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Army Experimentation Strategy: The Network Integration Evaluation and Rapid Acquisition

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The Network Integration Evaluation (NIE) is the centerpiece of current Army efforts for innovation in network capabilities and rapid acquisition processes, but it has been criticized for cost-effectiveness. This study questions the role of the NIE in Army experimentation and its relevance in rapid acquisition. It assesses the strategic context for military experimentation in general and the NIE specifically. It then examines the range of current military experimentation in policy and doctrine, and explores the concepts of divergent and convergent experimentation activities. Alternative rapid acquisition processes are defined and compared to the NIE's Agile Process. The NIE is then assessed in the context of the range of experimental concepts and rapid acquisition processes to determine what roles it is performing and the extent to which those roles are effective. The study concludes with recommendations for revision of Army experimentation strategy and strategic communication about the NIE itself.

Army Experimentation Strategy: The Network Integration Evaluation and Rapid Acquisition

A dramatic revision in the way the Army develops and delivers new capabilities is under way in the desert at Fort Bliss, Texas. The Army's Network Integration Evaluation (NIE), the largest set of live military experiments in a decade, takes place twice each year to evaluate a range of technologies to drive development of Army capabilities for the future. In the Army's view, it is delivering significant cost savings while developing an adaptive and agile process to deliver warfighting capability.[1] At the same time, the effort is coming under significant scrutiny from Congress, the Government Accountability Office (GAO), and others in the Department of Defense (DoD).[2] From the GAO's viewpoint, the NIE has cost the Army almost $800 million and delivered only one capability: a tactical router.[3] The GAO thus criticizes the NIE for inefficient delivery of capability in an environment where defense budgets are under severe pressure. Which assessment is correct? The reality is that the criticism may be accurate, but it is strategically off the mark. The NIE has strategic value for warfighting experimentation, but an over-focus on its use as an acquisition activity is distracting from its overall potential for advancing Army capabilities.

Defense leadership should ask four broad strategic questions regarding the concept of the NIE: Where does the NIE fit in the current overall Army capability development strategy? Is that role the correct one? How does the NIE's purpose mesh with the advertised expectation of a dramatic revision in the acquisition process? Finally, is the NIE structured to deliver on the Army's strategic expectations? This study will assess Army experimentation, its relationship to the elements of evaluation and acquisition, the NIE itself, and concepts of rapid acquisition to answer those questions.

The evidence demonstrates that the Army has created its own strategic quandary through the difference between the focus of strategic communication and actual NIE activities. Over-emphasis on what will be shown to be a convergent activity--rapid acquisition--is distracting from the great strategic value that the NIE can deliver--divergent experimentation that offers the potential for great innovation in the way the U.S. fights.

Answering questions about the strategic role of the NIE begins with assessing the strategic context for military experimentation in general and the NIE specifically. This requires examination of the range of current military experimentation in policy and doctrine, and exploration of the concepts of divergent and convergent experimentation activities. Rapid acquisition processes will be examined and compared to the NIE's Agile Process. The NIE will then be assessed against the range of experimental concepts and rapid acquisition processes to assess its effectiveness and answer the key strategic questions. Those answers will result in recommendations for revision of Army experimentation strategy and strategic communication about the NIE itself.

Experimentation in Context

Since the end of World War II (WWII), the U.S. military has maintained a significant technological advantage over potential enemies.[4] However, as Secretary of Defense Hagel recently emphasized, "Development and proliferation of more advanced military technologies by other nations . . . means that we are entering an era where American dominance . . . can no longer be taken for granted."[5] Maintaining a competitive warfighting advantage requires innovation driven by an experimentation process that takes risks to identify new concepts and technology. As articulated in *Joint Vision 2020*:

> We must foster the innovations necessary to create the joint force of the future . . . with a reasonable tolerance for errors in the experimentation process. . . [A]n experimentation process with a low tolerance for error makes it unlikely that the force will identify and nurture the most relevant and productive aspects of new concepts, capabilities, and technologies.[6]

Fortunately, the Army has a significant and productive history of large-scale warfighting experimentation dating from before WWII. The Louisiana Maneuvers in the 1940s were experiments, in the guise of training exercises, that ultimately served to develop and test the doctrine and organizations that the Army used in WWII, which resulted in the creation of separate armored divisions.[7] Experimentation in the early 1960s with the use of helicopters for mobility ultimately led to the creation of an airmobile division and the concept of helicopter-borne air assault.[8] In the 1990s, the Task Force XXI Advanced Warfighting Experiment developed and tested doctrine, organization, training, and materiel concepts for the digitization of Army forces in the transition to the information age, again combining training and experimentation.[9] In each of these historical cases, the availability of new technology coupled with large-scale experimentation resulted in new doctrine and warfighting organizations as well as clear requirements for new technologies based in operational experience.[10] This must carry forward into the future; as General Odierno recently challenged the force: “We now need to start thinking about what we need to look like 2025. There will be continued pressure on the budget. So what do we need to do in order to ensure that we have the priority to meet the missions of the future?”[11]

Beyond the value of maintaining a warfighting edge by modernizing doctrine, organizations, and equipment, experimentation provides for efficiency. Since the Army cannot build all possible future military forces, it requires some means to assess and evaluate alternatives. Experimentation helps to determine a balance between legacy

capabilities to be sustained versus new capabilities to be acquired, while avoiding focusing on an existing force concept that may ultimately prove to be inadequate.[12] For example, consider the flawed French view in the 1930s that future warfare would repeat the linear defenses of World War I, resulting in the construction of the Maginot Line. Experimentation also helps to avoid potentially expensive false starts, investing in capabilities that appear adequate but ultimately prove ineffectual. For example, early Navy experimentation in the use of aircraft carriers in the 1920s successfully identified the potential of fast carrier task forces, but had the Navy's experimentation not continued, early decisions would have led to a force of carriers too small to be effective.[13] Experimentation can thus help determine not only how to fight and what to fight with, but also how not to fight and what not to develop in a changing environment.

The Army's Network Integration Evaluation began as a focused evaluation and evolved into a much broader range of experiments. Rooted in the Army's interest in net-centric warfare, the NIE resulted from the April 2009 termination of the Future Combat Systems (FCS) program and the need to evaluate the remaining FCS "spin out" programs.[14] Though the "spin outs" were eventually terminated in February 2011,[15] the NIE had already evolved into a broader effort to evaluate a range of network technologies to be packaged as Army brigade capability sets.[16] It has ultimately and perhaps unfairly become identified as a means to quickly adopt commercial capabilities for Army use.[17] Though the NIE and its processes include more than the semi-annual events which receive much of the attention, the NIE events themselves are the largest live experiments within an overall set of Army experiments that includes the Unified

Quest war games, the Air Assault Expeditionary Force experiments, and a range of smaller scale test, evaluation, simulation, and experimentation activities.

The Experimental Continuum

One of the first challenges in assessing the Army's experimentation strategy and the NIE's place in it is the lack of a consistent set of experimental definitions for a continuum of warfighting experiments. The term "experiment" does not exist in current Joint doctrine and is not defined, though the acronym "JE" for "Joint Experimentation" still exists as an undefined reference in Joint Publication 1-02.[18] Nor does the implementation guidance for the current Joint Capabilities Integration and Development System (JCIDS) use the terms "experiment" or "experimentation,"[19] though Joint Experimentation was defined in support of the Requirements Generation System that preceded JCIDS.[20] The prior definition is still useful:

> *Joint experimentation* is defined as the application of scientific experimentation procedures to assess the effectiveness of proposed (hypothesized) joint warfighting concept elements to ascertain if elements of a joint warfighting concept change military effectiveness. . . The Joint Experimentation program examines new warfighting concepts or techniques . . . to shape the concepts, doctrine, and materiel systems requirements for the future joint force.[21]

Army doctrine reflects a similar definitional vacuum. Army Regulation (AR) 71-9, *Warfighting Capabilities Determination*, references experimentation and makes the Training and Doctrine Command (TRADOC) responsible for the conduct of experiments, but does not define or provide scope for what warfighting experiments comprise.[22] This is despite a definition of "warfighting experiments" in AR 73-1, *Test and Evaluation Policy*, which reads:

> Warfighting experiments are conducted . . . to provide data and insights in support of the requirements determination process, the force development process, and the technology transition process. They examine the

> effectiveness and ability to achieve warfighting concepts, the military utility and burden of new or existing technology, and the contribution of new ideas in doctrine, training, leader developments, organizations, and soldier specialties. They are not elements, as such, of the acquisition process.[23]

Unfortunately this very descriptive definition is now obsolete, as it references AR 71-9 for further clarification, and that document has dropped the requisite definitions.

TRADOC partially fills the doctrinal void in TRADOC Regulation (TR) 71-20, *Force Development: Concept Development, Capabilities Determination, and Capabilities Integration* with a discussion of the roles, responsibilities, and campaigns of Army experimentation. The document lacks a concise definition of experimentation like that provided earlier, but does provide a suitable rationale for the conduct of experimentation--"to learn, to mitigate risk for current and future forces, and to deliver the right capabilities to the Soldier"--as well as how experimentation is conducted: "by placing concept and capability development products into a representative environment to discover something unknown, test or validate a hypothesis, or establish/demonstrate some knowledge within a specific context."[24] TR 71-20 goes on to note that Army experimentation focuses on Army initiatives, Unified Quest war games, and senior leader questions in order to "develop solutions and determine which solutions . . . result in the highest level of capability, effectiveness, and efficiency."[25] It also specifically "enables us to recommend mature capabilities for evaluation in the NIE."[26] Note that these explanations focus more on selecting specific tools of warfighting, and less on a broader range of warfighting alternatives, unlike the older AR 73-1 definition.

TR 71-20 fails to provide an adequate definition of experimentation that accounts for the complete range of experimental activities. Why is this important? First and most importantly, it would enable the concept of experimentation to be expanded to include

tool selection as well as alternative methods of warfare (a concept which will be expanded upon in the next section). Second, a complete definition would provide linkage to Joint efforts and place Army experimentation in a Joint strategic framework. Finally, an adequate definition would provide linkage to the range of activities that support experimentation that exist as acquisition processes in order to establish a continuum of experimentation. The TR 21-20 explanation is inadequate to fully support innovation.

The Defense Acquisition System (DAS) has several processes that support warfighting capabilities determination and that can be seen as specific elements of a broader set of experimentation tools. These processes include operational assessments, demonstrations, and test and evaluation (T&E). Operational assessments are:

> An evaluation of operational effectiveness (OE) and operational suitability (OS) . . . on other than production systems . . . [to focus] on significant trends noted in development efforts, programmatic voids, risk areas, adequacy of requirements, and the ability of the program to support adequate Operational Testing (OT).[27]

Demonstrations include:

> All efforts necessary to evaluate integrated technologies in as realistic an operating environment as possible to assess the performance or cost reduction potential of advanced technology . . . and includes [sic] Advanced Technology Demonstrations (ATDs) that help expedite technology transition from the laboratory to operational use.[28]

Finally, T&E is the "process by which a system or components are exercised and results analyzed to provide performance-related information."[29] The three activities are similar, but generally require an increasing investment in time and money as well as data fidelity from operational assessment to demonstration to test. Operational assessments and

demonstrations also typically deal with technology development efforts or assessments of off-the-shelf technology whereas tests are performed on programs of record.[30]

There are also two acquisition processes that are often confused with the three outlined above; market research and source selection. The Defense Acquisition University defines market research as “a process for gathering data on product characteristics . . . plus the analysis of that data to make acquisition decisions.”[31] Source selection is similarly defined as “the process wherein the requirements, facts, recommendations . . . in a competitive procurement of a system/project are examined and the decision made.”[32] Neither is an experimental process, though source selection may use data generated by experiments and market research may provide data to support subsequent experimentation. These two processes are business processes governed by the Federal Acquisition Regulations and as a result are tightly constrained even when they may contain or support elements that look like operational assessment, demonstration, or test.

The three acquisition evaluation processes are typically focused on products for which there is already a warfighting concept or operational requirement against which the product is evaluated. Developing the concept or requirement in the first place requires an experimental process that is broader and precedes the acquisition-specific processes. A complete experimental definition should define a continuum of warfighting experiments that begins at one end with broad experiments designed to identify warfighting concepts and new ways of warfare, continues through experiments that develop and evaluate specific doctrines, organizations, and materiel requirements, and ultimately includes the acquisition activities of operational assessment, demonstration,

and test and evaluation that select specific warfighting products. All of these activities are present in the NIE processes that the Army conducts today, and these activities are aimed at producing innovation in the Army's warfighting concepts and processes.

Innovation via Divergent and Convergent Experimentation

A consistent theme in Army messaging about the NIE has been the concept of change and introducing something new--innovation. According to one Army press release, "the NIE is a new way of doing business--a fundamental change in how we deliver capabilities to our Soldiers."[33] Military history is rife with examples of successful innovation, and equally filled with examples of militaries that resisted innovation.[34] The historical evidence suggests, though, that experimentation is one of the means through which militaries have successfully innovated.[35] As the Army enters a period in which it is not actively engaged in conflict, experimentation provides a means to substitute for a projected future war environment that does not yet exist.[36] This suggests a continuing need for an experimentation strategy that enables and encourages innovation.

Effective, innovative military experimentation produces knowledge that can be applied against a range of future warfighting conditions.[37] An effective experimentation strategy focuses on exploration and discovery in its early phases,[38] and progresses into greater specificity and maturation in later phases.[39] The strategy should be iterative, not sequential, revisiting earlier exploration activities based on more concrete and specific outcomes identified in later experimentation phases.[40] D. Robert Worley proposed a continuum of "upstream" and "downstream" experimentation, where "upstream" activities focus on identifying capability gaps and deficiencies and "downstream" experiments focus on identifying solutions.[41] Worley notes that most military experimentation is focused on "downstream" issues and risks identifying the right

solutions to the wrong problems, whereas the “upstream” activities present the best opportunity for dramatic and innovative change.[42]

The model proposed here for Army experimentation strategy has its roots in the processes of creative and critical thinking--the concepts of divergent and convergent problem solving processes--and applies them to Worley’s experimental continuum. Divergent thinking is required for creativity and intended to operate in an open-ended fashion to generate ideas and options that may address a problem.[43] Convergent thinking, on the other hand, is critical, analyzing and comparing ideas and options to find the most effective and appropriate means to solve a problem.[44] Applying those concepts to a continuum of experiments leads to the concepts of divergent and convergent experimentation.

Divergent experiments address Worley’s “upstream” issues, and are intended to identify and explore capability gaps and generate possibilities for new warfighting approaches. They are open-ended, with potentially unknown outcomes. The output of divergent experiments is a range of alternatives. They can spawn other divergent experiments as new alternatives or ideas are identified. In a military context, divergent experiments seek to answer questions such as:

- What are our capability gaps?
- What options might exist to close those gaps?
- What requirements might apply to a military problem?
- Given an emerging technology, what does it enable us to do, and what options does it open for exploration?

Convergent experiments, on the other hand, address Worley's "downstream" issues, and are designed to narrow possibilities from a broader set of options to a smaller set of practical possibilities. They are designed to ultimately arrive at an answer to a specific question. Convergent experiments typically lead to further, more focused convergent experiments with greater levels of detail as options are narrowed to arrive at a final solution. In a military context, convergent experiments seek to answer questions such as:

- Given a range of doctrinal approaches, how should we fight?
- What organization or system best achieves a desired warfighting outcome?
- What technical solution best meets a set of established requirements?

An effective Army experimentation strategy must contain both divergent and convergent experiments. Convergent experiments ultimately support the selection of specific, employable warfighting concepts or capability. However, without divergent experimentation to develop options from which to converge, the Army runs the risk of not having explored the entire available problem space. It may find the solution to a particular problem--but have solved the wrong problem. Divergent and convergent experimentation must also be linked in an iterative process rather than being conducted sequentially. Outcomes from convergent experiments--the selection of a specific piece of hardware to perform a specific warfighting task, for example – can generate new and unforeseen options when fed back into a divergent experiment, asking the question "what new options does this solution now provide?" Both types of experiments must also leave open the possibility of failure, identifying when a particular approach is not

viable and causing a return to an earlier stage of experimentation and a re-evaluation of assumptions.

Evaluating experimental activities using the concepts of divergent and convergent experimentation makes it clear that there are a number of established means of convergent experimentation. Operational assessment, test and evaluation, and source selection are all highly convergent activities, focused on the question “does this system perform its required task?” or “among several options, which best meets the operational requirement?” Demonstration bridges a gap between divergent and convergent activities as it can include exploring the ideas of “what does this new system allow the force to do?” Truly divergent experimental activities are less well defined, though they do exist. Market research is one divergent activity, designed specifically to generate options and alternatives. Many current war games and exercises from Unified Quest to the NIE to the Air Assault Expeditionary Force Experiment have divergent elements as well,[45] though there are not precise definitional terms for these experiments to clearly delineate them from convergent activities. Army experimentation strategy only lacks the precise definitions and linking frameworks needed to establish a more formal experimental system.

Network Integration Evaluation Experimental Structure

The Army’s Network Integration Evaluation can be looked at broadly as two sets of activities: the semi-annual exercises themselves, and the set of processes that coordinate and integrate various stakeholder activities in order to plan and execute the exercises. Both sets of activities have experimental elements, though the exercise portion is typically viewed as the primary experiment.

Labeled an evaluation--defined in one Army Capabilities Integration Center article as “connect[ing] Soldiers to mature network capabilities in order to determine whether they perform as needed, conform to the network architecture, and are interoperable with existing systems”[46]--the NIE exercise portion is advertised primarily as a series of convergent activities. The centerpiece of the NIE’s field experimentation is a series of evaluations of “systems under test,” which are programs of record conducting formal T&E activities, and “systems under evaluation,” which are industry-submitted alternatives undergoing operational assessment.[47] These efforts focus on narrowing options and identifying potential solutions by evaluating the performance of equipment against interoperability, operational suitability, and utility requirements.

The NIE also contains divergent experimental work. The Army is making a deliberate effort to expand the NIE beyond the evaluation of specific hardware and examine how different systems interact and influence how units operate.[48] This type of activity, which seeks to determine what new tasks network capabilities enable units to perform, asks what level of performance might be sufficient, and assesses options for materiel requirements, is a highly divergent experimental activity. The processes which underlie the NIE--linking industry, units, materiel developers, and the Army test community to find ways to learn from process revisions in how the Army assesses, acquires, and integrates equipment[49]--are also divergent activities by their open-ended nature.

The result is that the NIE does not fit neatly into any one category. It has a structure that contains both divergent and convergent experimental activities, which have the potential to both complement and compete with one another. This creates the

potential for a mismatch between strategic expectations and outcomes, particularly when Army strategic communications regarding the purpose and outcomes of the NIE come into play. This strategic disconnect is evident because of Army messaging that is focused primarily on the rapid acquisition element of the NIE.

Rapid Acquisition Processes

From a majority of Army press releases[50] to the *Army Equipment Modernization Plan*,[51] achieving rapid acquisition through the NIE is a common theme. Communication about the NIE has focused on a goal of achieving rapid and agile acquisition processes to, in the Army's words, "keep pace with industry and technological advances and accelerate the pace of network modernization to a rate unachievable by traditional acquisition strategies."[52] Before assessing these claims and their link to experimentation strategy, a brief assessment of what constitutes rapid acquisition is required.

Deliberate acquisition is governed by the DAS and is the process for translating capability requirements into materiel solutions.[53] DAS operates in concert with the JCIDS process and the Planning, Programming, Budgeting, and Execution System in order to develop capabilities. Though widely criticized for being long, bureaucratic, and expensive, DAS nevertheless provides a generic set of guidelines for the development and acquisition of virtually any type of military capability, from a brand new technology to a system modification or a commercial-off-the-shelf capability. DAS uses a set of milestone decisions to define phases of a development program in which each phase progressively matures and evaluates the proposed materiel solution (see Figure 1).

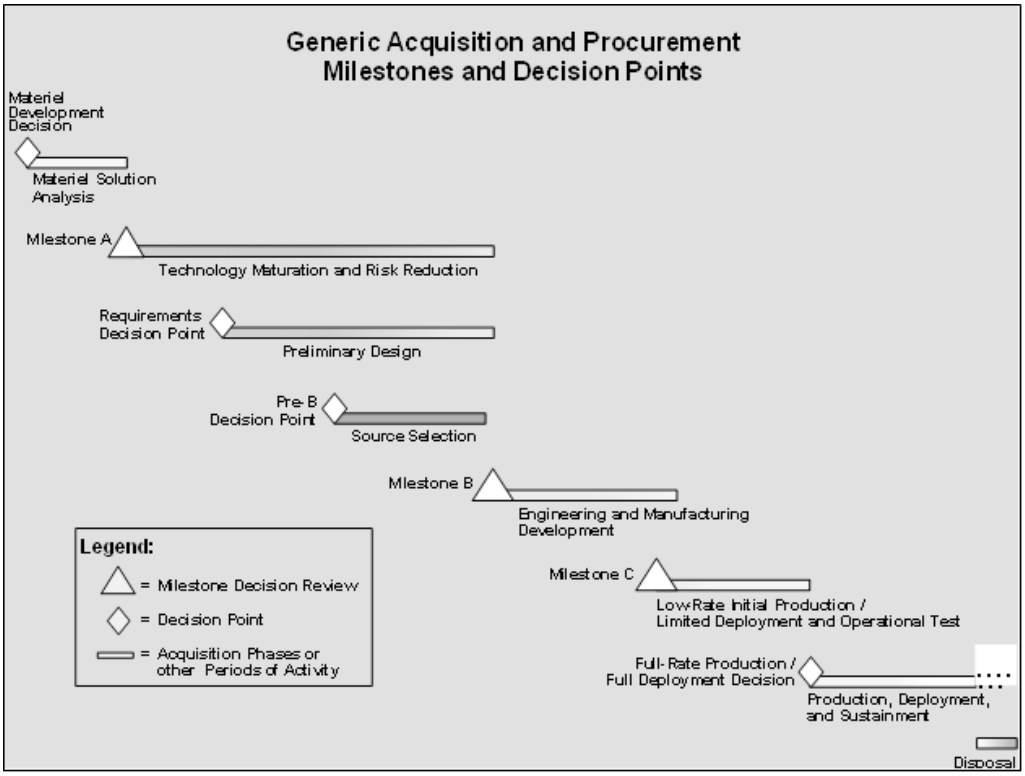

Figure 1. Generic Program under the Defense Acquisition System[54]

Rapid acquisition processes were developed to meet urgent warfighter needs and bypass the perceived inefficiency of the DAS. The Joint Staff defines Rapid Acquisition as:

> a streamlined and tightly integrated iterative approach, acting upon validated urgent or emergent capability requirements to: conduct analysis and evaluate alternatives and identify preferred solutions; develop and approve acquisition documents; . . . and rapidly produce and deliver desired capabilities.[55]

Many different forms of rapid acquisition processes already exist within the Department of Defense with a great deal of overlap between them.[56] These range from rapid equipping processes designed to expedite the fielding of off-the shelf technologies such as those used by the Army's Rapid Equipping Force; to means to accelerate entry into DAS like the Defense Acquisition Challenge Program;[57] to defense authority for Quick Reaction Special Projects;[58] to the (now unused) Warfighter Rapid Acquisition

Program.[59] Even the DAS now contains an accelerated acquisition process model (Figure 2) in its governing Department of Defense Regulation 5000.02.

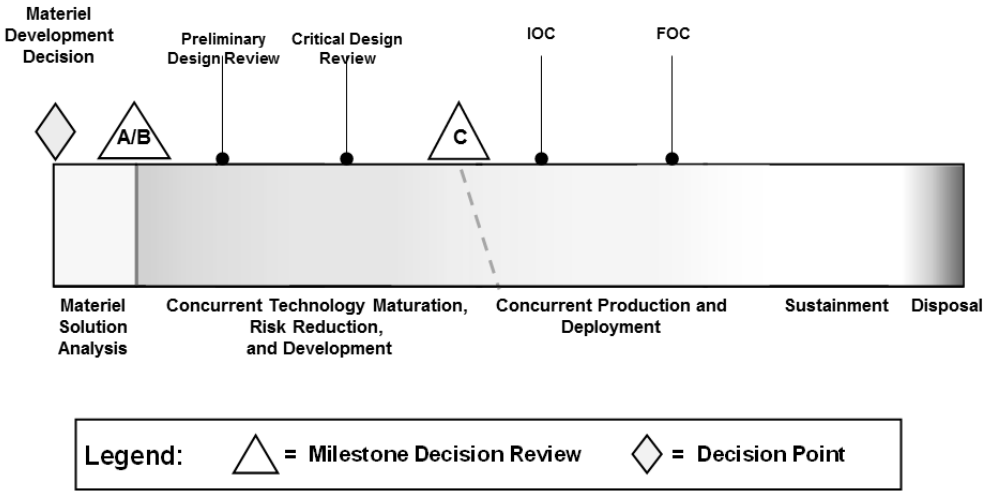

Figure 2. DAS Accelerated Acquisition Program.[60]

The large number of existing rapid acquisition efforts suggests there may be common elements which support rapid execution. A GAO study of rapid acquisition identified common themes in successful rapid acquisition efforts which included: use of off-the-shelf technology;[61] quick decision and funding processes;[62] providing early access to funds; having high levels of support; enabling close communication with the warfighter;[63] and having close cooperative relationships with the test and logistics communities.[64] Most of these efforts did not use competitive procurement due to the use of the compelling urgency exception for sole-source contracting, and thus did not undergo a competitive source selection process.[65] These projects all accepted some form of risk tradeoff--typically in cost, level of oversight, operational performance, or logistical support--in order to achieve speed of execution.[66]

The Army has developed a new rapid acquisition process, called the Agile Process, intended to procure and integrate systems to meet operational needs that

result from operational assessment at the NIE.[67] This process, as diagrammed at Figure 3, is advertised as the centerpiece of the NIE that will enable rapid deployment of technology.[68]

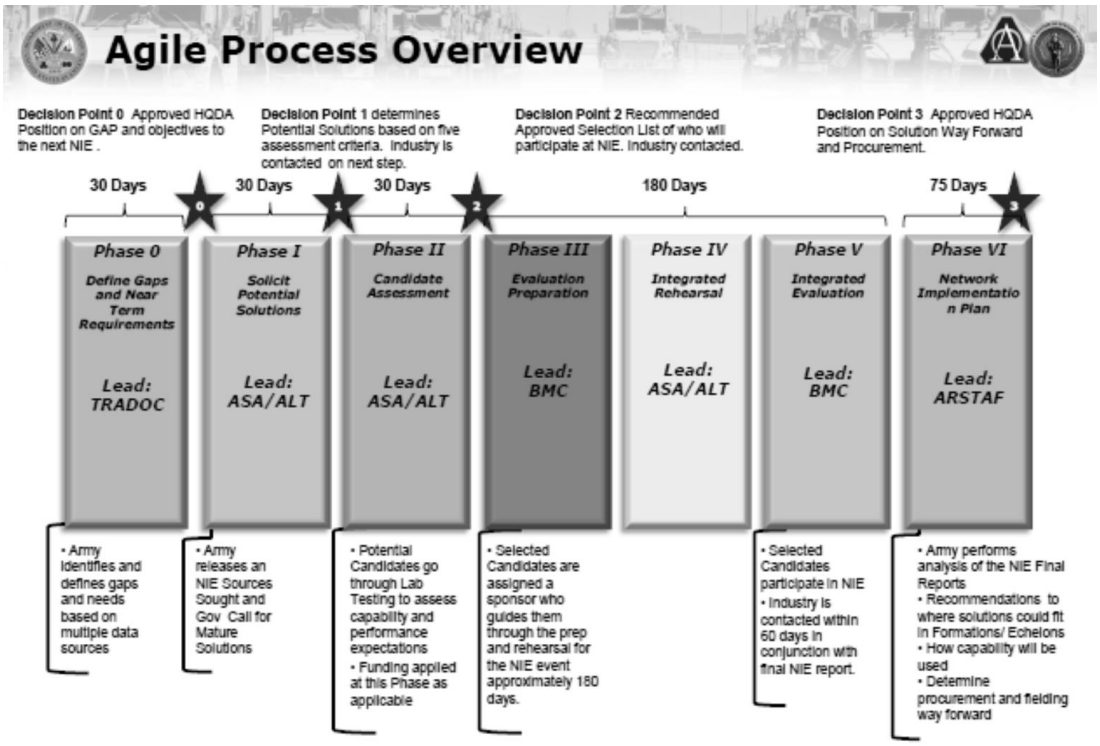

Figure 3. Army Agile Process[69]

Setting aside other rapid acquisition alternatives for the moment and comparing the Agile Process to the DoD 5000.02-based processes reveals striking similarities. The Agile Process and the deliberate acquisition processes use similar maturation phases, albeit with different names and timing. Since the NIE enjoys many of the benefits common to successful rapid acquisition systems--a focus on demonstrated off-the-shelf technology, high level support, dedicated funding, flexible contracting, high levels of end-user involvement, and close test community integration--the Agile Process appears to be structured to be a highly successful rapid acquisition activity, within certain limits. The strategic question is should the Agile Process be the NIE focus, and if so, what are

the potential limits to success? Answering those questions requires an assessment of NIE execution to date.

Assessing the Network Integration Evaluation

Assessing the NIE as a whole is difficult because it is a complex activity whose objectives and focus have shifted over time, and not all of the NIE activities lend themselves well to traditional methods of evaluation. The NIE exercise consists of many sub-elements and a series of processes, not all of which function equally well or necessarily work well together. Nevertheless the functions of the NIE can be assessed individually to identify the elements of greatest value to Army innovation and experimentation. The NIE was initiated specifically as a test event for FCS spin out systems, and testing program of record network systems in an integrated fashion as capability sets remains one of its primary functions.[70] It serves as a mechanism for evaluation and assessment of commercial systems, and a means of assessing the potential for integration of new network components in a representative environment.[71] The NIE has used the Agile Process to rapidly procure and integrate new network capabilities.[72] The Army credits it with reducing costs and refining business practices,[73] and with gaining Soldier feedback on equipment and refine tactics, techniques, and procedures (TTPs) for network capabilities.[74] Finally, the NIE is also a means of linking Army network stakeholders to aid in requirements definition for an Army network architecture baseline that will help define network capabilities for the future.[75] Each of these activities will be explored in turn.

NIE test efforts are the most successful elements to date. The test outcomes from the initial NIE events resulted in the termination of the FCS “spin-out” programs and of the related Enhanced Infantry Brigade Combat Team (EIBCT) programs.[76] The

Army evaluated nineteen “systems under test” (SUT) at the NIE, and according to the Director, Operational Test & Evaluation (DOTE) the NIE integrated test events are sound test designs that reduce overall test cost by combining events.[77] The DOTE criticized the Army for not fixing problems uncovered in testing, and for fielding capability sets despite poor performance at the NIE.[78] Those criticisms are more appropriately directed at the decision processes associated with those programs of record rather than the NIE test process. A more valid criticism of NIE test events is that other NIE activities such as the evaluation of “systems under evaluation” (SUE) have little to do with the outcomes of formal test events, and thus detract from efficient conduct of tests. The NIE could be more streamlined and efficient were it solely a test event, neglecting efficiencies gained from having one evaluation unit conduct both SUE and SUT events, but that would sacrifice the value of other NIE activities to Army innovation. Tests are important convergent activities, but are not major contributors to innovation because they occur at the end of the experimental process. A test ultimately confirms or denies if a piece of equipment meets requirements and demonstrates value; it is a validation of innovation but not a driver of it.

Evaluation of industry-developed systems is a more innovative process that may identify solutions for future capability gaps and uncover new means of operation, but results are mixed. Of 123 SUEs evaluated in the first five NIE cycles (though the end of fiscal 2013), 26 were rated “field” – i.e., they had potential for utility as is – while another 29 were rated “field and continue to develop” that showed some partial immediate potential. As an innovation exercise, that represents a roughly 20% return on the evaluations, which represents an excellent return. Yet lacking a plan and process to

acquire those solutions, the Army could not translate that innovation into military capability, and ultimately decided to plan to purchase only three items.[79] This is a flaw potentially addressed by evolution of the Agile Process, but is also a risk to continued innovation. The SUEs come to the Army at relatively low cost, as industry representatives pay for much of their participation through a "challenge-based" acquisition process (estimated at $1M per SUE).[80] If industry does not see a return on their participation in some form, they may not continue to participate. Further, although evaluation is a convergent experimental activity, the SUEs have potentially divergent applications – a new, previously unknown system may open up new warfighting options if the Army can continue to experiment with it. Continuing the Soldier-led Experiment-Refine-Experiment cycle in order to identify new and potentially innovative options via divergent experimentation is one of the great opportunities the NIE presents.

The NIE has included rapid acquisition activities since its inception, but to date the Army has procured only one capability – a tactical router –as an NIE outcome, with three more systems pending decision, all at a cost of $791 million for the first five NIE events.[81] Though this may change with greater use of the Agile Process in FY2014 and beyond NIE cycles, procurement to date does not present a particularly convincing argument for the NIE as a rapid acquisition exercise. If direct acquisition of an Army-wide capability is a measure of success for the NIE, the NIE is likely to be assessed as a failure. Despite the Agile Process' potential as an effective rapid acquisition vehicle, the NIE cannot deliver the defined requirements and funding necessary to buy and field large quantities of equipment.[82] It is probably not the place to conduct final integration of network solutions into other systems, as many of the Army's vehicle platforms are not

prepared to accept network integration and require additional development.[83] Conducting source selection for competitive procurement, which requires well-defined, measureable requirements and procedures, also does not fit particularly well with the other, broader experimental NIE activities. The Army's plan to align new NIE-identified capabilities with existing programs and requirements, effectively leveraging standard acquisition processes to procure solutions identified via the NIE, is a prudent one.[84]

Rapid acquisition via the Agile Process has an important place in the NIE, though, as a means of fostering innovation by procuring smaller quantities of promising technologies to enable continued exploration and experimentation in subsequent NIE events. This "buy less, more often" approach not only provides some immediate return for industry, but allows for iterative, Soldier-involved development. It will not immediately result in a large, Army-wide procurement that transforms the force in a short time, but it does mean that a solution that is adopted Army-wide through this process has been thoroughly evaluated and that fewer high-cost programs will be pursued that result in expensive program terminations.

The Army credits the NIE with significant cost avoidance due to the EIBCT systems that were terminated after testing.[85] While true, this may be misleading – those systems were likely to have been terminated anyway, whether by individual tests or subsequent budget pressures. NIE cost savings and avoidance credit should focus instead on benefits from ongoing NIE activities. Testing efficiencies through combined activities are one significant benefit; with $86 million potential test efficiencies identified to date.[86] Harder to quantify, but probably more important, is the potential for the NIE to prevent the Army from pursuing ineffective programs. Traditional JCIDS-based

acquisition processes begin with approved requirements, but have difficulty in assessing the cost-and operational effectiveness of those requirements before operational testing--at which point if a system proves not to be operationally effective or suitable, a significant investment has been lost. By pursuing divergent experimentation first--experimenting with multiple potential options, and only beginning to converge to a single set of requirements once the most promising capabilities are demonstrated--the NIE helps reduce significant risk up front for program investment.

The NIE cannot bear the weight of the Army's network program risk reduction alone. Already, industry is submitting immature solutions to the NIE for evaluation, and the NIE now conducts a lab-based risk reduction process to increase maturity.[87] While it is prudent not to risk time and money experimenting with very immature systems at the NIE, this is also an area where additional stakeholder partnerships can be leveraged. The technology demonstration process managed by the various Army labs and engineering centers, exists to mature promising technologies. The NIE should not be expected to be both a field experiment and laboratory technology development exercise, though it can assist in identifying capability gaps and requirements on which lab-based technology development can be built.

The NIE is further challenged by its schedule-focused nature. The semi-annual timeline leaves very short periods of time in which to identify, select, integrate, train, and determine how to evaluate solutions. This lack time for preparation and training impacts the performance of systems under evaluation and can skew results.[88] Fielding decisions for capability sets are driven by schedule, resulting in the delivery of under-performing systems.[89] In experimentation, however, knowledge is the main product. Effective

innovation will depend on making knowledge-based decisions. Some network capabilities might be adequately assessed during one experiment, while others might require several iterations to fully explore the new options they provide warfighters. The NIE might serve the Army better through either a single iteration per year--to allow more time for planning, training, and assessment--or by reducing the scope of each exercise to allow more time for repeated and exploratory evaluation, alternating between divergent and convergent activities. The product of the NIE would then be warfighting knowledge and options with its activities and schedule driven by the knowledge gained and options identified rather than by the calendar.

Potentially the most valuable outcomes from the NIE are those most difficult to quantify in a pure cost-benefit evaluation: the value of adequate requirements, TTPs, and the Army's network architecture baseline. These are the most divergent experimental elements in the NIE. In order to arrive at solutions a number of potential options must be first developed, explored, and evaluated. Broad experimentation around the question of "what does this network technology enable us to do?" must precede the determination of requirements which answer the question "what characteristics of systems are needed to enable the way we want to fight?" Converging on a specific requirement too soon, without experimenting first with a range of alternatives, runs the risk of developing the wrong requirement. Even clearly defined and supported requirements can lead to ineffective solutions if they are not accompanied by adequate and appropriate TTPs. Developing requirements and TTPs together increases the likelihood that the requirements are correct, executable, and operationally meaningful. The network architecture baseline is the most critical

requirement, and developing it requires an iterative process. If the network baseline requirements are not stable, there is no means to accurately measure overall network performance, and subsequent derivative systems may build the wrong capabilities, just as a house built on an uneven foundation is likely to have tilted floors and an unstable roof.

This assessment suggests that more of the value of the NIE is built from the relationships and processes that the NIE enables than from the semi-annual exercises themselves. Iterative, divergent-convergent experimentation that results in innovation requires close cooperation between the Army's user, technical, acquisition, and test communities. Other rapid acquisition efforts indicate that simultaneous participation from these communities and linkage between them will reduce risk and cost, and increase speed compared to separate requirements development, technology development, and system evaluation. Knowledge and requirements are the NIE's key outputs; integration and iteration are the keys to agility.

Considering the strengths and challenges of the NIE to date, what does this suggest for the answers to the strategic questions about the NIE's place in Army experimentation? First, the Army's own history shows the importance of a continuum of experimentation that includes large scale experiments to identify and develop innovative concepts and methods of warfighting. Though experimental doctrine has lost some of its specificity in recent years, that continuum includes divergent experimentation that generates a range of options, and convergent experimentation that selects specific options and systems to employ. The NIE provides the Army's large scale live experimentation laboratory, and conducts both divergent and convergent activities.

Though its public focus has been on convergent activities of test and evaluation, its greatest value is in developing a range of divergent options which can be evaluated through convergent experimentation, and then iterated to continue to evolve and improve warfighting concepts.

The NIE is capable of performing this role, but in order to do so the Army's strategic focus and communication, which have emphasized rapid acquisition, must be re-oriented in favor of a focus on developing new and innovative concepts, requirements, and TTPs through an integrated, iterative collaboration of all Army stakeholders in capability development. The Agile Process is appropriate and capable of supporting this experimentation, but its execution should focus on procuring the materiel needed to support continuing iterative experimentation. Execution of large scale procurements should result from concepts and requirements demonstrated and refined within the NIE, but ultimately executed by the larger acquisition system. The NIE's focus ultimately should be on defining network architecture and processes that allow those architecture requirements to be refined through multiple experimental iterations.

The basic NIE concepts are sound, but more emphasis is required on knowledge-driven iterations versus schedule-driven iterations, potentially changing the NIE's current schedule. Army strategic communication about the NIE must change, not only to emphasize the innovative nature of the divergent experimentation and collaborative processes that are occurring, but also to de-emphasize rapid acquisition. This will better control expectations from Industry and DoD, and encourage

assessments of the NIE based on options developed and warfighting concepts changed rather than experiment cost and number of new systems purchased.

Alternative Views

This study argues that the NIE is valuable in the overall context of Army experimentation and broader capability development strategy, but that strategic emphasis and focus should be shifted from convergent activities like procurement to more divergent activities experimenting with networked warfighting concepts and other Army capability development processes, while retaining the full divergent-convergent range of efforts under the NIE. There are other significantly different alternatives, ranging from increasing focus on the rapid acquisition activities to ending the NIE efforts entirely. Exploring these alternatives is worth a moment's consideration.

One alternative approach is to reinforce current Army messaging, and put even greater emphasis on the NIE as a rapid acquisition activity. This viewpoint argues that since deliberate acquisition has not proven as flexible and adaptive as needed, resulting in the creation of many alternative rapid acquisition systems, that retaining focus on an alternative system is critical for future capability development. Further, network technologies are developing in the commercial sector much more quickly than other military applications, and new approaches are needed which the NIE has the potential to provide. Finally, open-ended divergent experimentation has the potential to lead nowhere, creating "paralysis by analysis" where ever more options are considered without translating them to actual warfighting capability--the Army should quit experimenting, settle on "good enough" and buy something.

There is certainly merit in this view. Few would argue that the deliberate acquisition system is as flexible or responsive as desired, and it is certainly true that

information technology is continuing to change at an extremely rapid rate. However, there are two strategic risks in over-emphasizing the NIE's ability to transform rapid acquisition: one of structure and one of strategic direction. From a structural standpoint, many of the authorities that enabled wartime rapid acquisition are being eliminated or significantly curtailed. For example, "compelling urgency" that allows bypassing competitive processes will be significantly harder to demonstrate in a post-Afghanistan environment. Neither do the NIE stakeholders have the robustness of funding nor program decision authority required to transition directly into large scale procurement of Army-wide solutions. They could not gain that authority without significant revision of law and policy to allow for pooling of network program requirements, funding, and decisions. Without significant policy revisions, deliberate acquisition efforts will still be required to exploit products identified through the NIE on a large scale.

The greater risk, however, is in strategic direction. If the NIE is focused on acquisition and procurement--the convergent, tactical level activities--where then is the mechanism for determining in what direction those activities should proceed? A broader set of network architecture requirements is not yet defined, and assessment and selection of hardware without that structure risks pursuing effective individual technologies that cannot be effectively combined to increase warfighting capability. Some activity must develop, assess, and exploit broader options enabled by the convergent activities, and the efforts must remain linked to enable iterative learning. The Army's history argues for having some large-scale experimentation that can specifically develop and evaluate new warfighting methods, whether linked to specific hardware

development or not. In the absence of the NIE performing this function, yet another large-scale experimental activity would be required.

The opposite extreme argues that the convergent activities performed by the NIE are not required and should not be performed at all. This view points to the absolute return on investment thus far, and argues that perhaps much more development and refinement of requirements could have occurred for the almost $800 million spent on the first five iterations of NIE if those funds were rolled into individual programs or capability-based assessments. The fact that many of the other Army programs required to host new network systems are unready for integration and will not be ready for some time reinforces this view, or perhaps the view that the NIE activities are occurring too soon and should be delayed until host systems are ready to accept new network architecture.

This view also has strong arguments in its favor, particularly in the significantly budget-constrained environment that the Army is entering. Wartime pressure for new solutions is easing and the Army could choose to slow capability development to reduce cost. Ending large scale experimentation, though, risks a return to the very processes that caused the Army to create the NIE in the first place--individual systems, developed in isolation, that only become integrated when deployed. If one of the lessons of capability development from the last decade of war is the value of integrating development with a high degree of warfighter involvement, then it would be unwise to reject that lesson just as the Army is trying to institutionalize it. Properly focused, the NIE is a laboratory for applying that wartime lesson. The argument here is to refocus

some of the NIE's activities to better enable the development and application of improved processes, not eliminate them entirely.

Conclusions and Recommendations

This study set out to assess the Network Integration Evaluation in the context of the Army experimentation and capability development strategies and determine if the role of the NIE was correct, particularly given the Army's public focus on the rapid acquisition aspects of the evaluation. In reviewing the history of Army experimentation successes, it is clear that experimentation influences the Army's ability to innovate. Effective experimentation is a continuum that consists broadly of two types of experiments, divergent and convergent, which seek first to discover options for warfighting concepts based on available technology (divergent) and then select appropriate technology solutions to achieve warfighting goals (convergent). The NIE links both types of experimentation, and thus plays an important role for the Army in enabling future innovation and selecting new warfighting tools. The two types of experimentation present a strategic challenge in explaining the purpose of NIE, and here the Army has focused on the convergent elements, particularly rapid acquisition.

Though the NIE is capable of delivering effective rapid acquisition through its Agile Process, the acquisition effort is less important to innovation than the divergent experimentation that explores what new tasks network technologies enable Army units to accomplish. Army strategic communications focused on the rapid acquisition elements of NIE neglect the value the NIE brings in building integrated capability development processes, and instead inviting unrealistic expectations from Industry and Congress about what large, rapid procurements the NIE will deliver. This brings intense scrutiny on the cost effectiveness of the NIE based on a purely dollars-spent-to-

systems-procured metric. A more effective focus would be on the requirement and TTP refinement the Army achieves by bringing users, technology developers, industry, and testers together in an operational environment. Realistic, field-proven TTPs and requirements enabling innovative operations will, in the long run, provide for more effective acquisition and be consistent with the Army's legacy of experimentation.

This study provides four closing recommendations to Army leaders regarding the Army's experimentation strategy and the Network Integration Evaluation. First, a continuum of warfighting experimentation should be restored to Army and Joint doctrine. Definitions provided earlier are an adequate starting point, but the experimental continuum should be expanded to include activities that traditionally fall into the realm of acquisition such as technology demonstration, operational assessment, and testing. Second, in building the future Army experimentation strategy, additional emphasis and investment should be placed on divergent experimentation--especially at the NIE. Developing and experimenting with a range of warfighting concepts, and discovering what new capabilities can be derived from emerging technologies, is more likely to develop innovative warfighting capabilities than a focus on selecting specific solutions. Third, for the NIE itself, knowledge-driven experimentation should be the primary focus, both in the field and in supporting development processes. Knowledge is the most important output of the NIE, and network architecture requirements are of greater strategic value than individual technology solutions. Rapid acquisition activities should be a part of the NIE, but be focused on procuring equipment to enable continued experimentation. Force-wide procurement should be passed to other agencies.

Finally, Army strategic communication about the NIE should be revised to focus on how the NIE develops new *ways* of fighting--new processes and concepts--rather than acquiring new *means* of fighting--the specific network components. The Army needs to reduce expectations that the NIE will procure large numbers of new systems, and instead emphasize how it exercises innovative, collaborative, iterative processes that will exploit new network technologies for better warfighting outcomes. With those changes, the NIE will be better positioned to realize a strategy for developing the Army of 2025 envisioned by TRADOC's General Cone: "I think our challenge is to identify the research hypothesis and then to develop a much more flexible way than two major exercises a year in the NIE . . . we really need a vehicle that is much bigger . . . to do the kinds of exercises and experimentation that we will need to do Force 2025."[90]

Endnotes

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