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INFORMATION PAPER

SUBJECT: Training and Doctrine Command's (TRADOC) Technology and Capability Objectives for Force 2025 and Beyond

1. **Purpose**. To provide an overview of and background for TRADOC's Technology and Capability Objectives for Force 2025 and Beyond analysis.

2. **Facts**. Stemming from a CSA tasking after the October 2013 Strategy and Future Force Review, TRADOC initiated a deliberate effort to identify and analyze emerging candidate technology solutions to inform the Army's Science and Technology (S&T) decisionmakers on the needs of the Warfighter.

a. Technology Objectives for Force 2025 and Beyond.

(1) Grow Adaptive Army Leaders, Optimize Human Performance. The Army must optimize the performance of each Soldier, Civilian, and team to meet future challenges with a smaller force. This will require better integration of current and maturing developments and exploitation of emerging areas of human performance science to accelerate development; improve cognitive and physical performance; improve social and interpersonal capabilities; improve health and stamina; and improve talent utilization. Achieving these goals will result in leaders possessing improved judgment and experience at lower levels, who build cohesive, resilient, effective, ethical, efficient organizations. The following are assessed as promising in achieving this objective:

(a) Army Leadership for 2025. The Army needs innovative methods to develop leader skills in mentoring, climate setting, and strategic thinking. These technologies will optimize the capabilities of smaller units by increasing battlefield intuition, military judgment, and decision making.

(b) The Future Holistic Training Environment (Live/Synthetic). Exploit other immersive full-spectrum training tools that enable the ability to train anytime, anywhere with embedded capabilities on real equipment to maintain "training overmatch" in a fiscally constrained environment.

(c) Sustain and Improve Cognitive Vigilance and Physical Performance. Explore approaches such as personalized medicine which can exploit biomarkers and research in sleep and supplements offer potential improvement in Soldier alertness and performance in extended operations.

(2) Maximize Demand Reduction and Improve Reliability. While Army resources are expected to remain flat, if not decline, the demand for Army forces is expected to

increase. The Army must retain combat power and maximize the combat potential of its formations. The following are assessed as promising in achieving this objective:

(a) Reduction. Technologies that reduce or eliminate manpower requirements while sustaining capability, such as the Survey Modernization effort, will become even more critical. As an example, affordable systems that can autonomously provide position, location, and orientation for artillery assets in a Global Positioning System (GPS)-denied environment could be used to eliminate the 13T MOS (field artillery surveyor/meteorological crewmember), reducing formations by several hundred Soldiers and nearly a hundred vehicles.

(b) Autonomous and Semi-Autonomous Systems and Operations/ Manned-Unmanned Teaming. Leveraging the success achieved with autonomous aerial platforms, these technologies offer similar capabilities for ground-based systems across all warfighting functions. A promising application would be autonomous ground-based resupply, which could provide optionally manned vehicle capability. Augmentation of our human capabilities will mitigate risk to Soldiers and reduce manpower requirements.

(3) Maintain Overmatch. The Army requires innovative approaches that recover, retain or improve the core operational advantages of Army forces. The following capabilities are assessed as promising in achieving this objective:

(a) Position, Navigation and Timing (PNT). Affordable technologies that ensure access to PNT information in GPS or otherwise denied environments.

(b) Lighter, More Effective Combat Vehicle Platforms. Technologies that augment the ballistic protection of combat vehicles against emerging threats, providing both a soft and hard kill capability to offset advances in threat lethality and break the armor weight paradigm.

(c) Extended Range Fires. Affordable technologies such as the Low Cost Extended Range Missile designed to counter increases in threat range and precision by delivering increased accuracy and volume of effects at extended ranges in all operational environments.

(d) Network Protection. Overmatch analysis highlights the critical importance of network protection/information assurance. Technologies contributing to a cloud-based intelligence enterprise architecture enable our ability to operate and protect the information environment where adversaries seek to degrade, disrupt, or interdict data.

(4) Enhance Expeditionary Capabilities. The increasing speed of events and their effects, driven by unprecedented levels of connectedness, combined with anti-access area denial strategies requires an increasingly CONUS-based Army to be capable of responding more rapidly with forces that possess strategic mobility, enhanced survivability, discriminant lethality, combined arms capacity, and logistical supportability. The following are assessed as promising in achieving this objective:

(a) Extend Operational Reach and Agility. Advanced rotorcraft and strategic mobility technology initiatives can modernize the current fleet, deploy the force more rapidly, and increase operational reach and agility, defusing adversary capabilities and disintegrating and dislocating their operations.

(b) Expeditionary Maneuver. Technologies that enable simultaneous force projection, entry, protection, and sustainment in austere and denied environments will enable the maneuver of Army combat forces, closing the seam between forcible entry and follow-on forces to ensure sustained momentum upon entry to seize, retain, and exploit the initiative.

(c) Demand Reduction. Technologies that provide alternate sources of water and production at the point of need such as water from air, reuse, and distribution technologies will reduce the sustainment and transportation structures required today. Improved reliability, fuel efficiency, reduced ammunition size, and vehicle weight reduction are other promising areas to reduce the size of the logistical footprint, improve unit self-sufficiency and operational agility, and allow redistribution of manpower.

(d) Lightweight Materials. Technologies that produce materials with improved specific strength, toughness, and ballistic resistance to weight ratios contribute to a more expeditionary Army by improving system and unit performance and their deployment, employment and sustainment footprints. Improvements include reducing the Soldier's burden, increased system mobility, reliability, availability, and maintainability, and reduced sustainment demand of ground vehicles, while retaining if not improving protection in all ground combat vehicles. For example, advanced composite materials used in the Lightweight Javelin Command Launch Unit yield 70% smaller volume and 40% lighter weight, reducing Soldier load and transport and stowage requirements. Similarly, over the next decade ground vehicle components, less armor, are on track to achieve up to a 50% reduction in weight and in some cases volume reductions. These component reductions equate to a 20% weight savings overall, less armor. In addition, protective armor materials must be improved to reduce the weight of armored volumes and account for advances in energetic solutions to improve system and unit performance and mobility and reduce deployment, employment, and sustainment footprints with superior reliability, availability, maintainability, and sustainment demand. Threshold reductions for future fighting vehicles should be no less than 15-20% (~55 tons) with an objective reduction of 40-50% (~35-40 tons), optimally achieved within the next decade to enable a new start combat platform best designed for the operational demands and challenges anticipated over the 30 plus years following fielding. We recognize this will require prioritization across component and subsystem design optimization, advanced material, manufacturing and design optimization and that weight, performance, and affordability will have to be balanced. Advances realized in fighting vehicle armor will favorably impact the performance and deployment, employment, and sustainment footprints of the vast majority of the ground vehicle fleet.

(5) Continuously Upgrade, Protect and Simplify the Network. Fielding a resilient, simplified, and protected network, specifically resistant to cyber attacks, integrated as a common operating environment across the Army is critical to enabling our Soldiers and leaders with decision-quality knowledge at speed. The following are assessed as promising in achieving this objective:

(a) Intelligence Enterprise Architecture. Critical enabling technologies for distributed processing, exploitation, and dissemination, plus analysis such as the Intelligence Community Cloud enable expeditionary intelligence and mission command by 2025 while providing a single global security architecture and common operational picture for cyberspace that is essential to overcoming growing cyber threats.

(b) Cyber, Communications, Intelligence, and Electronic Warfare Convergence. Hardware and software technologies to fuse communications, intelligence, and electronic warfare capabilities into a common, singular cyber capability enabled by upgrades to tactical networking waveforms will allow increased network user capacity, dynamic unit re-tasking, and performance in spectrum-contested environments.

(c) Mission Command on the Move. Technologies that allow commanders to remain mobile without giving up mission command capability increase the agility, speed, discrimination and effectiveness of units at all levels.

b. Beyond 2025. The technology objectives above support the force of 2025 and set conditions to significantly improve the Army in the far-term (2030 and beyond). TRADOC has developed S&T lines of effort (LoEs) to provide a clear and concise articulation of the capabilities needed that stand to fundamentally change the force in the decade of the 2030s. The Army requires expeditionary technology-driven capabilities allowing rapid deployment of scalable, power projection forces on short notice to austere locations to conduct the full range of military operations immediately upon arrival, often in persistent anti-access/area denial environments. Below are TRADOC's recommended LoEs to guide delivery of the capabilities for this period:

(1) Mobile Protected Platforms. To enable a globally-responsive force that is rapidly deployable, the Army must significantly reduce the weight and volume of combat vehicles through the use of lighter materials and novel protection system to protect against both kinetic and non-kinetic future threats. These vehicles will be augmented by unmanned vehicles and unmanned aerial systems.

(2) Improved Lethality and Effects. The Army requires munitions, platforms, and mission command systems that enable the detection, identification and engagement of threats with precise, scalable and tailorable effects, both kinetic and non-kinetic, in a contested environment.

(3) Logistics Optimization. In order to have an expeditionary capability to fight in a contested environment, the Army must increase logistical efficiencies, increase unit self-sufficiency, and decrease demands.

(4) Aviation. The future Army requires aviation assets with extended reach, increased lethality and increased responsiveness, capable of operating in all environments and conditions. The future Army will depend on its aviation assets to deliver decisive combat power to austere points of need with the speed that matters. This demands aviation assets with at least twice the range and increased speed compared to current platforms, upgrading older platforms will not be sufficient to provide the capabilities.

(5) Cyber Electromagnetic Activities. Commanders and staffs must integrate and synchronize cyberspace operations, electromagnetic spectrum management operations and related capabilities in a contested environment.

(6) Accelerated Data to Decision. The future demands our Soldiers be empowered with situational awareness and understanding to make rapid decisions by accelerating the flow of information to the point of need at the speed of war. This must be done without increasing the Soldier's cognitive burden, necessitating more effective user interfaces such as heads-up displays to replace traditional radios and handsets.

(7) Human Performance Enhancement. The Army must maximize the return on its most critical resource. The future requires Soldiers who have enhanced cognitive, physical and socio-cultural skills in order to be effective in the complex environment in which they will operate.

(8) Robotics. The Army needs affordable, interoperable, and autonomous unmanned systems to enable integrated manned-unmanned teaming and serve as force multipliers across all echelons and war fighting functions. Artificial intelligence capabilities will be critical to empower unmanned systems and serve as decision aids.

c. Supporting Documents. This information paper represents an overview of the significant effort undertaken by the Capability Developer S&T community over the past 9 months. It was developed in coordination with: TRADOC's Centers of Excellence; Combined Arms Center – Training; U.S. Army Medical Department Center and School; and the Human Dimension Division. Each organization has developed a memorandum that articulates its S&T needs and identifies technology efforts they have reviewed which begin to exemplify some of the capability desired. These are posted on an AKO site we established https://www.us.army.mil/suite/files/43196236. Also on that site are: the ARCIC S&T Lines of Effort White Paper that elaborates the Warfighters' S&T needs beyond 2025, results from the FY14 TRAC Scoring Conference, and the analysis of stated objectives as they relate to policy documents.