



Realizing the ‘Transparent Battlefield’ in 2040: Objectives, Challenges and Solutions

ABSTRACT

The United States Army’s Project Convergence effort envisions a new style of coordinated maneuver warfare; accelerated ‘hyper war’ made possible through the combined digital integration of sensors, A.I. enabled command networks, with manned and unmanned lethal capabilities. Embedded in this concept is the notion of a ‘transparent battlefield’; a vision of near perfect situational awareness of terrain, friendly forces, and the composition and disposition of the enemy combined to enable the Army to fight faster than its enemies and kill with greater precision. It is a bold vision, but the key to its realization lies not in the mere ability to produce innovative technologies. While the real-world testing of technology is important, it is difficult to field expensive tech, e.g. robots, sensors, autonomous weapons, hyper-velocity munitions, advanced communications systems, etc, at scales sufficient to show the value added proposition of integrating legions of these systems into the Army. Instead, testing success might first be found in dedicated digital engineering labs. In digital labs, the Army could synthetically test a variety of concepts and applications, run at scale, over hundreds of thousands of hours of combat scenarios. This approach would enable the Army to vigorously test concepts and prototypes digitally first, before spending large sums of money bending metal to test things that might fail. In this way, the Army would be able to more quickly and affordably achieve its vision of a high tech ‘transparent’ battlefield.

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The Army’s Vision of a Transparent Battlefield Rests on the Integration of Multiple Innovative Technologies

It is a time of transformation and technological revolution for many western militaries. The U.S. Army’s “Project Convergence” offers a window into the Army’s vision for a new way of war. To be sure, the nature of war has not changed, as it remains an intensely human endeavor; however, the intent behind the Army’s recent project is to accelerate how it is conducted at all levels. Project Convergence is an outgrowth of Multi-Domain Battle, the doctrine the Army is exploring to integrate its warfighting across air, maritime, land, space, and cyber domains. In every concept brief and experiment conducted so far for Project Convergence, the vision portends a capability that exists as a sort of hyper war battlefield, where the speed of friendly reconnaissance, information synthesis, intelligence processing and distribution, command and control, and targeting all move at speeds no enemy can replicate. Project Convergence seeks to integrate, or rather “converge,” what sensors in all domains see and transmit, into what other humans and machines then interpret, maneuver against and target. It is vision of the clock-speed of battle increased exponentially.

To achieve this capability, the Army is exploring several lines of effort that rest on the integration of multiple key technologies, nearly all at once. First, a reliable communications backbone network must exist onto which all of the C2, intelligence sharing, targeting, and instructions will rely, that is both resilient against cyber-attack and carries enough bandwidth to handle massive amounts of data streaming. Mere air-to-ground integration is not enough. Every maneuver element in every domain must have access to the Convergence backbone architecture for this to work as it is envisioned.

The second key technology is an A.I. assisted data aggregation and decision augmentation system robust enough to handle multiple sensor feeds from manned and unmanned systems, as well as process this data into useful intelligence and targeting information. This information, along with friendly unit locations and dispositions, will also exist and be managed on the network. Much the same as the data streaming through an F-35 pilot’s helmet, Soldiers, both mounted and dismounted on the ground with their Integrated Visual Augmentation System (IVAS) will receive and harvest useful information from this network.

The third key ingredient is the acceleration of the kill chain. Detection, targeting, and optimization of the best shooters will be central to Project Convergence’s purpose, once combat is joined with and enemy force. Direct fire, indirect fire, and precision guided munitions will work through this convergence system to find, fix and finish the enemy quickly.

Fourth, and perhaps the most critical component of Project Convergence, is the successful integration of both individual platform autonomy as well as multi-agent or unit-level autonomous capability. The presumptions of Project Convergence’s accelerated, integrated warfighting rests on robotic and autonomous systems assuming risks currently shouldered by

humans. Without the displacement of risk from manned platforms onto robotic systems, truly more aggressive maneuver will be a challenge. Conversely, if tactical individual platform autonomy is functionally achieved for combat robotics, with multi-agent behaviors and control built on top of it, the Army’s vision of truly transformative maneuver may be possible.

The last component of this vision boils down to increased speed of command. Commanders will understand their situations faster via the network and thus be able to direct advanced-teaming formations of manned and unmanned assets on this same architecture. This digital command capability will occur ideally with intuitive user interfaces, where commands given are easily understood and executed by both man and machine alike.

The First Challenge: Clarifying the Army’s Vision for Hyper War

Multi-Domain Operations and Project Convergence offer a broad set of goals for Army transformation. Nothing great happens in Army modernization without bold vision, and these concepts and projects are an important first step. Both industry and the American military have now entered a delicate phase in this transformation process where buzzwords, jingoisms, and techno-speak can take over the conversation. While it is clear there are multiple lines of effort among the Army’s Cross Functional Teams chasing the technologies and the capabilities described above, the current dilemma is currently one of ambitious goals, with limited clarity on their ultimate objectives. At this phase, the Army needs absolute clarity and concrete goals for warfighting in 2040 and beyond. What is the purpose of a “transparent battlefield” unless it leads to enhanced and accelerated lethality? What does a so-called Convergent Warfare Force of 2040 really look like? Are we to assume all of this capability is successfully integrated by then; if not when? The Army needs an endstate and straightforward capability goals for this innovative period. Any solution must propose a deliberate prioritization of those capability goals, technologies and efforts that deliver the following warfighting objectives for the Convergent Warfare Force of 2040:

Goal #1: The Clock-Speed of Battlefield Tempo is Exponentially Increased

- We see the enemy faster, via improved optics and agile forward autonomous and sensor assets
- We understand the enemy’s disposition and intent faster, via A.I. decision making aids
- We decide faster, via A.I. aggregated, managed and monitored decision triggers
- We act faster, via the assurances provided by precision Situational Awareness, precision intell products, and an accelerated and more efficient Kill Chain methodology
- We move faster than the enemy because we see the battlefield better than him, can accept more risks than him, and can sustain constant pressure on him he cannot contest

Goal #2: The Destructive Power of Advanced Teaming Capability is Fully Revealed

- Recon 'Shut Out' Achieved- Every first direct/indirect fire contact with U.S. Convergent Forces must be lethal and near total to our foes; there must be no enemy surviving scouts or sensors left to provide an accurate picture to enemy HQ
- Viciousness of Combat Rendered in 360 Degrees- U.S. Army units must be able to mass fires in volume and in degrees of precision and intensity enemy main body units cannot endure beyond mere minutes once battle is joined
- Accelerated, Repeated Kill Chain Cycling- The interconnected convergent network of A.I. enabled human C2, swarms of sensors, swarms of expendable UGV and UAS assets, and swarms of smart munitions teamed with their human masters enables U.S. Army units to execute the Decide/Detect/Deliver/Assess (D3A) process, reorient, and kill again at scales no near-peer threat can match.

Goal #3: Establish Autonomous Task Reorganization as a Constant in Convergent Warfighting

The "transparent battlefield" of tomorrow is meaningless without the existence of a maneuver force designed from the ground up to exploit it. Convergent warfighting offers the Army an opportunity to redesign new brigades with the capability to emplace a mechanism of task organization 'on the fly,' sometimes described as "mosaic warfare," where units are organized by mission requirements. The advent of maneuver forces comprised primarily of robotic and autonomous systems of air, ground, and even maritime domains, all managed by a A.I. decision augmentation architecture, could be organized and reorganized several times in a single mission without worry of confusion or complicated human deconfliction requirements. Reconfigurable robotic and sensor formations would offer manned formations the potential to tailor the augmentation of their supporting robotics package to support each mission with just what assets they need when they need it. The following tenets of mosaic style autonomous reorganization offer a suggestion for their value added proposition:

- All components of Convergent Warfighting Brigade run their C2 systems on the Project Convergence backbone; otherwise the entire concept of intel sharing, targeting, control, etc as optimally designed will not function. Out of the box, these new formations will fight faster and with better coordination than legacy formations.
- The organic maneuver battalions are all reconfigurable components of a Convergent Warfighting Brigade. They each come with a core Task Organization of manned units that do not change; however they can be "mosaically reorganized" at any time with a pool of RAS assets held by the Brigade A.I. task organization decision augmentation tool.
- Ground and air maneuver components exist together in this Convergent Brigade and are themselves modular units capable of taking and accepting missions with different non-organic units pushed down to them from Brigade HQ
- Convergent Brigades degrade more gracefully than purely human maneuver formations. Machines do not experience loss of morale from combat losses, nor do they grow tired.

While combat losses will be inevitable, robotic platforms be more easily replaced than a human, without the loss of professional experience commonly associated with human attrition.

The Second Challenge: The Tyranny and Expense of Building and Testing Physical Prototypes at Scale

Clearly, the Army is pursuing ambitious new warfighting capabilities on a very aggressive timeline. With the permission from 4-Star and Secretary of the Army levels to try new acquisition paths, experiment where needed and “fail fast,” there are several physical robotic combat vehicles undergoing development. To their credit, the Army’s engineering teams leading these various prototype lines of effort are proving valuable and providing critical inputs to inform future robotic requirements. The purpose of this discussion is not to criticize these ongoing efforts. The purpose here is to point out the challenge in making Project Convergence a reality lies not in the failure to conduct substantive trail-and-error tests; it is in the absence of the ability to execute these tests at scale. A demonstration of a platoon of RCVs moving through a Movement-to-Contact and handing off targets to a platoon of manned M1A2 Abrams tanks on a firing range is useful to inform small unit autonomy discussions. However, until the same actions can be shown at equivalent levels of proficiency and vehicle quantity one might see in legacy Brigade Movement-to-Contact at the National Training Center at Fort Irwin, we are not anywhere close to achieving the Army’s ultimate aims for Project Convergence. The central challenge here is not the development of autonomous behaviors necessary for maneuver nor is it the speed at which we build the next increment of robotic evolution. It is the prohibitive cost, in billions, it would likely take to manufacture hundreds of these prototype platforms necessary to maneuver and test that at scale, especially if the entire group of gadgets were to fail. There must be another way; another tool we can use to work alongside and augment the ongoing more affordable platform and small unit level autonomy tests.

The Solution: Adding Dedicated Digital Engineering and Synthetic Prototyping as an Augmentation to Physical Testing

The Army needs a dedicated digital engineering entity to augment the current state of experimentation for the various Project Convergence efforts. This ‘Digital Battle Lab’ would be singularly focused on the integration and testing of various Project Convergence components. While there are a number of Battle Labs at the various Army Centers of Excellence performing testing and modeling and simulation teams at various S&T entities that explore some synthetic prototyping and modeling, there does not seem to be one entity that does it all in a way useful to this period of accelerated transformation. There needs to be an effort to centralize a lab somewhere with multiple model based systems engineering tools and simulation and wargaming tools combined together. Such a lab, if it existed, would be invaluable to testing the combat formations of 2040, at scale, in a way that could answer the value added proposition of why these technologies

must be developed. Such a lab would possess the following attributes capabilities:

- Combined access to engineering test and simulation programs such as MACE, AFSIM, VBS4, CAMEO and the high speed processing computer hardware necessary to run it all
- The ability to model/replicate legacy and proposed future force combat units in digital combat testing scenarios, with all Warfighting Functions and domains depicted
- The ability to depict these vignettes graphically, in video useful for briefings and concept marketing
- The ability to exercise Model Based Systems Engineering (MBSE) in the repeatable exercises necessary to capture hundreds of thousands of hours of use case data and outcomes sufficient as to be able to show the value added differences between Legacy Forces and new Convergent Forces
- The ability to run Soldier innovation workshops and digital combat simulations at the same location as the MBSE work to permit real time refinement of digital engineering products that better reflect the user community's needs.

Should the Army establish such a lab, and charter it with the task of testing the various permutations of Project Convergence concepts, it may assist the various divergent robotics S&T projects to focus on one unified vision. It is this unity of command/unity of effort the Army needs at this moment. Such a digital lab, directed with the mission to test all of the Army's prioritized capabilities synthetically, might also help the Army answer critical questions about its vision for innovation sooner and save itself both considerable time and money while small scale physical testing and development continues.