The Human–Machine Paradox

A Balanced Approach to Finding and Fixing in 2035

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We are under no illusions that these machines improve the nature of the information. This will always depend on the reliability of the source and the skill of the analyst.

—Allen Dulles, 1963

In Ridley Scott's 2008 spy thriller *Body of Lies*, a CIA handler played by Russell Crowe attempts to describe the complexity of modern targeting operations to moviegoers. Crowe's character narrates a montage in which he explains how jihadists who adhere to ways of the past often favor Cold War tradecraft like dead drops to elude those who would use futuristic technology to locate them.[1] Though fictional, the film's plot syphons off the testimonies of those who led the intelligence war against al-Qaida in Iraq such as Gen. Stanley McChrystal.[2] Conceptual and disciplinary interoperability became as valuable as digital innovation in Anbar Province circa 2006. Locating the enemy in the coming era of Third Offset technologies, such as artificial intelligence (AI) and machine learning (ML)-enabled programs, will be no exception.[3] Exploring challenges and opportunities in the targeting process will lead to solutions in line with this logic.

Senior Army leaders commanding cross-functional teams (CFT) tasked with pursuing modernization initiatives are clear on the difficulties that lay ahead: "We cannot modernize to parity … We must modernize to overmatch and maintain that overmatch through incremental upgrades."[4] Current procedural and doctrinal constructs do not support the degree of technical and operational sophistication required to meet this demand. How, then, can the joint force develop reliable, resilient means of locating its enemies amidst a backdrop of such technological fluctuation?

AI and ML, or advanced analytics capabilities, are unique in that the most tangible operational implementations manifest in Hollywood movies or Arthur C. Clarke novels. Hence, the approach to advanced analytics in support of joint targeting must be driven by the synergistic effects of enhanced human knowledge and sensor capability. Rather than absolving the user of responsibility, digital systems of increasing complexity will demand more intellectual capital from the operator. This is the human-machine paradox. To capitalize on germane modernization efforts, the joint force must develop a personnel strategy that builds on recent technical innovation training initiatives by nesting them with operational doctrine and military education. Doing so creates multifunctional stakeholders to adopt and operationalize the tech, thereby balancing the weight of human and machine inputs and outputs. How the U.S. Army negotiates this concept will shape its capacity to target effectively during joint all-domain operations (JADO) in the coming years.

Previous page: Marines with Marine Corps Forces Cyberspace Command observe computer screens 5 February 2020 at Lasswell Hall in the cyber operations center at Fort George G. Meade, Maryland. (Photo by Staff Sgt. Jacob Osborne, U.S. Marine Corps)

Innovations, Limitations, and Threats

Any hypothetical discussion about the future of targeting should begin with a fundamental question: *How does one prioritize targeting efforts by separating wheat from chaff in an uncertain future environment*? With the advent of the 2018 *National Defense Strategy* and a return to training for great power competition, it is widely accepted that if such a conflict were to arise, the joint force would need to fight with at least some of its assets degraded if not completely denied.[5] This factor alone will dictate how the Army locates its enemies because it will determine the resources to which it has access during operations. Not dissimilar to the conditions that preceded the Global War on Terrorism, it is often external actors who determine where and how the United States fights next. The same is true today. Not only must the joint force train to fight in *all* domains, but it must also be ready to fight in *each* domain independently while others are degraded or denied in a form of "mosaic warfare."[6] A depth and breadth of understanding regarding digital intelligence architectures is therefore paramount to successful targeting in JADO.

In one of the conceptual frameworks of Army targeting known as F3EAD (find, fix, finish, exploit, analyze, and disseminate), finding the target is rightfully the first order of business.[7] The explosion of interconnected commercial sensors over the last ten years, known as the Internet of Things (IoT), will make hiding much more complex in the future. Comprised of some estimated two hundred billion devices capable of connecting to a wireless network—such as home security systems, fitness watches, and even refrigerators—the IoT is the aggregate of data collected by these sensors.[8] This volume of data lends to an imperative that advanced analytics support to targeting be implemented at scale to conserve limited human resources and maximize not only analytical capacity but also quality of target selection. Feedback from recent Joint All Domain Command and Control (JADC2) experiments underscores the requirement for command-and-control structures that scale numerous targets rapidly. Doing so refines the target prioritization process by delineating between scheduled and on-call fire missions. Leveraging the IoT for military targeting purposes in such a way is a long-term endeavor, but the joint force may very well be training on the "battlefield of things" in support of the near-term fight.[9]

Discussions surrounding the role of advanced analytics platforms in the kill chain are heavy on concepts but light on specifics.[10] In part, this shortcoming is a product of the inconvenient truth that most of the technology under discussion is either not yet invented or not yet operationalized for military application, which in some cases leads to a reliance on science fiction to carve out a way ahead.[11] This challenge has long plagued integration of innovative tech. Operationalizing a new capability where it might have the greatest impact requires a unique blend of technical and operational know-how.

Digital kill chain debates focus primarily on reducing hit-to-kill times, but "sensor to shooter" (S2S) is the doctrinal framework for applying Army and joint fires to prioritized targets on the battlefield. Establishing S2S kill chains is summarized in doctrine as the "sensor to shooter challenge." It codifies two requirements for establishing a kill chain. First, it must "coordinate *multiple* sensor-to-command-to-shooter missions," and second, it must "assure *timely* execution of missions." These challenges highlight the "targeting goal": minimizing sensor acquisition times, processing times, command times, and shooter response times.[12]

Adding context to the digital kill chain, or "the life of the message," it is appropriate to look at digital frameworks that currently support targeting methodologies. Digital kill chains are simply an extension of sensor processing timeliness. The intelligence warfighting function is directly responsible for managing this timeliness from a procedural and technical perspective. However, this responsibility is not managed unilaterally. It is directly related to and contextualized by outputs of targeting methodology provided by the fires warfighting function, specifically the timeliness criteria of target selection standards (TSS). The difference in S2S between striking and missing a reported target correlates with analysis of the adversary's systems displacement doctrine. Targeting dictates that adversaries assume they have been targeted for attack and *will react appropriately* by displacing at the earliest opportunity, which is codified analytically as "target decay." Therefore, it is imperative to know how various message types traverse a theater intelligence architecture, from what sensors or domains they derive, and most critically, how much time is expended during the process.

Constructing a digital kill chain ecosystem consists of industry vendors developing and managing divergent machine language formats, such as the U.S. Air Force Universal Command and Control Interface or the Defense Department's U.S. Message Text Format systems and their associated networks. Message protocols are critical to interoperability between machines, and while the Universal Command and Control Interface may "establish a set of messages for machine-to-machine, mission level command and control for airborne systems" for the U.S. Air Force, it is not a Defense Department standard.[13] Digital modernization and convergence efforts notwithstanding, maintaining even the most basic competence in foundational interoperability requires a considerable technical pedigree.

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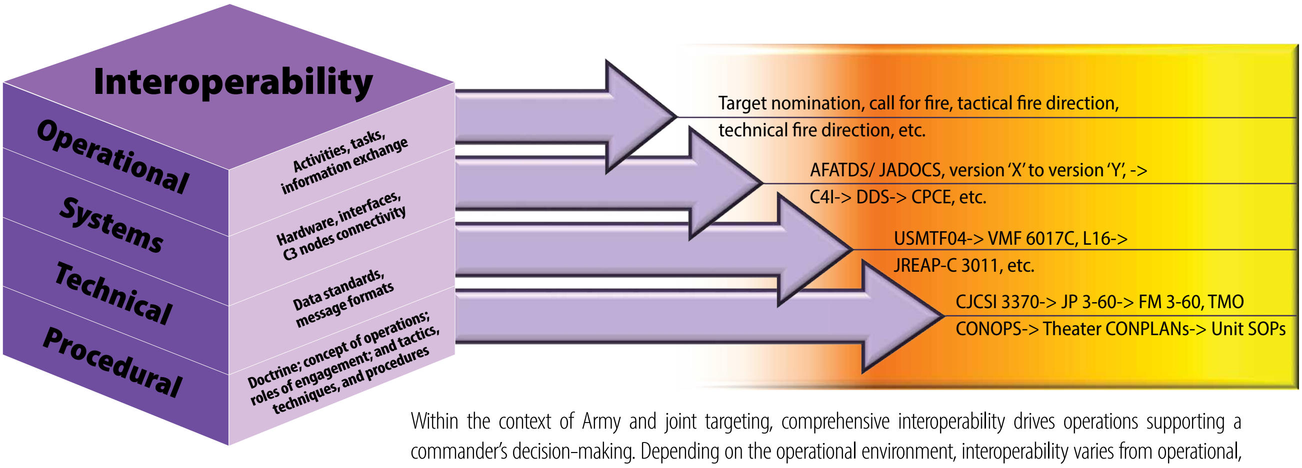
Fire support command and control systems interoperability

Comprehensive interoperability requires familiarity with both technical and human domains. Interoperability can be process-based (standard-operating-procedure-oriented), or technical-based (systems-configuration-oriented).



Within the context of Army and joint targeting, comprehensive interoperability drives operations supporting a commander's decision-making. Depending on the operational environment, interoperability varies from operational, systems, technical, and procedural categories. However, all four must be present in any given system's targeting enterprise for targeting automation to function.

(Figure by authors)

Figure 1. Visualization of Systems Interoperability Requirements that Facilitate Army Targeting

This interoperability must meet four criteria defined by the activities, tasks, and information exchanges between systems within the kill chain. Systems interoperability is the hardware, interfaces, and connectivity between mission command nodes. Operational interoperability encompasses the routine tasks that support operations, often conceptualized as a mix of human and digital processes. Technical interoperability is the data standards and message formats between distinct machines. Lastly, procedural interoperability is the doctrine, techniques, procedures, and rules of engagement between organizations who manage those machines and systems. The joint force must consider these criteria prior to the development of any new system in the kill chain (see figure 1).

Today, the ecosystem represents a loosely banded cluster of agencies, repositories, and systems underscored by lackluster cohesion, and myopically focused on procedural interoperability criteria. To overcome this challenge, the joint force must couple its technical implementation with the operational doctrine—procedural interoperability layered with systems and technical interoperability prescribed in the same cross-functional doctrine. Beyond this consideration, additional challenges exist at echelons above corps that will influence the tactical kill chain by denying access to sensors and disrupting their communications pathways.

Competitors of the United States are already developing numerous capabilities that would circumvent, degrade, or destroy the most advanced sensors employed by their adversaries.[14] Whether in the form of weaponized satellites, electromagnetic weapons, or hypersonic missiles, nations such as China, Russia, and Iran are acutely aware of how the U.S. military fights and upon which resources it relies to do so effectively, such as space connectivity.[15] We see reflections of this concern in the Army's professional education courses that are reverting to analog training methods even as the conversation surrounding the digitization of operations intensifies. This holds true in everything from field artillery schools to military intelligence courses.[16] Clearly, the Army cannot effectively implement advanced analytics targeting methodology *at scale* without a recalibration of how it is codified in military reference material.

To give the reader an idea of the magnitude of information that will inundate future battlefields, some estimates place the annual global production of data at 175 zettabytes (175 trillion gigabytes) by 2025.[17] Defense

Intelligence Agency leaders are shaping the role of advanced analytics to support national intelligence records with the development of the Machine-Assisted Analytic Rapid-Repository System that uses ML to aggregate metadata for analysts.[18] Machines will drudge through this data, but human operators must still make sense of it to develop a lucid common intelligence picture for their principals; alas, the concept of database management, however dated it may appear, will continue to frustrate modern digital implementations.

While understandably focusing a great deal of attention on emerging technologies because of their potential, the U.S. Army would be wise to not lose sight of who is orchestrating the implementation of these sophisticated programs at echelon. Human ingenuity has, after all, handed the joint force many of its wins over the last two decades.[19] With finite resources at hand and a budget to balance, this is easier said than done, but adopting a balanced philosophy that encourages leaders to invest as much time in their thinking humans as their thinking machines is a good start. In essence, the Army must transform into a digital enterprise that evolves proportionally with the operational environment, equitably distributing the efforts and talents of the human and the machine.

Recommendation 1: Talent Management Reforms

The first step to building an advanced analytics platform capable of thriving in 2035 is to develop a component-level strategy for finding and retaining tactical leaders who serve as the connective tissue linking "big Army" ideas at echelons above corps to battlefield effects. These advocates would forge a conglomerate of future-thought leaders who can synchronize individual unit requirements with emerging capabilities and doctrine by articulating them to key decision-makers and industry shareholders through Army Futures Command liaisons and CFT representatives. Although the Department of the Army (DA) and Army Futures Command directives offer a broad vision for AI investment, most junior service members are unaware of how, when, or why this technology will be developed or applied—and they will be the ones harnessing its potential.[20]

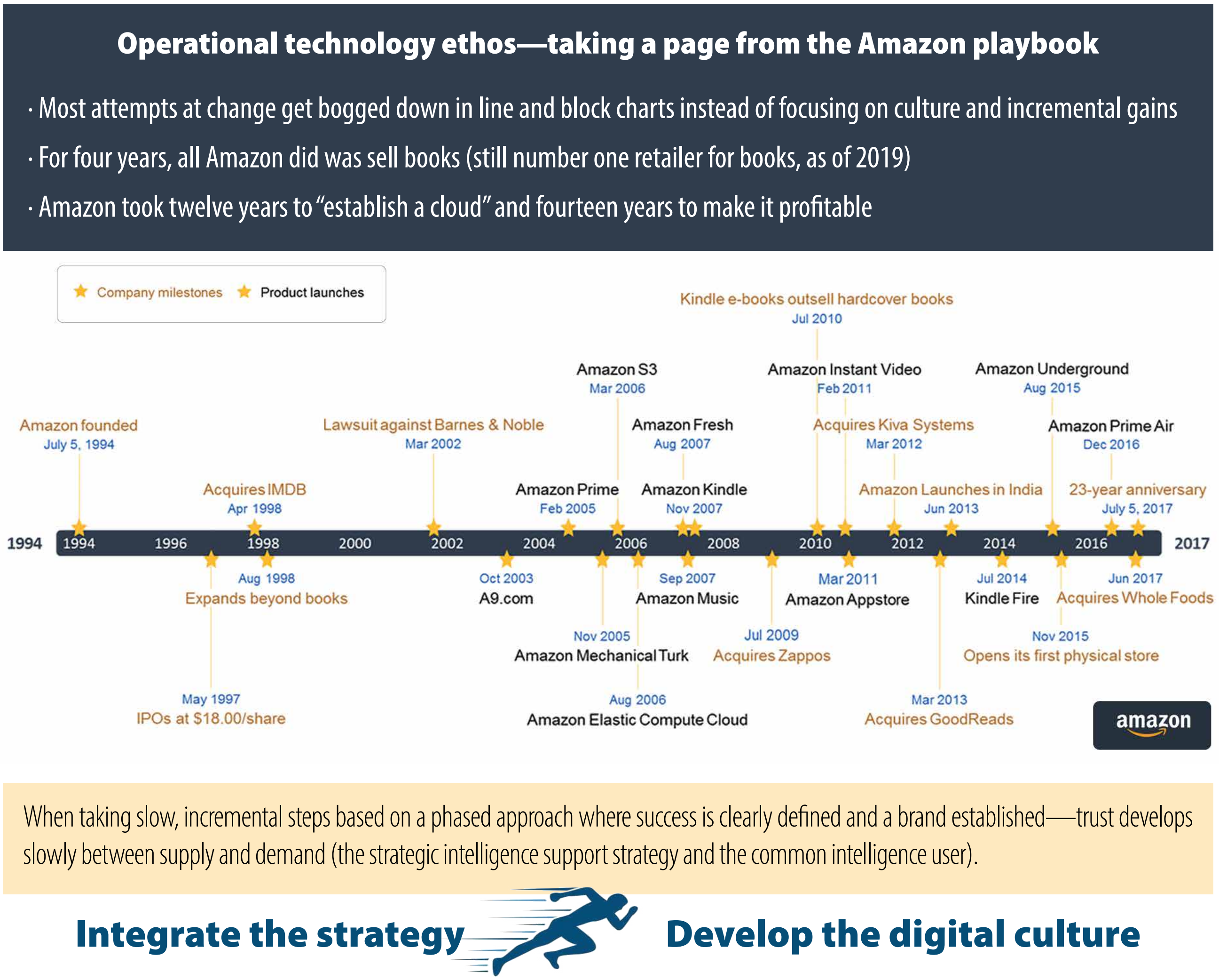
Further challenging modernization is the lack of agility within most institutional training venues. A recent JADC2 experiment highlighted the need for a more robust joint experimentation infrastructure to test emerging concepts in live and simulated environments.[21] Creative and immersive digital problem-solving spaces go a long way in preparing a force for what lies ahead, but however relevant those conclusions might be, they are simply not a priority when measured against the backdrop of Army training and readiness requirements (see figure 2, page 44).

Discovering solutions to these challenges will take a concerted effort across every echelon of the joint force, thus extracting precious time from formations that are already stretched thin with competing demands. As emerging technologies become more prevalent and explicable, an *early* and *often* education model will be essential to bolstering the joint force's creativity in the interim. The *early* program would begin in a recruit's commissioning source or individual training pipeline where assistant professors of military science and senior instructors are trained to provide blocks of instruction on these concepts. This feeds into the objectives of the Army's Talent Management Task Force by familiarizing formations with the benefits, capabilities, and risks associated with automation and targeting.[22] In turn, this initiative could stimulate growth of critical knowledge, skills, and behaviors as service members progress in their careers, allowing the Army to "grow its own" digital warriors rather than simply recruit them (which is a mounting concern).[23] High-performing enlisted and officer recruits interested in pursuing these ideas further would be placed into a queue for attending advanced private industry training that meets the Army's targeting needs, similar to the Graduate Study Active Duty Service Obligation program. If the Army wants to lead these efforts in 2035, it simply cannot wait for junior leaders to become familiarized with them later in their careers.

Recommendation 2: Educational Reforms

The *often* approach institutionalizes programs of self-study that foster lifelong learnership at the DA level. With the complexity inherent in future operations, now more than ever, military professionals cannot afford to let their comparatively narrow personal experiences define their understanding of the operating environment between mandated professional military education courses. Former Secretary of Defense Gen. James Mattis put this best: "If you haven't read hundreds of books, you are functionally illiterate, and you will be incompetent, because your personal experiences alone aren't broad enough to sustain

Illustration courtesy of the U.S. Army



(Figure by authors and Rob Coon, Intelligence and Security Command. Amazon graphic courtesy of officetimeline.com)

Figure 2. Using Amazon's Model to Demonstrate the Dedication Required to Build an Effective Digital Culture

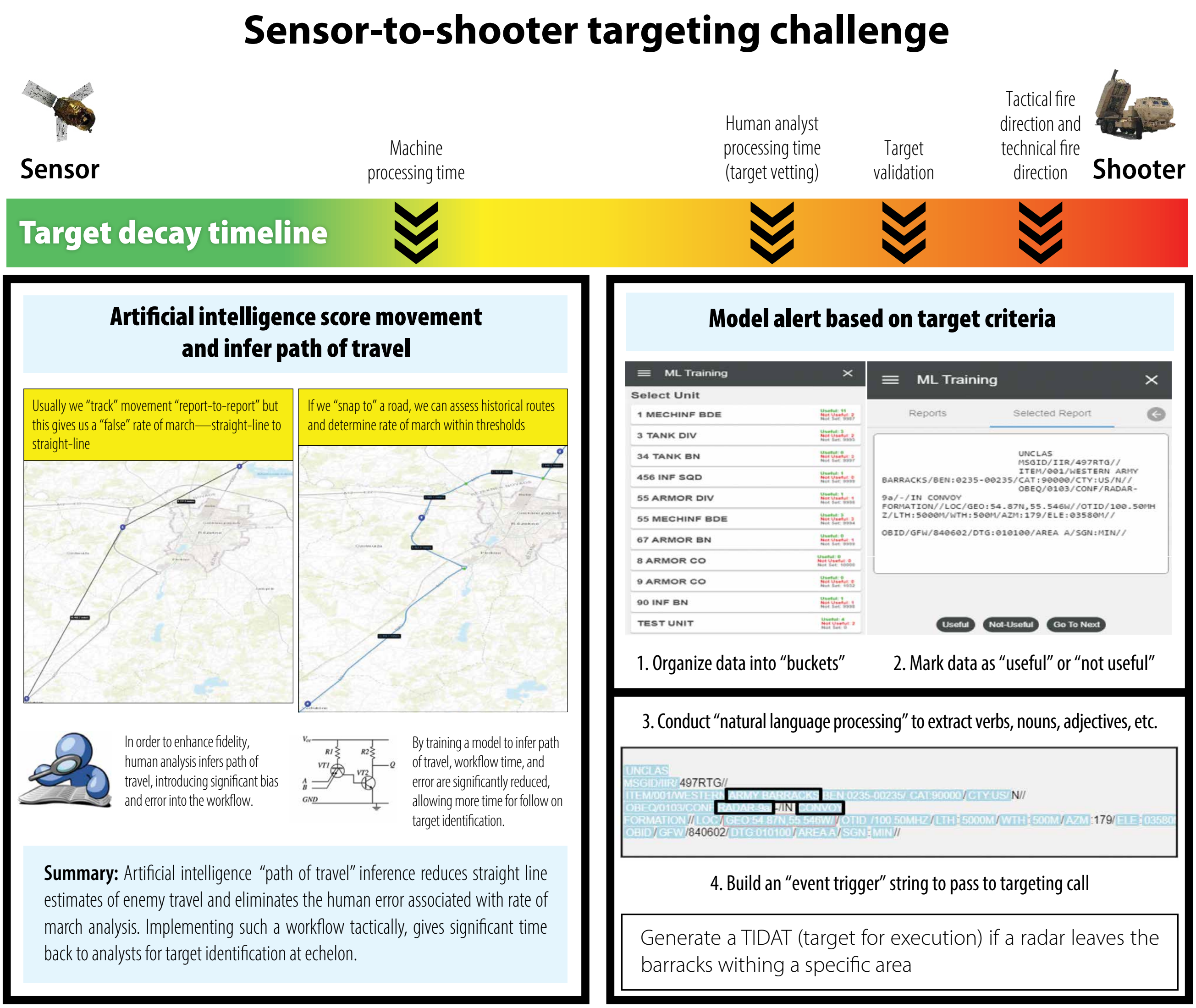
you."[24] Developing a forcing function at the DA level similar to the U.S. Marine Corps' professional reading program would provide a baseline of historical and technical understanding among Army leaders regarding modernization initiatives outside of their personal experience.[25]

Another component to the *often* approach is the revolutionary digital training platform established by U.S. Army Forces Command (FORSCOM) with support from Intelligence and Security Command (INSCOM). By pooling local resources and technical talent, FORSCOM and INSCOM continue to develop a robust subculture of digital disciples capable of collaborating on and implementing the types of elegant solutions required to support targeting at echelon by 2035. Unconstrained by the policy and decorum that sometimes accompanies the institutional domain, FORSCOM's Digital Intelligence Master Gunner strategy seeks to build digital depth within its formations to confront the future operating environment. As a perennially evolving strategy, this FORSCOM venue is uniquely postured to deliver a service member capable of operationalizing concepts in an advanced-analytics-optimized environment.

The Digital Intelligence Systems Master Gunner Course establishes competencies in legacy intelligence systems —joint or otherwise—with a keen eye on implications for the current and future era of digital transformation. Driven by the above strategy, the course builds capacity to support the human component involved in operationalizing the science fiction references mentioned previously. Discussion of spatial analytics and natural language processing, and how users may apply those solutions tactically, are rife throughout Digital Intelligence Systems Master Gunner Course academics (see figure 3).

In the meantime, the all-domain sensor fabric is likely to consist of tactical or local cloud capabilities that synchronize a broad suite of interconnected sensors, soldiers, and vehicles providing real-time updates to the warfighter. In the past, many of the challenges associated with finding the enemy hinged on getting the right information at the right time to the right decision-maker. In this regard, the battlefield of things might help dislodge stovepipes in information sharing processes by flattening the trajectory of information.

There is no way to say with any certainty that investing in a particular technology will enable superior targeting in the next conflict, because there is no guarantee that



(Figure by authors)

Figure 3. Example of Subject Matter Introduced in the Digital Intelligence Systems Master Gunner Course

Students problem-solve ways to reduce cognitive load on analysts in support of targeting the joint force will have access to the full services of that technology. There is, however, strong evidence to support the notion that when properly invested in, the right people in the right place will carve out a path to success when the inevitable worst-case scenario arises. Lending to this conclusion is McChrystal's assessment that the successful targeting of al-Qaida in Iraq was as much a product of cultural and conceptual adaptability as it was technical exploitation.[26] Intuition, intellectual curiosity, and creative thinking are essential to this process because every assessment of future war is pure speculation, and to be candid, most militaries do not have a particularly sterling track record when it comes to predicting future war conditions.[27]

Conclusion

Army leaders must recognize that there is no purely organizational or technological solution to the future targeting equation. The above proposals alone will not close the loop on finding and fixing in 2035 any more than the AirLand Battle efforts of the 1980s made targeting a linear process in 2006.[28] Rather, these recommendations will arm leaders across the targeting enterprise with the ingenuity required to drive cultural change toward a more holistic shared understanding of digital targeting requirements. It is the authors' intent that this understanding might lead to a more inclusive undertaking that operationalizes the work of the various CFTs by building the human terrain necessary to support digital targeting innovations in JADO.

Advantages provided by emerging tools such as tactical cloud devices and advanced analytics in battlefield synchronization systems are real, and the U.S. Army has set up a robust architecture of cross-functional teams, integration centers, and commissions to explore the possibilities.[29] That said, if the Army truly aims to prepare for the harsh reality of great-power conflict in the twenty-first century, its development of people must evolve concomitant to its development of machines. Leaders cannot afford to be blindsided by the expanding technical expectations of the future operating environment. They have a responsibility to develop critical competencies in niche areas, including digital proficiency, to support the rapid integration and implementation of a multi-echelon targeting strategy enabled by advanced analytics. Without accompanying doctrine and innovative training venues, such as FORSCOM G-2 initiatives, the joint force will never be able to execute such an endeavor at scale.

Chief of Staff of the Army Gen. James McConville certainly endorses a human-centric philosophy toward the Army of 2035, something he underscored in his welcome letter to the force.[30] Decades ago, Allen Dulles acknowledged both the centrality of technology to intelligence support and the enduring need for human prudence and wisdom to guide the process. Even *Ghost Fleet* coauthor and future war theorist August Cole admits that the recruitment of service members who have the "capacity to decide, communicate, and act in the *hyperwar* environment will be perhaps more important than any investment in machines."[31] In times of vast technological enterprise within the defense and intelligence communities, pioneers have advocated for a balanced approach to targeting that exploits the benefits of technology by reforming the way in which organizations think about and invest in the operators actioning that exploitation. Considering the highly disruptive and uncertain nature of current threat trends, leaders navigating the human-machine paradox at every echelon should do the same. ■

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Notes

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