in the use of learning ecosystem components. With its focus on data, and in using validated methods that put learning data to work in the service of improved learning outcomes and institutional effectiveness, this emerging field takes a step beyond traditional instructional design.” (pp. 307-308)

the people who drive this change, day to day into the future, have the capabilities, organizational mechanisms, and administrative tools they need to succeed.

3-5. Component of the solution 1: Optimize the Army as a learning organization

a. By 2040, the Army transitions to an information age, learner-centric model that blends technology-based learning, self-paced learning, and face-to-face instruction across the range of formal and informal learning experiences. This requires a cultural shift. The total Army must actively foster a permissive, multi-modal learning culture that recognizes that learning is always happening, whether in formal settings, such as physical or virtual classrooms, or in self-directed, just-in-time, social, experiential, or other informal ways. Diverse learning opportunities must incorporate the fundamental individual and collective tasks needed to win our nation's wars. Learning opportunities must also incorporate competencies, such as critical and creative problem-solving, digital literacy, social and cultural awareness, and effective decision-making strategies to conduct MDO in the future OE.

b. The Army supports organizational learning processes and continues to transform individual and collective learning tools. Organizational learning is an intentional, continuous improvement process meant to help an organization acquire, create, and share knowledge among its members. Organizational learning relies on individuals sharing what they have learned with the group, so that knowledge spreads across the organization and the organization has the flexibility to adapt its processes accordingly. The future Army adapts by integrating continuous learning into its culture, processes, and infrastructure. Senior leaders lead a culture shift, with a shared vision and common understanding, to enable the Army and its subordinate organizations to exchange knowledge, leverage diverse perspectives, and ultimately enhance Army effectiveness.

c. Behavioral and task performance optimization demands frequent cooperation among individuals, teams, and units; open, honest, and clear communication at all levels; and a culture founded upon trust—wherein Soldiers and Army Civilian professionals demonstrate and nurture continuous learning as a core organizational value. Building a learning organization requires the intentional application and assessment of specific characteristics. Figure 3-2 provides an example of a possible application and behavioral assessment framework for developing as a learning organization.

d. The Army empowers individuals and fosters their sense of responsibility for learning. One way to nurture continuous improvement is to empower individuals and leaders to manage lifelong learning objectives through enablers, such as career tracking applications that help learners, supervisors, and mentors monitor accomplishments, explore possible career paths, and set developmental goals. The Army combines these enabling systems with encouragement for personal responsibility and initiative and reinforces open discussions within chains of command so that supervisors and mentors can monitor the status of their subordinates and enable their progress.

Dimension 1: Cultivation of Learning Support	
Maintaining a culture that is conducive to continuous learning for individuals and teams by providing resources, removing obstacles and incentivizing and modeling behaviors that support learning.	
Attribute 1	Communicates the value of learning, new ideas and open dialogue across all levels of the organization.
Attribute 2	Recognizes and rewards initiatives to generate and share new knowledge.
Attribute 3	Encourages learning that promotes continuous self- and organizational- improvement.
Attribute 4	Provides resources and opportunities to enable learning and development.
Dimension 2: Orientation toward a Shared Future	
Creating a shared organizational vision and a common understanding of how learning is used to collectively achieve the vision.	
Attribute 1	Collaborates to define strategies for learning to achieve shared goals.
Attribute 2	Demonstrates a unified purpose for how learning is used to create change and achieve a shared organizational vision.
Attribute 3	Works together to integrate learning into daily operations.
Dimension 3: Exploration of New Perspectives	
Searching continuously for new perspectives and information and challenging current thinking to give rise to improvements.	
Attribute 1	Conducts ongoing assessment of the organization to determine where learning is needed.
Attribute 2	Challenges current practices and generates new methods for achieving objectives.
Attribute 3	Applies new ideas that lead to innovation.
Attribute 4	Builds a foundation of trust to encourage generation and implementation of new knowledge.
Dimension 4: Synchronization of Capabilities	
Aligning capabilities and resources to achieve interdependencies that promote learning and enhance effectiveness.	
Attribute 1	Integrates capabilities across the organization to achieve a common goal.
Attribute 2	Leverages diverse perspectives and experiences to create value for the organization.
Attribute 3	Considers the complex relationships among environmental and organizational elements when identifying courses of action.
Dimension 5: Management of Organizational Knowledge	
Engaging in ongoing activities to identify, capture, store, transfer and apply knowledge to address knowledge gaps and optimize performance.	
Attribute 1	Maintains processes for knowledge exchange and continuity of operations.
Attribute 2	Connects communities of interest to promote knowledge exchange and integration.
Attribute 3	Leverages systems to share knowledge that aligns with work requirements.
Attribute 4	Captures and disseminates lessons learned.

Figure 3-2. Dimensions of a potential learning organization⁵

e. The Army enables learners to seek out instructional resources, including those validated learning experiences from other organizations. Digital age learners continually seek information and want those needs gratified immediately. The Army should empower those same learners to seek instructional resources for assignment-oriented skills, career advancement or change, pursuit of civilian education goals, or to prepare for military-to-civilian transition. Organizations outside the Army develop learning resources and prompt the Army to validate those learning experiences. The Army ensures doctrinally correct, relevant, and approved learning solutions, maintains system security, ensures quality standards, and verifies authoritative sources.

⁵ *Development and validation of the U.S. Army Learning Organization Maturity Model.* (2021). Available at <https://apps.dtic.mil/sti/trecms/pdf/AD1146687.pdf>

f. The Army cannot overstate the importance of incorporating meaningful, valid, and reliable assessments of learning and behavioral development. With appropriate assessments, leaders tailor training and education to learners' needs and level of experience, including testing out of competencies already mastered. Behavioral and task performance measures shape learner feedback; and post-learning assessments can verify and validate that learning has occurred to standard. Behavioral assessments incorporate a composite of descriptive, quantitative, and qualitative sources; for example, post-learning survey results, direct job observations, and interviews provide valuable data. In addition, learning experiences need both objective and subjective assessments. Feedback, when collected and compiled electronically, facilitates rapid updates to learning products in support of continuous Army improvement. Continuous improvement depends on closing the loop between data collection, analysis, and intervention as opposed to behavioral assessments without established processes for responding to insights the compiled information provides.

3-6. Component of the solution 2: Invest in proven learning strategies

a. Advancements in human cognition and learning science have yielded practical and quantifiable results and implementing these practices in Army learning systems improves their outcomes. The Army commits to the use of these practices and invests in the people and enabling organizational processes to integrate learner-centric principles and practices across operational, institutional, and self-development domains of training and education – tailoring the design and delivery of learning to meet the unique needs of each learner.⁶

b. While well-structured tasks generally have a basic protocol or procedure for completion, complex, ill-structured tasks require competencies of problem solving, investigation, assessment, and inquiry. Clearly, a mix of well-structured and ill-structured tasks confront the learner in the future OE and require learning strategies that address multiple types of competencies to prepare Soldiers and Army Civilian professionals to conduct MDO in complex and uncertain situations.

c. Soldiers and Army Civilian professionals prepare for the contested, degraded, and operationally limited information environment. Information is one of the most important and most useful tools at all levels of warfare. Sorting through misinformation, disinformation, and an overwhelming volume of data creates cognitive overload and requires superior cognitive ability. Soldiers and Army Civilian professionals learn to respond decisively within informationally challenged environments in ambiguous and chaotic situations. Technical proficiency alone will not suffice in MDO to address these requirements.

⁶ “Learner-centric” refers to the active support of each learner’s development, with activities such as mentor collaboration and peer-to-peer learning. It does not necessarily require more interaction between learners and facilitators or learners and learning content. Learners will possess tools and knowledge to create learning content, such as digital applications, videos, and updates to doctrine; From an ideal position, Soldiers and Army Civilian professionals at the edge of operational adaptation gather and transmit operational experiences and lessons. Soldiers and Army Civilian professionals routinely connect with peers across various networks, and the Army must leverage this capability to build dynamic vertical and horizontal social networks for formal and informal information sharing. The ease in communicating with peers across networks suggests digital age Soldiers and Army Civilian professionals will readily establish trust across operational communication networks; essential in the conduct of decentralized operations. The Army must establish guidelines and security protocols to maximize the value of peer-based learning and information sharing.

d. Army learning environments address the impacts of cognitive load on the learning process to include development of right attitudes. Although Soldiers and Army Civilian professionals need to cope with an overwhelming amount of information in the OE, that level of realism is not appropriate for all learning contexts. For example, a simulated environment that includes too many irrelevant cues inhibits learning and distracts a more novice learner. As an enabler to address these limitations, advanced technologies provide instructional designers and learning engineers the capability of modifying virtual learning environments for cognitive load considerations.

e. Leaders include explicit teamwork development in addition to traditional work activities. Social cognition (the process to store and apply information with other people in social interactions) reduces cognitive load on a single learner and self-correcting patterns emerge through shared knowledge and experiences. Training and education emphasize the effects of team behaviors on individual performance to replicate team performance in MDO—including human-machine teams. Scenarios that simulate real-world environmental stressors as well as consideration of interpersonal and team dynamics benefit future performance in units. Leaders afford learners opportunities to deal with the myriad of challenges that occur in teams before, during, and after tactical decisions are made.

f. Learning product developers and instructional designers tailor learning strategies for the desired learning outcomes. Learning approaches associated with behaviorist learning theory focus on development of technical competencies and tasks that are well structured and mainly repetitive in nature. Historically, the Army has overemphasized this one learning theory and its techniques; in the future, the Army will consider all major learning theories and their implementation. For example, the Army's use of technology for social interactions became a critical aspect of its digital learning environment. Inclusion of a theory, such as connectivism, in the design and development process supports the creation of corresponding, appropriate learning products.⁷ Good ISD incorporates the most appropriate learning theory or theories—matching the intended outcomes with the learners' attributes, course content, and delivery methods.

g. For Army learners to succeed in digital environments, instructors and students must learn how-to-learn using advanced technology. Implementation of emerging technologies requires supporting strategies to develop new learning competencies. Trust in emerging technology comes through understanding how the technological systems operate and depends on learners' competency with the technology. Any student and instructor relationship entails varying degrees of skepticism and trust, including learning environments that rely on automated instruction. Learning product developers and instructional designers must understand and account for these trust relationships and integrate steps to help learners develop the necessary competencies to excel in digital learning contexts.

⁷ Connectivists do not view technology as a mere tool; instead, they posit that the way learners use technology actually shapes their thinking. Behaviorists focus on observing changes in behavior to determine if learning occurred. This document suggests consideration of multiple learning theories during instructional design.

h. Training and education developers' required knowledge, skills, and attitudes required must include a rich and comprehensive set of competencies to create learning products. While behaviorist learning theory is critical for the development of technical competencies and tasks, developmental courses should include and inform instructional designers on the theoretical underpinnings of all major learning theories. For example, instructional designers can use social and cognitive learning theories for team building and group problem solving. Strategies associated with learning theories such as cognitivism, constructivism, social cognition, and hybrids of these theories maximize the development of higher-level thinking regarding ill-structured tasks. Failure to understand the connection between research-based theoretical principles, and instructional techniques and strategies derived from those principles, could lead to erratic and inadequate instructional design when coupled with advances in areas such as neuroscience, AI, and other technology support systems.

3-7. Component of the solution 3: Invest in enabling technologies and use learning science to guide their employment

a. The Army increasingly employs advance technologies in all aspects of its operation. The Army needs technologically knowledgeable and digitally literate Army personnel across occupations. As the need for science, technology, engineering, and mathematics (STEM) skillsets increase in the force, technology affects almost every Army occupation. Future operations require a dynamic interaction of STEM skillsets integrated with ethical, leadership, and health considerations that interplay with, and impact, the use of technology.

b. The Army employs digital learning as one facet of a complex combination of instructional tools within a learning science framework. Through an integrative approach, the Army benefits from the strengths of various learning technologies along with the best practices from traditional training and education, in-classroom instruction, field exercises, and knowledge developed in operational contexts with experts about current operational challenges. Through this integrative approach, complex scenario development enhances technologically advanced environments where, once immersed, the learner develops and integrates psychomotor, attitudinal, and cognitive skills at the same time.

c. Trainers and educators assess learners on digital competencies interwoven into an overall tailored competency framework that includes creative and critical thinking and the myriad of leadership competencies.⁸ Unique competency requirements emerge in tandem with rapidly evolving technological environments, with application during the design, development, and fielding of stand-alone and embedded technologies. Proponents evaluate competency development maps as they emerge to ensure effective transfer of new competencies across operational, institutional, and self-development training domains. Trainers, faculty, coaches, and mentors use data-driven competency development maps to diagnose learning levels, identify

⁸ *Modernizing Learning: Building the Future Learning Ecosystem*. (2019). "Organizational competencies need to be encapsulated within a competency framework to map all learning activities a learner might encounter within an organization. A competency model (also called a competency framework) combines multiple competencies, and their underlying factors, into a framework related to particular domain, career, or job area. Some competency models further separate this information into levels of mastery, such as information about the level of competence required at different occupational levels, and these various elements within a competency framework can have many nonexclusive relationships with one another." (pp. 114-115)

challenges encountered during learning, and make choices to tailor instruction to specific occupational, individualized, and personalized learning requirements.

d. Proponents apply an instructional design framework to a piece of Army technology prior to and as the technology develops. Army proponents develop operational capability requirements and develop pre-programmatic prototype systems based on known gaps. Novel situations require learning environments that provide learners with opportunities to apply technical and tactical competencies in different learning contexts. Army technology incorporates user interfaces that help guide learners and their trainers, faculty, coaches, and mentors. Digital technologies should feature an interface supporting growth and learning achievement as commonplace. For example, an instructor who understands cognitive biases should manipulate embedded training to provide cues that allow a learner to see a situation differently, thereby exposing the learner's biases and supporting behavioral development.

e. Placing individuals and units in immersive and engaging experiential events in a controlled data-rich synthetic setting enables rapid exposure to task elements and decision points with coaching support based on learning science best practices. A realistic learning environment, that approximates the complex OE, facilitates individual and collective competency development. The learning environment includes suites of approved common scenarios with associated databases, mission-focused orders for both friendly and enemy forces, and fully developed actor taxonomies that accurately portray the operational and mission variables of the OE. Embedded intelligent tutoring functions personalize synthetically controlled learning events to assess learner interaction and behavioral performance in real-time, provide feedback, and adjust challenges where needed.

f. The Army learning enterprise takes full advantage of emerging technologies, such as extended reality (XR), intelligent tutoring systems, and AI to enhance learning and provide a greater sense of presence. For instance, leveraging natural language processing, which captures text or voice inputs, allows learners to engage more authentically with scenarios and gives trainers, faculty, coaches, and mentors a better sense of how individuals may behave in actual operations. Advancements in behavioral assessment technology, when combined with those technologies above, allow measurement of knowledge, skills, and attitudes during learning and training activities in real-time.

g. Where feasible and applicable, learning environments include technologies that create a dynamic relationship (feedback loop) among learners, the learning content, and the learning context. Enhanced, complex learning environments allow the learner to engage emotionally and cognitively with the content and context to achieve a deeper level of learning. For example, haptic devices including wearables and stress sensors can feed real-time information into process-improvement models. Analysis of the resultant data can inform immediate actions, inform real or virtual tutors' feedback, and inform needed updates to learning objectives.

h. Exploiting emerging technologies and environments across the operational, institutional, and self-development training domains, a future learning infrastructure enables learner-centric environments with realistic and experiential-focused training and education. Through a combination of traditional brick-and-mortar and virtual learning spaces, learning infrastructure

incorporates innovative technology to facilitate full and partial virtual, augmented, and mixed reality immersion as well as supporting team collaboration and development. The infrastructure uses interoperable standards as new technologies emerge to support the learning environment.

i. An established Army learning ecosystem includes the modernization of Synthetic Training Environment (STE) as a core functionality. STE simulation software, in combination with training management tools, enable authoring and delivery of discrete experiential scenarios for learning support and competency development. Readily available gaming and XR components of this learning ecosystem, across formal and informal learning contexts, enable point of need⁹ access to synthetic learning resources and virtual forums.

j. To fully exploit emerging technologies across operational, institutional, and self-development training domains, the Army develops an enabling learning infrastructure that integrates across its components. The infrastructure allows access across a single, networked, cloud-enabled system of systems that incorporates the variety of applicable resources, including the Army's communications network, training information systems, and training support systems. The infrastructure accommodates individual learners engaged in self-development, small teams at dispersed locations, and large-scale exercise partnerships as well as on-demand learning across domains. A simple, persistent machine-readable identity for all approved users, aligned to directed cyber-survivability requirements, allows continuous access to data repositories of training and educational resources in a pervasive infrastructure. Learners circumvent obstacles in areas such as connectivity, bandwidth, on-site technicians, and network management through an adaptive, flexible, and reliable infrastructure.

3-8. Component of the solution 4: Build the Army's data-informed learning infrastructure

a. The Army develops and uses common, standardized, shareable, and secure data standards. These fundamental building blocks are the foundation for interoperability and analytics, assist with the implementation and long-term sustainability of the learning ecosystem, and accommodate the integration of future technologies; complementarily, competency-based learning strategies drive implementation. This emphasis on a holistic network-centric architecture requires careful technological efforts to manage data dependencies across disparate learning events and interdependent technologies. These efforts provide the ability to communicate training completion and unit readiness to Army systems and contribute to the development of a learner's expertise. A data strategy, aligned with the Department of Defense Architecture Framework, guides interoperability specifications and policies for data governance, privacy, and security. The Army can support talent management using industry data standards, machine-readable competency frameworks, and learning science principles. For example, enterprise competency data can identify individuals needed to meet team competency requirements or map individual competencies to a desired career path.

⁹ Enabling individual and team training [through] the seamless conduct of training and education between the operational and institutional domains (in other words., supports more efficient institutional and operational training that better prepares Soldiers' transition to and development in the operational Army).

b. Proponent developed competency frameworks are the keystone of the learning ecosystem data strategy. They define the required personnel capabilities for the force, set standards for personnel performance, and create the roadmap for aligning learning outcomes to career tracking. The required competencies evolve over time to reflect the changing OE. Similarly, the Army learning infrastructure includes processes to identify changes in required competencies over time and to integrate those updates into its learning systems. This approach includes common leader military occupational specialty, and area of concentration specific competencies as well as emerging competencies for both individuals and teams. The infrastructure enables direct proponent authoring, management, refinement, and removal of competency frameworks to support evolving operational requirements.

c. Where feasible and applicable, the Army uses aggregate data on learners' performance, through machine learning, to support quantitative evaluations of the quality of a piece of training content or the instructional approaches used in each course. In turn, these analyses inform continual refinement of curricula to meet performance objectives. The data-informed infrastructure incorporates a suite of AI-based recommender decision support engines (technology designed to collect large amounts of user data and offer recommendations) to optimize different learning trajectories based on goals for the target audience. Related AI techniques also inform updates to competency frameworks and drive automated content and scenario generation, to better align learning experiences to learners' needs and enable a dynamic library of learning experiences.

d. Common, standardized, shareable, and secure data drives interoperability (across platforms and experiences), the facilitation of data capture across learning events, monitoring of progress towards long-term objectives, and targeted competency development to inform future learning opportunities. When captured and stored, data in repositories updates AI-based recommender decision-support engines and analytical tools to optimize learning pathways applying machine-learned patterns to historical data sets. These same engines apply competency decay algorithms to automate scheduling and delivery of refresher training to maintain required proficiency levels, customized to each competency framework defined within the infrastructure.

e. The learning infrastructure enables collection of relevant data from across all learning resources and technologies, even informal learning experiences. This data collection capability captures, stores, and aggregates evidence on collective and individual tasks and their subordinate knowledge, skills, and attitudes from across widely different contexts. The data collection capability may nest a modular breakdown of competency structures into multiple levels within a task framework. Curriculum design involves path sequences through learning resources to meet established learning outcomes defined in the task and competency framework. Informed by data analytics, deficiencies in behavioral and task performance can map to learning ecosystem resources that support remediation and reinforcement across associated knowledge, skills, and attitudes. Data processes within the infrastructure support the measurement of behaviors, competency, proficiency and determination of the level and type of remediation required for individuals and across teams.

f. The training information system of systems provides individual and collective audiences with access to their learning records and competency frameworks to inform developmental

needs. The infrastructure also allows trainers, faculty, coaches, and mentors to explore competency frameworks and their learners' relevant behavioral and task performance. This requires advanced data analytics and visualization processes for communicating current individual and team competencies against desired levels of proficiency. Training and education records linked to learning infrastructure activities and AI-based recommender decision support engines can assist determination for learning needs best met within the unit, at home station, or with support from regional or Army-wide training resources.

g. Authoritative resources in this networked environment include: designated trainers, faculty, coaches and mentors, as well as automated intelligent agents responsible for guiding learning in an interactive manner. The Army's challenge is validating socialized solutions as authoritative to ensure doctrinal correctness and relevance before incorporation into the learning ecosystem for enterprise level access. Institutional schoolhouses and operational forces at home station request information from forward deployed subject matter experts, to gather the same situational awareness of the OE, providing just-in-time access to data used to select and refine learning resources based on operational needs.

3-9. Component of the solution 5: Foster human capital and workforce development

a. The Army adapts systems, processes, and workforce development to shape how trainers, faculty, coaches, mentors, and developers support Soldier and Army Civilian professional recruiting, development, employment, and retention through a talent management system designed to meet MDO challenges. Each service member supporting the Army talent management system understands Army human capital requirements at a granular level to inventory capabilities within the force, gauge the demand for capabilities required for operations, and identify the gaps between inventory and demand.

b. The training and education workforce understands talent management systems and employs an Army Talent Attribute Framework (ATAF) – a common framework for identifying and communicating personnel attributes, talents, knowledge, skills, behaviors, and preferences. The ATAF uses feedback, assessments, research, and data science to support personnel and their development and employment decisions within the Army. To optimize support to Army military, civilians, and organizations, proponents fully integrate and synchronize learning strategies with talent management strategies.

c. The training and education community supports a culture of assessment through robust developmental and diagnostic assessments connected to predictive assessments for talent management. For example, predictive talent assessments continue to evolve to shape the assignment of personnel to positions of increased responsibility or positions of unique knowledge and skills. Correspondingly, developmental assessment tools evolve to focus individuals on competency gaps. Proponent learning strategies identify the best opportunities to develop critical competencies across the operational, institutional, and self-development training domains and meet the Army's need for optimized teams.

d. However, proponent learning strategies and the associated training and education workforce continuously adapt, as the Army futures and research communities continue to

identify evolving operational requirements and talent demands for MDO. To thrive in this state of continuous adaptation, the Army invests in training and education workforce development. The workforce includes leaders, mentors, teachers, instructors, facilitators, training managers, training and education developers, and multi-media specialists who facilitate individual and collective competency development across the operational, institutional, and self-development training domains. Achieving the Army's MDO competency goals for 2030-2040 requires developing human capital effectively with a "leaders teach, teachers lead" philosophy, resulting in a complex community of professional learning specialists. As learning is a strategic enabler to Army readiness, the Army ensures that leaders in the operational force have effective training, coaching, and mentoring skills and that the trainer, educator, developer, and facilitator institutional workforce develops and sustains the expertise to enable the MDO-capable force. Due to the pace of efforts to develop capacity to address MDO challenges and the rapidly changing OE, the training and education workforce risks not keeping up with the quantitative and qualitative demands levied. Any unaddressed gaps in the training and education workforce become more acute as demands increase.¹⁰

e. The training and education workforce provides experts and authoritative sources for learners at the point of need – whether at an institution, across post, to a remote location within the U.S., or to a distant site overseas. The institutional workforce supports operational force reach to proponent subject matter experts in support of MDO requirements, in addition to resident facilitators engaging with remote learners. The learning enterprise continuously adapts learning strategies and systems to change with the OE and account for evolving MDO doctrine, warfighting systems, and critical individual tasks in support of mission essential collective tasks. The Army learning enterprise needs aggressive efforts to inculcate the technical, tactical, and operational competencies to meet these demands.

f. Through face-to-face and virtual interactions, Soldiers and Army Civilian professionals develop and create tacit knowledge as part of the learning experience. By sharing the "unique, personal store of knowledge gained from life experiences"¹¹, classmates can develop fellow colleagues and teammates with input of their intuitions and stories. Tacit knowledge sharing can accelerate knowledge transfer and increase group participants' mental agility in dealing with new problem sets and hands-on job activities.¹² In a group setting a "majority of learning relies on the acquisition of tacit knowledge through practicing, discussing, adjusting, and refining...Because of the experiential and personal nature of that learning, an important factor for effective acquisition of tacit knowledge is the feedback that is given when learning...[w]ith the assistance

¹⁰ *Instructional design perception and practice in United States Army training organizations: A case study.* (May 2020). "Personnel who are not in an [instructional design or instructional systems specialist] ID or ISS position and do not fulfill the requisite background in education are required to design and develop training courseware...PowerPoint presentations, lesson plans, student handouts, and assessments. These same government institutions often hire individuals with no educational background specific to ID into ISS positions (Department of the Navy United States Marine Corps, 2009). Moreover, there is no date of expiration on educational requirements being met. In short, a person who has completed only the required 24 academic credit hours in a physical education degree in 1980 is technically as eligible for hire as a person who has acquired a doctorate in ID in 2020. Unfortunately, there is little to no professional development or performance support when the ISS is asked to make course modifications in response to unit and Army mission needs. This is due to the lack of understanding of the ID profession (Klein & Kelly, 2018). This results in training decisions being made with little consideration to design option solutions that can improve the quality of training and maximize utilization of course resource constraints." (pp. 3-4)

¹¹ ATP 6-01.1. *Techniques for Effective Knowledge Management* (2015). This ATP also describes a methodology for creating knowledge maps in Chapter 2 "to provide an assessment of existing or required knowledge".

¹² *Tacit Knowledge Cultivation as an Essential Component of Developing Experts.* (2019).

of an expert qualified coach/mentor providing insights and feedback, [together the group] can ‘create’ new knowledge...[If] processes are in place and assessments are created, understanding how to accelerate tacit knowledge transfer could result in better training for future, yet unknown, skill sets.”¹³

g. The Army identifies and recruits diverse, talented military and civilian personnel to train and educate a MDO ready force. Talent managers find opportunities for trainers, educators, and developers to expand their own talents, close their own talent gaps, and maximize their contributions to the total Army. Aligning operational force leader, trainer, developer, and educator assignments, credentialing, and certification more closely with demonstrated and measurable talent, rather than time in grade, service, or position, will leverage preferences, knowledge, skills, and attitudes to increase Army readiness.

h. By proper application of talent management tools, the learning enterprise produces fully functional multidisciplinary learning development and employment teams comprised of experts in subject content, learning theory, ISD, and media development. To optimize operational reach and learning outcomes, desired learning enterprise competencies include tactical and technical expertise, video production, game-based scenario design, digital tutoring and tailored assessment, social media engagement, and use of emerging technologies – both synchronous and asynchronous – to facilitate, mentor, and guide learners.¹⁴ The single most important factor that enables the integration of acquiring, developing, employing, and retaining talent in the learning enterprise is an integrated talent assessment framework. The Army will shift from simply distributing personnel to deliberately managing the talents of leaders of learning.¹⁵

i. To improve Army learning strategy design and implementation, the Army will need to grow the skilled corps of learning and support specialists to keep pace with training and education science/technology and MDO learning demands. The Army training and education workforce continues to evolve the integration of the institutional and operational Army and transcend the distinctions between formal, informal, episodic, and career-long learning. The training and education workforce and supporting workforce internally apply the culture of assessments applied to the broader Army workforce. The institutional workforce and the formal and informal instructors, trainers, coaches, and mentors that support individual learning in the operational force require capability assessments. The training and education workforce need robust career-long skills development and certification to ensure personnel remain adaptive and support increased readiness demands. The Army learning workforce continues to expand its expertise in designing and development of curricula for and the employment of sophisticated learning enablers (for example, virtual learning tools and the STE) and data-driven mechanisms to

¹³ *Tacit Knowledge Cultivation as an Essential Component of Developing Experts*. (2019).

¹⁴ *The Army People Strategy: Civilian Implementation Plan* (May 2020) Line of Effort 3, Employ Talent, reinforces the tenet that “The Army must be able to effectively match Civilian Corps capabilities with mission requirements. This means projecting future demands for talent and maximizing Army Civilian professionals’ talents and preferences by aligning them with organizational demand – benefiting the individual, the organization, and the Army... [The Army Civilian Education System must also directly support the] ...process and framework for regular, repeatable, strategic workforce planning to enable talent management informed by robust data, driven by readiness, and responsive to incentives that drive efficiency in our investments.” (pp. 21-23)

¹⁵ The DOD’s *Preserving Our Competitive Advantage: Personnel and Readiness Strategy for 2030* (P&RS) (October 2020) states that “P&R must guide the abandonment of industrial-age human resource management practices, enable the transition to comprehensive talent management fit for the Information Age and meet the expectations of the generations of 21st century people we must attract. P&R will enhance our warfighters’ intellectual overmatch by enabling, guiding, and assessing an optimized professional military education structure.” (pp. 10)

enhance learning and competency development across the operational, institutional, and self-development domains of Army learning.¹⁶

Chapter 4

Conclusion

To meet the learning challenges of 2030-2040 and beyond:

a. The Army, as a learning organization, commits to a culture of continuous responsibility for the development of individuals, teams, and the organization overall to achieve intellectual overmatch of any adversaries.

b. Leaders evaluate individual and team performance across operational, institutional, and self-development training domains to identify their strengths and weaknesses and, by linking learning and development processes to an improved talent management system, take actions to increase the Army's competitive edge.

c. A system of systems provides tailored learning experiences to hone individuals' and team's competencies at echelon. Routine behavioral performance feedback from data-driven processes across operational, institutional, and self-development training domains informs rapid adjustments to learning products, highlights talent in diverse areas, and empowers lifelong learners.

d. The Army effectively manages and develops Soldier and Army Civilian professional competencies, pushing military and civilian personnel to their limits in areas of physical, cognitive, and emotional performance to win in MDO.

¹⁶ *Instructional design perception and practice in United States Army training organizations: A case study*. (May 2020). "Having a diluted workforce made job and project assignment much more difficult. The Department of the Army may benefit from considering new educational requirements specific to instructional design and the development of a formal and robust peer-to-peer design mentorship program that pairs novice designers (with non-ID [instructional design] specific experience) with expert designers (with ID experience). The Army, Training and Doctrine Command (TRADOC) organizations, and professional organizations such as the International Board of Standards for Training, Performance, and Instruction (IBSTPI) could benefit from considering distinct duties, competencies, and approaches between design and development processes and procedures." (p. 85)

Appendix A

References

Unless otherwise indicated, TRADOC publications and forms are available on the TRADOC Administrative Publications website at <https://adminpubs.tradoc.army.mil/>. DA publications and forms are available on the Army Publishing Directorate website at <https://armypubs.army.mil/>. DOD issuances and forms are available on the Executive Services Division website at <https://www.esd.whs.mil/DD/>.

Section I

Required Publications

AR 350-1

Army Training and Leader Development

Assistant Secretary of the Army (Manpower and Reserve Affairs). (October 2019). The Army People Strategy. Retrieved from <https://armypubs.army.mil/ProductMaps/PubForm/StrategicDocuments.aspx>

Assistant Secretary of the Army (Manpower and Reserve Affairs). The Army People Strategy: Civilian Implementation Plan (Available at <https://www.army.mil/armyequityandinclusion#org-resources-reports>)

Assistant Secretary of the Army (Manpower and Reserve Affairs). The Army People Strategy: Military Implementation Plan (Available at <https://www.army.mil/armyequityandinclusion#org-resources-reports>)

ATP 6-01.1

Techniques for Effective Knowledge Management

Babin, L.B., & Garven, A.J. (April, 2019). *Tacit knowledge cultivation as an essential component of developing experts*. Journal of Military Learning, 3-18. Retrieved from <https://www.armyupress.army.mil/Journals/Journal-of-Military-Learning/Journal-of-Military-Learning-Archives/JML-Apr-2019/Babin-Garvin-Tacit-Knowledge/>

Calton, M.A., Freeman, T.E., Cronin, C.B., Thompson, C., Warner, K., Morath, R., & Smith, M. (March 2021). *Development and validation of the U.S. Army Learning Organization Maturity Model* (Technical Report No. 1395). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

DA Pamphlet 25-403

Army Guide to Recordkeeping

DOD Dictionary of Military and Associated Terms. (Available at <https://jdeis.js.mil/jdeis/>)

Parker, C.K. (2020). *Instructional design perception and practice in United States Army training organizations: A case study* (Publication No. 28149643) [Doctoral dissertation, Indiana

TRADOC Pamphlet 525-8-2

University]. ProQuest Dissertation Publishing. Retrieved from
<https://files.eric.ed.gov/fulltext/ED607592.pdf>

TP 525-3-1

The U.S. Army in Multi-Domain Operations, 2028

TR 350-70

Army Learning Policy and Systems

Under Secretary of Defense for Personnel and Readiness. (October 2020). *Preserving Our Competitive Advantage: Personnel and Readiness Strategy for 2030*. Retrieved from
https://prhome.defense.gov/Portals/52/Documents/Strategy/PR_Strategy_FINAL_.pdf

Walcutt, J.J. & Schatz, S. (2019). *Modernizing learning: Building the future learning ecosystem*. Washington, DC. Government Publishing Office. Retrieved from
<https://www.adlnet.gov/resources/>

Section II

Related Publications

A related publication is a source of additional information. The user does not have to read a related publication to understand this publication.

AR 1-1

Planning, Programming, Budgeting, and Execution

AR 10-87

Army Commands, Army Service Component Commands, and Direct Reporting Units

AR 71-9

Warfighting Capabilities Determination

AR 71-32

Force Development and Documentation Consolidated Policies

AR 210-14

Installation Status Report Program

AR 350-52

Army Training Support System

AR 600-100

Army Profession and Leadership Policy

DA Pamphlet 600-3

Officer Talent Management

CJCSI 1800.01F

Officer Professional Military Education Policy (Available at <https://www.jcs.mil/Library.aspx>)

CJCSI 5123.01I

Charter of the Joint Requirements Oversight Council and Implementation of the Joint Capabilities Integration and Development System (<https://www.jcs.mil/Library.aspx>)

CJCSI 5760.01B

Records and Information Management Policy (<https://www.jcs.mil/Library.aspx>)

Field Manual 1-02.1

Operational Terms

Joint Publication 3-30

Joint Air Operations (Available at <https://jdeis.js.mil/jdeis/>)

Military Handbook 29612-4A

Glossary for Training (Part 4 of 5 Parts) (Available at <https://assistca.dla.mil/>)

TP 350-70-3

Faculty and Staff Development

TP 350-70-14

Training and Education Development in Support of the Institutional Domain

TP 525-92

The Operational Environment and the Changing Character of Warfare

TR 10-5

U.S. Army Training and Doctrine Command

TR 10-5-4

U.S. Army Combined Arms Center

TR 71-20

Concept Development, Capabilities Determination, and Capabilities Integration

Section III

Prescribed Forms

This section contains no entries.

Section IV

Referenced Forms

DA Form 2028

Recommended Changes to Publications and Blank Forms

Appendix B

Required Capabilities

B-1. Introduction

This appendix reflects required capabilities necessary to conduct operations as described in this concept.

B-2. Required capabilities for Army Learning 2030-2040

a. Future Army forces require an information-age model learning paradigm with interconnected systems of technological and human infrastructure in order to maximize learning outcomes on demand. (para 3-4.)

b. Future Army forces require the capability to access, learn, and apply MDO competencies to novel situations, on demand, in order to compete in an ever-changing environment. (para 3-5.a.)

c. Future Army forces require the capability to gain and maintain an "operational mindset" during functional training and [professional military education] at institutions by gaining access to unit lessons learned, [tactics, techniques, and procedures] and knowledge of the current OE within a shared Institutional - Operational Learning Environment. (paras 3-5.a and 3-5.b.)

d. Future Army forces require the capability to house and access pervasive feedback repositories in order to facilitate quick response changes to MDO learning content. (paras 3-5.f and 3-7.g.)

e. Future Army forces require the capability to store, share, synthesize and apply MDO competencies across organizations to rapidly support improvements in organizational operations in MDO environments. (paras 3-5.b and 3-5.c.)

f. Future Army forces require the capability to train while deployed (to include contingency operations) by accessing the latest synthetic training technologies, training methods and knowledge about friendly/enemy capabilities and the OE regardless of location. (paras 3-5.c, 3-7.a, and 3-7.i.)

g. Future Army forces require the capability to manage the accessibility of, and provide standards and security protocols for, Soldier and Army Civilian professional created learning content anytime and anywhere in order to proliferate best practices. (paras 3-5.e and 3-8.g.)

h. Future Army forces require the capability to validate outside organizations authoritative resources in order to ensure doctrinal alignment and operational relevance while expanding social solutions to Army problems. (paras 3-5.e and 3-8.g.)

i. Future Army leaders at every echelon require the capability to engage as active participants in an individual's career-long learning process, in order to improve existing behavioral performance into mature MDO competencies. (para 3-5.d.)

j. Future Army forces require the capability to support learners with ever-present career-tracking tools to allow learners to manage their lifelong learning objectives and monitor their progress toward completion of requirements and career goals. (paras 3-5.d and 3-8.d.)

k. Future Army forces require the capability to simulate environments they cannot replicate live across the operational, institutional, and self-development domains of training and education, in order to provide otherwise unavailable learning opportunities. (paras 3-6.d, 3-6.e, 3-7.b, and 3-7.e.)

l. Future Army forces require the capability to rapidly understand, develop, and implement training and education changes in order to meet shifting operational demands in the MDO environment. (paras 3-6.b and 3-8.b.)

m. Future Army forces require the capability to design and develop learning products based on theory, techniques, and strategies appropriate for the learning content, and the learner, in order to support the acquisition of higher-level cognitive skills along with technical competencies and the right attitudes needed to win in a MDO environment. (paras 3-6.a through 3-6.h.)

n. Future Army forces require development of learning-to-learn competencies in order to effectively perceive and process training and education stimuli within digital learning environments. (paras 3-6.d and 3-6.g.)

o. Future Army forces require data-driven competency development in order to tailor learning to specific and personalized needs in a rapidly evolving technological environment. (paras 3-7.c and 3-9.i.)

p. Future Army forces require the capability to learn to reduce cognitive load by sharing burdens between humans and machines during learning events in order to optimize the behavioral and task performance of small teams and minimize the complexity of MDO. (paras 3-6.c through 3-6.e.)

q. Future Army forces require the capability to develop the knowledge and skills, including character and resiliency (create ethical dilemmas in training, not just in classroom hypotheticals), through individual and collective training in a tough realistic environment that approximates the stresses of combat across [the operational variables] to enable Soldiers, leaders, and units to operate under conditions of uncertainty across the [Range of Military Operations (ROMO)]. (paras 3-6.e, 3-7.a, and 3-7.g.)

r. Future Army forces require the capability to train and educate strategic thinkers and leaders to develop flexibility, creativity and thinking (outside of the box and risk accepting) abilities to formulate and implement military goals, determine actions to achieve the goals, and mobilize

resources to execute the actions with mission partners at the operational and strategic levels of warfare in any strategic OE. (paras 3-5.a, 3-6.a, 3-7.c, and 3-9.d.)

s. Future Army forces require the capability to access live synthetic training capabilities through a unified communications network regardless of location with a training network infrastructure that provides improved, secure data sharing (at the appropriate classification levels) in a Mission Partner Environment to enable MDO training at all echelons and support commander driven, mission-oriented training at the point of need. Environment may include an automated data-sharing repository of sharable data accessed by login credentials. (paras 3-5.a, 3-6.a, 3-7.c, 3-8.e, and 3-9.d.)

t. Future Army forces require the capability to train Soldiers and leaders to understand and execute tasks to optimize the human performance required to employ warfighting capabilities across multiple domains and enhance operations in a decentralized [command and control (C2)] environment. (paras 3-6.a and 3-6.e.)

u. Future Army forces require the capability to plan and conduct mission rehearsal on both organic and simulated equipment, establish connectivity while distributed, and receive customized learning content to meet individual, small teams, or unit requirements, on a learning continuum, at the point of need. (paras 3-7.b and 3-7.d.)

v. Future Army forces require the capability to conduct and assess training, planning, and mission rehearsal on organic/issued equipment and hardware to enable Soldiers and Leaders to gain and maintain an “operational mindset” during Functional Training, while also providing Soldiers the ability to establish connectivity and learn during training opportunities and collective training events at the point of need. (paras 3-7.b, 3-7.d, and 3-7.j.)

w. Future Army forces require a realistic training environment at home station (HS), combat training centers (CTCs), and while deployed that represents current and future complex operating environments across all operational domains (land, air, maritime, space, and cyberspace) in support of LSCO across a full ROMO. The training environment must converge capabilities and adapt to changes in OE variables to help minimize the strategic and tactical risks between HS, CTC, and theater. This must include training of force projection tasks and conduct of [reception, staging, onward movement, and integration activities] from installations to aerial points of debarkation and sea points of debarkation. (paras 3-7.e and 3-7.i.)

x. Future Army forces require the capability to access and protect learner data across the operational, institutional, and self-development training domains – and across organizations – in order to optimize behavioral and task performance and align MDO competent and credentialed Soldiers and Army Civilian professionals at the point of need. (paras 3-7.j, 3-8.a, and 3-8.f.)

y. Future Army forces require the capability to execute real-time collaborative training between institutions, HS, and deployed regions to accomplish individual and collective training with the agility to assess and adapt the training conditions and associated training support enablers in support of MDO. (paras 3-7.b and 3-7.g.)

z. Future Army forces require a realistic [Force on Force and Force on Target] training environment at HS, CTCs and while deployed that integrates combined arms capabilities across all warfighting functions, at all echelons of commands, with realistic, actionable, and synchronized effects for all current and future weapons systems to train as expected to fight. (paras 3-7.a and 3-7.e.)

aa. Future Army forces require the capability to train cross-matrixed, decentralized C2 in multiple domains to enable effectively cohesive combined arms teams to employ the full range of joint, inter-organizational, multinational, and Army capabilities distributed across echelons and installations. (paras 3-7.b and 3-7.j.)

bb. Future Army forces require the capability to train disaggregated formations and context-centric [command, control, and communications (C3)] by leveraging communications network and novel C3 arrangements in live, virtual, and constructive environments to train ad hoc mission dependent formations (Army, joint, and multinational) that do not habitually work together. (para 3-7.j.)

cc. Future Army forces require the capability to capture and track learner data from interoperable training systems and warfighting systems in order to optimize career long learning continuums for individuals and teams. (paras 3-8.c and 3-8.e through 3-8.g.)

dd. Future Army forces require the capability for trusted, validated sources to align, certify and credential behavioral and competency data in the operational, institutional, and self-development training domains and then communicate that behavioral and competency data to personnel systems. (paras 3-9.e and 3-9.g.)

ee. Future Army forces require a centralized interface with all authoritative systems and data sources, establishing a common operating picture (COP) for users of the learning infrastructure, in order to support data-driven training and education management. (paras 3-8.b through 3-8.g.)

ff. Future Army forces require the capability for commanders and leaders to better assess, analyze, and implement training via a COP of the training environment across all training domains (includes persistent, consistent access to training information/products, associated resources, and Soldier/unit data) that improves daily management and execution of operational training. (paras 3-8.c through 3-8.g.)

gg. Future Army forces require advanced training and instructional skills in order to manipulate operationally relevant content in digital and interactive environments across the operational, institutional, and self-development domains of training and education. (paras 3-6.d, 3-6.g, and 3-7.b through 3-7.g.)

hh. Future Army forces require the capability to leverage training technology that simplifies training management and reduces the commander's training burden by enabling persistent and consistent access to time sensitive training information/products, associated resources, and Soldier/unit data at the point of need. (paras 3-7.d, 3-7.g, and 3-6.c through 3-6.e.)

ii. Future Army forces require the capability to rapidly develop, update, and share digitized learning content through an in-house workforce skilled across multi-disciplinary domains (instructional design, media development, gaming, simulations, and others) and empowered to apply innovative, evidence-based strategies to support Army-wide, on-demand learning with relevant, engaging learning products. (paras 3-9.c through 3-9.i in support of paras 3-6, 3-7, and 3-8.)

jj. Future Army leaders require the capability to manage talent by assessing the development and assignment of trainers, educators, and developers across the operational, institutional, and self-development domains of training and education in order to optimize learners' preparation for MDO. (paras 3-9.a, 3-9.b, 3-9.g, and 3-9.h.)

kk. Future Army forces require capability to create incentivized, developmental, career-enhancing assignments through policies and procedures to attract the most qualified trainers, educators, and developers. (paras 3-9.d. and 3-9.g. through 3-9.i.)

ll. Future Army forces require the capability to measure and assess tacit knowledge in order to provide effective feedback on group innovation and individual's contributions to their team's expertise, agility, adaptability, and speed. (paras 3-9.f, 3-9.b, 3-5.b, 3-6.e, 3-6.h, and 3-8.e.)

mm. Future Army forces require the capability to conduct career-long learning competency inventories; predictive and developmental behavioral assessments; and development and certification processes to remain adaptive and support MDO readiness demands. (paras 3-5.d, 3-5.f, 3-8.f, 3-9.a, and 3-9.i.)

nn. Future Army forces require the capability to manage talent data through a common framework, enabling development and employment of analytic concepts and strategies to maximize the insights derived from talent data, and enable a data-centric approach to developing and employing personnel in optimal ways. (paras 3-9.e. and 3-9.g.)

oo. Future Army forces require the capability to accurately assess and develop individuals, teams, and units using data-centered fieldable approaches that provide for refinement of the talent management system and human-centered methods for improving and sustaining unit performance. (paras 3-5.d, 3-5.f, 3-8.f, 3-9.a, 3-9.b, and 3-9.g. through 3-9.i.)

pp. Future Army forces require the capability to train in a realistically replicated information environment that links information actions and effects across echelons within all training environments so that Army forces face the information complexity in training that they can expect to encounter during operations. (paras 3-6.c, 3-7.b, and 3-7.e.)

Appendix C

Science and Technology

C-1. Introduction

a. Science and technology advancements will enable the convergence of capabilities in Appendix B. To achieve this, the Army must work with academic experts, joint partners, industry leaders, and key stakeholders.

b. Appendix C does not encompass all research within the Army Modernization Enterprise. Instead, it includes a subsection of the disruptive scientific discoveries and emerging technologies the Army executes to overcome technical challenges that prevent the realization of the required capabilities articulated in Appendix B. The learning enterprise will revisit Appendix C on a frequent basis to provide guidance that reflects the anticipated and evolving needs associated with conducting training and education to support operations while taking advantage of potential scientific discoveries and technological innovations.

c. Paragraphs C-2 through C-6 below identify key science and technology research areas that enable the associated required capabilities at Appendix B and have the greatest promise for transforming Army learning.

C-2. The Army as a learning organization

a. Research to identify and develop tools and analytic techniques enabling Army organizations to develop more fully as learning organizations along with rapid institutional adaptation and correspondingly individual learning. Tools and techniques for sharing and synthesizing information between and across organizations will include identification of emerging requirements and new methods for understanding the ever-changing security environment. (Required capabilities, paras B-2a, B-2b, B-2d, B-2e, and B-2h.)

b. Research to facilitate leaders' growth as mentors, teachers, and trainers based on data-informed approaches to improve mentorship and tailoring of developmental experiences for subordinates, that crosscut institutional and operational domains and learning continuums, providing an essential basis for maturing MDO and emerging competencies. (Required capabilities, paras B-2i, B-2x, B-2cc through B-2ee, and B-2nn.)

c. Research to determine the most effective behavioral development interventions that optimize learning based on the intersection of individual learner characteristics (for example, learning orientation, developmental needs) and contextual characteristics (for example, climate, training transfer to a particular job) to ensure learning continues beyond the traditional learning environment and informs optimal pathways to achieve needed learning for different career goals. (Required capabilities, paras B-2j, B-2o, and B-2mm.)

d. Research to identify and create tools, techniques, and methods that minimize the burden on individuals and units to track indicators of learning and their impact on operational performance. (Required capabilities, paras B-2j and B-2mm.)

C-3. Proven learning strategies

a. Research on how learners relate to and engage with emerging learning technologies, and identify the organizational barriers that impede learning, particularly along dimensions relevant to learners' skepticism/trust in automated/algorithmically driven aspects of those systems, to enable instructors to implement those technologies effectively. (Required capabilities, para B-2n.)

b. Research on instructional design frameworks and strategies, (including techniques for formative and summative behavioral assessment and feedback) that best support the design, implementation, and application of emerging learning technologies tailorable to learner existing talents, proficiency levels, and background experiences, will enable training and education developers to apply complex emerging technologies effectively in a competency development context. (Required capabilities, paras B-2l through B-2m.)

c. Research on interventions intended to enhance competencies, will enable learning designed around perceptual, social, and other cues that mirror the critical aspects of the context of behavioral performance (for example, ensuring authenticity and relevance of features included in simulations). (Required capabilities, para B-2k.)

d. Research on how best to design leadership courses to replicate team performance, and the effects of team behaviors on individual performance, will enable instructors to provide leaders accurate performance feedback for application at operational units. (Required capabilities, paras B-2k and B-2u.)

e. Research into knowledge and skill acquisition and retention will determine how quickly learners internalize content and how long learners retain content before retraining or further education to reinforce required competencies. This research will enable leaders to track training and educational outcomes more effectively and enable leaders to better integrate targeted training and education opportunities into their training cycles. (Required capabilities, paras B-2j and B-2cc.)

C-4. Enabling technologies and learning science to guide their employment

a. Research on the most effective strategies for blending instructional models that incorporate adaptive instructional systems technologies with existing instructional methods will enable the instructor and learner to understand and use self-regulation strategies (including what these strategies are) to maintain motivation and engagement in a highly demanding learning context. (Required capabilities, paras B-2n and B-2ii.)

b. Research on relevant learning-centered competencies (for example self-directed learning, interpretation and sense-making, self-regulation) will enable instructors and students to learn more efficiently both individually and in groups. (Required capabilities, paras B-2n and B-2ii.)

c. Research on the interactions between instructors, learners, and emerging learning technologies (particularly those utilizing AI and virtual replicas of physical devices) will enable development and building of a model of how human learners may most effectively learn in a technology-rich, AI augmented, context. (Required capabilities, paras B-2m through B-2p.)

d. Research to identify the unique differences in cognitive skills required in different technical performance domains relevant for the future OE and MDO. The development of associated educational content design and instructional techniques will enable the creation of tools, techniques, and behavioral assessments to enhance technical competency acquisition and individual and collective performance. (required capability B-2.m.)

e. Research to develop frameworks that delineate levels of concurrent task demands, task complexity, time-sensitivity, and informational ambiguity reflecting human and machine tasks to enable optimal assignment of cognitive resources, enable cognitive load sharing, and fully support timely, accurate decision-making. (required capability B-2.p.)

f. Research to develop and validate scientific measures of complex cognitive and metacognitive skills critical for the development and assignment of leaders for cognitive overmatch in future operational environments, based on quality (that is, valid and reliable) data. (Required capabilities, paras B-2m, B-2p, B-2cc, B-2dd, and B-2nn.)

g. Research on the types of formative and summative behavioral assessments and developmental feedback provided through emerging learning technologies, based on a common vocabulary, as well as traditional educational modalities will enable instructors to effectively elicit and develop targeted competencies. (Required capabilities, paras B-2m, B-2x, and B-2cc.)

C-5. The Army's data-informed learning infrastructure

a. Research on techniques for evolving proponent competency development maps and the provision of tools to iteratively update competency maps based on data insights and AI services. (Required capabilities, paras B-2o and B-2mm.)

b. Research on identification and description of developmental trajectories for novel competency requirements, emerging in tandem with a rapidly evolving technological environment, will enable development and implementation of AI algorithms that align with the state of the art in learning sciences, matching algorithmic design and implementation to competency development domains and applied behavioral performance requirements. (Required capabilities, paras B-2ee and B-2mm.)

c. Research on recommender engines that provide specific recommendations across all learning modalities and prescribe specific learning experiences with the highest probability of increasing competency states for individuals and teams. (Required capabilities, paras B-2cc, B-2ee, and B-2mm.)

C-6. Fostering Human Capital and Workforce Development

a. Research on the improvement of developer and instructor support systems, that make the manipulation of content in digital and interactive environments both intuitive and flexible as operational demands change over time, will enable Army training and education developers and instructors with tools to provide content and use learning methods to optimize Soldier competency development across operational, institutional, and self-development training domains. (Required capabilities, paras B-2k, B-2m, B-2u, and B-2gg through B-2ii.)

b. Research into successful, rapid role and duty transitions will enable the Army to improve, refine, and sequence targeted content delivery and enable leaders to assume new responsibilities efficiently as they progress through their career. (Required capabilities, paras B-2l, B-2jj through B-2kk, and B-2oo.)

c. Research into effectiveness of collaborative learning techniques in increasing tacit knowledge transfer from experts to novices will improve observer, coach, and trainer feedback to students in collaborative settings to optimize group performance. (Required capabilities, paras B-2ll and B-2e.)

C-7. Conclusion

The scientific research and technology enablers in this appendix support the required capabilities necessary for Army learning 2030-2040 and beyond. Achieving these capabilities will require targeted investment, extensive experimentation, and continuous collaboration with academic experts, joint partners, key stakeholders, and industry leaders. These research efforts will enable required capabilities for Army learning, and those solutions will enable Army forces to dominate and win in close combat, deterring or defeating near-peer threats, achieving mission objectives, and returning to competition on favorable terms.

Glossary

Section I

Abbreviations and Acronyms

AI	artificial intelligence
ALC	Army Learning Concept
AR	Army regulation
ATAF	Army Talent Attribute Framework
C2	command and control
C3	command, control, and communications
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
COP	common operating picture
CTC	combat training center
DA	Department of the Army
HS	home station
ISD	instructional systems design
LSCO	large-scale combat operations
MDO	multi-domain operations
OE	operational environment
ROMO	range of military operations
STE	Synthetic Training Environment
STEM	science, technology, engineering, and mathematics
TP	U.S. Army Training and Doctrine Command pamphlet
TR	U.S. Army Training and Doctrine Command regulation
TRADOC	U.S. Army Training and Doctrine Command
XR	extended reality

Section II

Terms

artificial intelligence

Implemented in electronic information system and mimics human intelligence to perform tasks and can improve themselves based on the data collected. (CJCSI 5760.01B)

assessment

See direct assessment and indirect assessment.

attitude

The mental state of a person that influences behavior, choices, and expressed opinions. Military training uses the term attitude to identify the psychological term affective domain. (Military Handbook 29612-4A)

attribute

A quality, property or characteristic of an individual that moderates how well learning and performance occur. (TR 350-70)

behavior

Specifies what a learner must do to satisfy a job performance requirement. Behavior may involve recall, manipulation, discrimination, problem-solving, performing a step-by-step procedure, or producing a product. (TR 350-70)

capability

The ability to complete a task or execute a course of action under specified conditions and level of performance. (CJCSI 5123.01I)

capability gap

The inability to meet or exceed a capability requirement, resulting in an associated operational risk until closed or mitigated. The gap may be the result of no fielded capability, lack of proficiency or sufficiency in a fielded capability solution, or the need to replace a fielded capability solution to prevent a future gap. (CJCSI 5123.01I)

coach

Assist with the development of goals and structured plans to enable making more informed career decisions with respect to their knowledge, skills, and behaviors, benefiting both the individual and the Army. (Army People Strategy: Military Implementation Plan)

competency

An observable, measurable pattern of knowledge, abilities, skills, and other characteristics that individuals need to perform work roles or occupational functions successfully. (AR 350-1)

core competencies

Technical areas of knowledge skill, abilities as well as other characteristics (non-technical competencies such as interpersonal skills) that cross all specialties that are required by the majority of the positions in an occupational series or career program for the successful execution of critical tasks associated with the duties and responsibilities of positions. (AR 350-1)

direct assessment

Measures of learning that are based on student performance or demonstrations of the learning itself. It gathers and analyzes data from student behavior tied directly to learning outcomes and provides demonstrable evidence that students achieved the learning outcomes. Direct assessment of learning can occur within a course and also across courses or a program. Examples include portfolios, presentations, tests/exams, projects, wargames/simulations, and written assignments. Direct assessments may be used for formative or summative assessment purposes. (CJCSI 1800.01F)

education

A structured process that conveys both specific and general bodies of knowledge and develops habits of mind applicable to a broad spectrum of endeavors. As viewed through the prism of “psychomotor, cognitive, affective learning,” education is largely defined through cognitive

learning and fosters breadth of view, diverse perspectives, critical and reflective analysis, abstract reasoning, comfort with ambiguity and uncertainty, and innovative thinking, particularly with respect to complex, ill-structured or non-linear problems. (TR 350-70)

faculty

Includes instructors, coaches and facilitators, developers, writers, training and instructional development managers, course managers, and Army authorized contractor personnel who have a role in the training, education, and professional development of U.S. Army personnel (TP 350-70-3)

human capital

An inventory of skills, experience, knowledge, and capabilities that drive productive labor within an organization's workforce. (AR 350-1)

indirect assessment

Measures that solicit perceptions and reflections or utilize secondary evidence to make inferences about student learning. It collects and analyzes perceptions of mastery of learning outcomes and may be self-reported or reported by others. Examples include students' self-assessments, course evaluations, alumni surveys, satisfaction surveys, and grades. (CJCSI 1800.01F)

instructional design

The process of creating learning products that enhances the quality, efficiency, and effectiveness of education and training. (TP 350-70-14)

knowledge

Information required to perform a skill or supported task. Knowledge is the basic building block of all learning. (TR 350-70)

leader development

Leader development is the deliberate, continuous, and progressive process - founded in the Army Ethic – that develops Soldiers and Army Civilian professionals into competent, committed professional leaders of character. Leaders are developed through the career-long synthesis of the training, education, and experiences acquired through opportunities in the institutional, operational, and self-development domains. Leader development is inclusive of all cohorts and components, beginning prior to accession and continuing until the leader leaves service. (AR 350-1)

learning

Cognitive and/or physical process where a person assimilates information, and temporarily or permanently acquires or improves skills, knowledge, behaviors, and/or attitudes. (AR 350-1)

learning continuum

The relationship between the learner and operational, institutional, and self-development training domains to include resident and non-resident learning events with opportunities designed to achieve established gates at initial entry, midgrade, intermediate, and strategic leadership levels.

Learning will continue at unit locations through learning content that is both pushed by the schoolhouse and pulled by the learner and supervisor, mandatory and self-directed, and competency-based. (TR 350-70, see continuum of learning)

learning ecosystem

A system of systems designed to support the diverse continuum of lifelong learning and behavioral development activities an individual or team may experience holistically.

learning outcome

A statement that indicates the level and type of competence a learner will have at the end of a course. The specification of what a student should learn as the result of a period of specified and supported study. See also Student learning outcome. (TR 350-70)

mentorship

The voluntary developmental relationship that exists between a person of greater experience and a person of lesser experience that is characterized by mutual trust and respect. (AR 600-100)

near-peer adversaries

Those nation states with the intent, capabilities, and capacity to contest U.S. interests globally in most or all domains, the [electromagnetic spectrum], and the information environment. (TP 525-3-1)

performance measures

Actions objectively observed and measured to determine if a task performer has performed the task to the prescribed standard. These measures are derived from the task performance steps during task analysis. (TR 350-70)

reach

The process of obtaining products, services, and applications, or forces, or equipment, or material from organizations that are not forward deployed. (JP 3-30)

skill

One's ability to perform a job-related activity, which contributes to the effective performance of a task performance step. There are three types of skills: physical, mental, and emotional. (TR 350-70)

student learning outcome

A measurable statement of what students should know and be able to do as a result of their course work and educational experiences at an institution or in a program of study. Student learning outcomes are operational statements describing the specific observable student behaviors that provide evidence of the acquisition of desired knowledge, skills, abilities, capacities, attitudes, or dispositions. (CJCSI 1800.01F)

Synthetic Training Environment

Soldier-centric training environment that optimizes human performance by converging virtual, constructive, and gaming training environments into a single-synthetic training environment that provides a common training simulation for the institutional, operational and self-development training domains.

talent

Unique, measurable clusters of highly interrelated knowledge, skills, and behaviors possessed by an individual, which results in effective performance when properly aligned against a particular job. (DA Pamphlet 600-3)

talent management

The system of Army policies, processes, practices, and tools to effectively organize and employ the attributes and capabilities of personnel to maximum effect and accomplish the Army's current and future missions and tasks. Talent management consists of four major elements: Acquire, Develop, Employ, and Retain.

talent management system

A set of processes that promotes having quality people with appropriate competencies performing mission-critical activities such as leadership. (AR 350-1)

task

A clearly defined and measurable activity accomplished by individuals and organizations. It is the lowest behavioral level in a job or unit that is performed for its own sake. It must be specific; usually has a definite beginning and ending; may support or be supported by other tasks; has only one action and, therefore, is described using only one verb; generally performed in a relatively short time (however, there may be no time limit or there may be a specific time limit); and must be observable and measurable. The task title must contain one action verb and an object and may contain a qualifier. (TR 350-70)

training

A structured process designed to increase the capability of individuals or units to perform specified tasks or skills in known situations. Process of providing for and making available to an employee, and placing or enrolling the employee in, a planned, prepared, and coordinated program, course, curriculum, subject, system, or routine of instruction or education, in scientific, professional, technical, mechanical, trade, clerical, fiscal, administrative, or other fields that will improve individual and organizational performance and assist in achieving the agency's mission and performance goals. (AR 350-1)

training and education developer

An agency or individual responsible for using the analysis, design, development, implementation, evaluation (ADDIE) process to develop training and education concepts, strategies, and products to support the training and education of all cohorts, Active Army and Reserve Component Soldiers, civilians, and units across the institutional, self-development and operational training domains. (TR 350-70)

Training Support System

The system of systems that provides networked, integrated, interoperable training support capabilities that are necessary to enable operationally relevant, [joint, interagency, intergovernmental, and multinational] training for Soldiers, units, and Army Civilian professionals anytime, anywhere. (AR 350-1)

Section III

Special Abbreviations and Terms

This section contains no entries.