International Journal of Security Studies & Practice

Volume 2 | Issue 1 Article 4

2022

Strategic Analytics for National Defense and International Security

Greg H. Parlier
NC State University, gparlier@knology.net

STRATEGIC ANALYTICS FOR NATIONAL DEFENSE AND INTERNATIONAL SECURITY

Greg H. Parlier, Ph.D.

gparlier@knology.net

Greg is a retired Army colonel. He was a paratroop commander in the 82nd Airborne Division for eight years, air-ground battle staff officer, joint operations planner, and Army strategist. His service included five operational deployments and 12 named operations in over 20 foreign nations. While assistant professor of Operations Research (OR) at West Point he helped create a new Department of Systems Engineering then subsequently served as one of the first associate professors. When he retired he was the Army's senior, most experienced OR officer. He then served at the Institute for Defense Analyses, advised several foreign governments on their defense reform initiatives, and was senior analyst for the multi-national forces command in Iraq. With advanced degrees in engineering, OR, and international security, he is a distinguished graduate of the United States Marine Corps Command and Staff College, a graduate of the Army War College, and a National Defense Fellow at the Massachusetts Institute of Technology.

Acknowledgements

This essay extends and expands upon the presentation of the same title during the *Symposium on National Security and Higher Education* held 6-7 April 2022 on the Dahlonega campus of the University of North Georgia. The author remains especially grateful for the invitation to participate in this unique conference and the opportunity here to further describe and elaborate upon "Strategic Analytics." Special thanks to Keith Antonia, Executive Director of the Institute for Leadership and Strategic Studies, and Billy Wells, Senior Vice President for Leadership and Global Engagement.

Strategic Analytics for National Defense and International Security

The observations and suggestions presented in this Practice and Perspectives essay orient on the future of our Military Operations Research (MOR) profession. Where do we *need* to be going? What *should* we be doing? How can those of us within the profession address, in imaginative and creative ways, the many persisting problems and seemingly intractable national and global security challenges that confront us? Strategic Analytics, the alignment of methods and models with the "ends-ways-means" strategy paradigm, is presented. To fully capitalize on advances in information technologies and rapidly growing big data opportunities, the complementary power of operations research, data sciences, and management innovation will be essential. Functional components and enabling disciplines are described: decision support capabilities, engineering systems, dynamic strategic planning, and "engines for innovation" to accelerate the integration of emerging technologies, encourage both social and technological ingenuity, and guide transformational endeavors.

This essay begins with an overview of the origins, historical role, and contributions of Operations Research to national security. Next, extracts from various independent assessments illuminate the deteriorating state of MOR across the Department of Defense with emphasis upon the U.S. Army experience during the past two decades. Perspectives on the essential contributions of both MOR education and institutional advocacy are also presented. The concept of Strategic

Analytics is then introduced, including a discussion of its purpose and foundational building blocks, followed by a summary of recent applications to persisting defense enterprise dilemmas and, finally, potential contributions to military innovation. We must integrate our intellectual capacities, considerable strategic planning acumen, diverse analytical skills, and bring them all to bear on formidable national and international security challenges of our time.

Historical Role and Contributions of Military Operations Research (MOR)

Early during World War II, a new multi-disciplinary approach to solve complex military problems and encourage innovation was pioneered by the British. "Operational Research" (OR) combined civilian scientific talent with Royal Air Force military staffs, initially to support Fighter Command's urgent preparations for what would become the existential Battle of Britain. OR rapidly gained credibility within the Royal Air Force and quickly spread to support the U.S. Army, both ground and air forces, as well as British and U.S. naval forces.

There is much to learn, including enduring principles, from these early World War II years when OR was conceived to integrate new technology (then recently invented radar) into combat systems, operational command and control for the Royal Air Force, and strategic air defense during the Battle of Britain. The idea for rapid learning using a "system of teams" defined and differentiated Operations Research at its inception. With expertise across a wide range of scientific and engineering disciplines, using empirical evidence from ongoing military operations

in conjunction with creative mathematical models for rapid learning, OR represented a technological advancement unique in the history of military decision-making. Working closely with, trusted by, and responsively advising high-level commanders and government leaders, all while operating under extraordinary pressures, was the hallmark of OR from its very beginning.

Now, 85 years later and following two decades of counter-insurgency conflicts, we are experiencing another transformational challenge on a dangerous geopolitical cusp of history. Successfully integrating emerging technologies into weapon systems, operational concepts, and strategic plans is a central challenge confronting military innovation. Today, as then with the example of radar, we are confronted with comparable challenges to integrate emerging technologies into combat platforms, systems, and strategies: robotics and autonomous systems, artificial intelligence and machine learning, micro-electro-mechanical systems and nanotechnology, hypersonics and directed energy.

At a time when Military Operations Research—both the practice and the community— appears to be at a crossroads, the trajectory of this unique problem solving discipline must be realigned to current and foreseeable challenges. Indeed, ongoing trends and emerging conditions now warrant a comprehensive evaluation of the current state of Military OR. Our defense establishment, in particular the U.S. Army, must learn from its own Operations Research heritage and then fully capitalize on its promise.

The State of Military Operations Research: Recent Study Extracts

During the past 20 years, since the end of the post-Cold War drawdown and transition to the Global War on Terror, numerous Defense Science Board studies have consistently addressed the lack of OR in several areas, among them: intelligence, surveillance, and reconnaissance; stability operations and "human terrain"; urgent needs for operational capability gaps; and cost-effective solutions across the various doctrine, organization, training, materiel, leadership and education, personnel, and facilities domain considerations (Defense Science Board, 2005, 2009a, 2009b). This section provides further extracts from additional reports, arranged chronologically, that describe the erosion of OR capacity from various perspectives and the resulting decline of analytical contributions across the Army over the past two decades.

Operation Iraqi Freedom AAR - 2010

The following extracts are official After Action Review observations from the senior Army OR Analyst who led the Institute for Defense Analyses (IDA) team assigned to Combined Joint Task Force Troy (CJTF-Troy, the Iraq theater counter-Improvised Explosive Device command) during the period 2009-2010:

> Utilization and Application of ORSA discipline within US Forces-Iraq (USF-I): There is no organic ORSA capacity allocated to: USF-I J-1 for manpower and personnel planning; the medical community within the Iraq Theater of Operations (ITO); or to USF-I J-4 for operational logistics,

transportation planning and analyses. The USF-I Science and Technology Acquisition Corps Advisor's office does not incorporate OR. Although CJTF Troy has a chief scientist in J-8, there are no organic ORSA billets anywhere on the Troy joint manning document. . . . although they are (and were) performing important tasks in most cases, ORSAs above division level have not been assigned to locations and elements across the commands and staff in sufficient numbers where they could potentially make a real difference. . . . although ORSAs certainly are physically [assigned] in ITO, the discipline of traditional 'military operations research' has not really been applied - at least certainly not to its full potential where, among other attributes, it brings multi-disciplinary approaches to large-scale, complex (certainly complicated) systems and challenges. . . . OR has not been focused on understanding critical cause-effect relationships and offering solutions for improved operations and decision-making derived from this knowledge. Beyond tactical and operational contributions, OR can also contribute significantly in the strategic realm as well. For example, not only can OR help to quantify and forecast instability risk, but could assist further in recognizing the nature and phase of conflict along the spectrum of operations, and guiding effective and timely responses from COIN to stability operations to foreign internal defense and security assistance. OR

> can indeed contribute much (more) to the attainment of a 'learning organization' which the US Army is self-ascribed to be. (Parlier, 2010).

Decker-Wagner Army Acquisition Review - 2011

The Army's problematic record of developing and fielding weapon systems was the subject of a special review chartered by the Secretary of the Army in 2010. The Army Acquisition Review panel, co-chaired by the Honorable Gilbert F. Decker, former Assistant Secretary of the Army (Acquisition, Logistics, and Technology) and General (retired) Louis C. Wagner, Jr., former Commanding General, Army Materiel Command, submitted their report entitled *Army Strong: Equipped, Trained and Ready, Final Report of the 2010 Army Acquisition Review* in January 2011. The extracts below provide an overview of recommendations explicitly pertaining to Operations Research support to Army Acquisition.

> Reestablish the position of the Deputy Undersecretary of the Army for Operations Research . . . and staff the office with 9 people, including 3 military analysts. . . . The Army will benefit from an independent perspective that provides systems analysis as new programs are advocated. . . . Increase the authorizations and fill of FA 49 [Functional Area 49 operations research and systems] military analysts needed to support Army acquisition. . . . Military analysts provide the basis for program analyses of alternatives (AoA), cost-benefit determinations and system tradeoffs. This keeps acquisition programs on cost and on schedule

> while determining the best value to the Army. There is a need for an increased number of qualified analysts to perform this role in existing and future acquisition programs. (Army Acquisition Review Panel, 2011).

Although all these recommendations were subsequently approved by the Secretary of the Army, in retrospect it is apparent that none were actually implemented.

National Research Council: Special Logistics Study - 2014

In 2013, the Assistant Secretary of the Army (Acquisition, Logistics, and Technology) and Headquarters Department of the Army G-4 requested a special study from the National Academies of Sciences and Engineering Board on Army Science and Technology entitled, *Force Multiplying Technologies for Logistics Support to Military Operations*. The study explored capabilities and technologies for distributed operations to meet sustainment requirements for the Army in 2020 and beyond in support of the Joint Force Commander primarily focused on the Asia-Pacific region. Emphasis was placed upon a wide variety of technologies to reduce drivers for logistics requirements and options to enable support to units operating in a global, complex environment and emerging anti-access and area denial security challenges. Relevant extracts from two chapters focused on the potential applications and contributions of Operations Research are provided below.

> Modeling and simulation resources (personnel and tools) are insufficient to evaluate, compare, and contrast various science and technology initiatives

> and their respective impacts on both the force structure alternatives currently under consideration and operational outcomes across the spectrum of operations. Army modeling, simulation, and analytical capacity for conducting strategic logistics is fragmented and is inadequate to provide the cause-and-effect understanding essential for designing the force of the future. . . . The Army should make an appropriate investment in organizing the Army analytical community to better support the materiel enterprise. Such an investment is a precondition for sustainment excellence. In addition to rebuilding analytical capacity within the materiel enterprise, the committee strongly suggests a more comprehensive assessment of the state of Operations Research across the entire Army. (National Research Council, 2014).

National Defense Strategy Commission - 2018

The National Defense Strategy Commission was created pursuant to the National Defense Authorization Act of 2017, to examine and make recommendations with respect to the national defense strategy of the United States and to assess the broad range of issues confronting the Nation. In January 2018 the Commissioners presented their findings to the President, Secretary of Defense, and both the House and Senate Armed Services Committees. In their Final Report the Commissioners warned

> that making informed decisions about strategic, operational, and force

> development issues requires a foundation of state-of-the-art analytical capabilities. We found that DoD [Department of Defense] struggled to link objectives to operational concepts to capabilities to programs to resources. This deficit in analytical capability, expertise, and processes is intolerable in an organization responsible for such complex, expensive, and important tasks, and it must be remedied. DoD needs a rigorous force development plan that connects its investment strategy to key priorities in order to compete effectively with China and Russia. Repairing DoD's analytical capability is essential to meeting the challenges of the National Defense Strategy and giving Congress confidence that DoD's budget requests reflect its stated priorities. (National Defense Strategy Commission, 2018).

Under Secretary of the Army Recruiting Study - 2019

In late summer 2018, shortly after failure to achieve the Army's annual enlisted recruiting mission became apparent, the Under Secretary of the Army directed an external review of research, studies, and analyses (RSA) programs supporting the Army recruiting enterprise. The final report provided three major perspectives on the role and contributions of RSA to recruiting success for the All-Volunteer Force: historical, operational, and strategic. Extracts relevant to Operations Research are provided below.

> The Army’s abilities to perform, manage, and capitalize on recruiting research, studies and analyses have eroded over the last 15 years to the point

where there is inadequate organic capacity left to responsively support fact-based decision-making across the recruiting enterprise. Modeling and simulation resources are insufficient to generate, evaluate, compare, and contrast various initiatives and their respective impacts on operational outcomes across the recruiting spectrum of operations. . . . Over the past two decades, USAREC [U.S. Army Recruiting Command] PAE (analytical) force structure was initially reorganized into higher HQ [headquarters] staffs, then eliminated due to force reduction measures. With the exception of the "mission" function (retained today by USAREC G2), . . . few residual elements exist today. They are fragmented and preclude unity of effort. A recruiting RSA *program*, an essential core competency supporting USAREC for the past three decades, no longer exists. The Army is not making an appropriate investment in organizing the Army analytical community to adequately support the human capital enterprise, especially recruiting... Since its inception, the history of the All-Volunteer Force clearly reveals both the necessity for recruiting research, studies, and analyses and their demonstrable impact. Such an investment remains a precondition for recruiting excellence. The net effect of accumulating evidence, overwhelming and compelling in its totality, suggests that the US Army may no longer value OR as an important, much less core competency. (Parlier, 2019).

National Research Council: Strategic Long Range Cannon - 2022

The House Armed Services Committee requested this special study in the National Defense Authorization Act for Fiscal Year 2020. An ad hoc committee of the National Academies of Sciences, Engineering, and Medicine was directed to independently examine the feasibility of the U.S. Army's Strategic Long Range Cannon (SLRC) initiative, which aims to fire hypersonic-glide projectiles up to 1,000 miles for precision fires. The study team was directed to place scientific, engineering, and analytical emphasis upon the propellant, projectiles, launch system, and the cannon itself, and to identify and evaluate the technology approaches, acquisition strategy, and concepts of operations of the program.

> Across three levels of integration [weapon system analysis, operational integration, and enterprise systems integration], we observed few indicators of the application of Operations Research (OR)... This diminished role [for OR] also afflicts other Army enterprise systems, and has been observed in several previous technical reports and special studies. In addition to noting the loss of analytical capacity in other Army enterprise domains, we also observe degradation in the use and applications of analytical methods for weapon system analysis, combat modeling, test and evaluation, and the broader land warfare analyses communities supporting the combat and force development functions within the institutional Army. . . . the Army would benefit from organizing the Army analytical community to better

> support the RDT&E [Research, Development, Test, and Evaluation] enterprise. Such an investment is expected to accelerate technology innovation and attain modernization excellence. In addition to rebuilding analytical capacity within the RDT&E enterprise, the committee strongly suggests a more comprehensive assessment of the state of OR across the entire Army . . . The SLRC project illuminates a broader challenge confronting the US military today. Successfully integrating emerging technologies into weapon systems, operational concepts, and strategic plans is the central challenge confronting military innovation. Better understanding this process and accelerating it in non-intrusive ways requires overcoming bureaucratic risk aversion. (National Research Council, 2022).

The State of U.S. Army Operations Research: An Assessment

With respect to OR contributions to broader Army challenges today, the persisting conditions described above are symptomatic of similar, pervasive conditions across an entire Army that continues to suffer from the post-Cold War decline of OR professionals, both federal civil service employees and especially the commissioned officer corps. Although the evidence for this has been irrefutable for over two decades now, there seems to be growing awareness and understanding of the widespread impact of this loss to both the operational and institutional Army. An analytical renaissance is desperately needed, long overdue, and a precondition

for restoring combat overmatch and significant improvement within all major enterprise systems that comprise the US Army.

Furthermore, the U.S. Army has not conducted a thorough, comprehensive assessment of the state of Operations Research in over two decades. The need for a comprehensive, forthright evaluation has become evident, especially given the paucity of existing analytical capacity allocated to various commands and organizations. Without introspection to generate a clear diagnosis, an effective prescription to pursue a cure will remain elusive.

A major precept of any learning organization is an ability to genuinely *learn* lessons from the past and then actually *apply* them, rather than merely observe them. Such a retrospective can reinforce rather than retard innovation by discovering enduring principles that should be resurrected and applied. One possible framework to rigorously assess the current state of operations analyses in military organizations is to apply enduring principles derived from the early experience of Operations Research during World War II, among them: capacity, capability, organization, utilization, and contribution (Parlier, 2015). The Army must learn from its rich Operations Research heritage in order to fully capitalize on its promise now.

Military Operations Research Education

Since the early 1980s, the United States Military Academy at West Point has offered an Operations Research major. But the focus of this undergraduate program has since drifted and no longer consists of the unique curriculum that was

once focused on weapon systems design and analysis, combat modeling, and simulation, war-gaming, and land warfare systems analysis.

The Naval Postgraduate School (NPS) aligns many academic programs to military service professional development requirements, including weapon systems engineering, acquisition, logistics, and Operations Research. In the past, at the Army's request, the NPS Operations Research department developed specific Master of Science in Operations Research tracks tailored to Functional Area 49 areas of concentration including combat modeling, test and evaluation, land warfare analyses, and manpower and personnel. Today, these Army-oriented MOR tracks no longer exist.

Throughout much of the Cold War era and into the early years of the Global War on Terror, the Department of the Army headquarters structure included a Deputy Under Secretary dedicated to Operations Research, a three-star general civilian equivalent. The roles and contributions of the former Deputy Under Secretary of the Army (DUSA) for Operations Research (OR) - were both unique and influential:

- Provided broad Department of the Army-level oversight and guidance for the MOR analytical communities across the U.S. Army.
- Guidance to ensure various education programs, both internal to the Army (e.g., Army Logistics Management College Operations Research/Systems Analysis Continuing Education Program) and graduate-level Advanced

Civil Schooling, met the needs of the Army and its OR communities, both military and civilian service.

- Influenced force structure and manning decisions to ensure OR capacity was sufficient, properly organized and allocated.
- Provided guidance, direction and coordination among Army Science & Technology, Test & Evaluation organizations, acquisition programs, and analysis communities.
- Supervised the OR professional development programs for both commissioned officer (FA49 [Functional Area 49 operations research and systems], Department of the Army Pamphlet 600-3) and civil service (Department of the Army Civilian operations research systems and cost analysts).
- Functioned as both a Chief Scientist and analytical teacher/mentor to the Army's senior military and civilian leaders.

In 2005, the DUSA (OR) office transitioned temporarily to DUSA (Business Transformation) for three years before being completely disbanded. Since then, as studies repeatedly reveal, the Army's enterprise-wide modeling, simulation, and analytical capacities have been depleted and fragmented. They are no longer sufficient to provide the cause-and-effect understanding essential for designing, acquiring, managing, and sustaining the future force.

Restoring Army Operations Research: First Steps

The following recommendations are offered. First, as an initial step toward restoring and rebuilding analytical capacity, a comprehensive assessment of Operations Research across all major defense enterprise systems should be undertaken using an evaluation construct that includes analytical *capacity, capability, utilization, organization*, and *contribution*. Next, appropriate investments must be made toward rebuilding analytical capacity and organizing the defense Operations Research community to better support all of its major enterprise systems that comprise both institutional and warfighting organizations:

- strategic resource planning
- research and acquisition (Research, Development, Test &Evaluation)
- force development (manpower and personnel, training and education)
- force employment (joint operations and land warfare analyses)
- sustainment

In particular, the Army should: re-establish the Deputy Under Secretary of the Army (Operations Research) or comparable position and office within the Army Secretariat; restore and update the Land Warfare Analyses program within the undergraduate OR major at the U.S. Military Academy; and restore the Land Warfare Analyses graduate program in the Operations Research Department at the Naval Postgraduate School for the U.S. Army, along with the tailored MSOR tracks

that align with current FA49 (Functional Area 49 operations research and systems career) Areas of Concentration.

Operations Research and Strategic Analytics

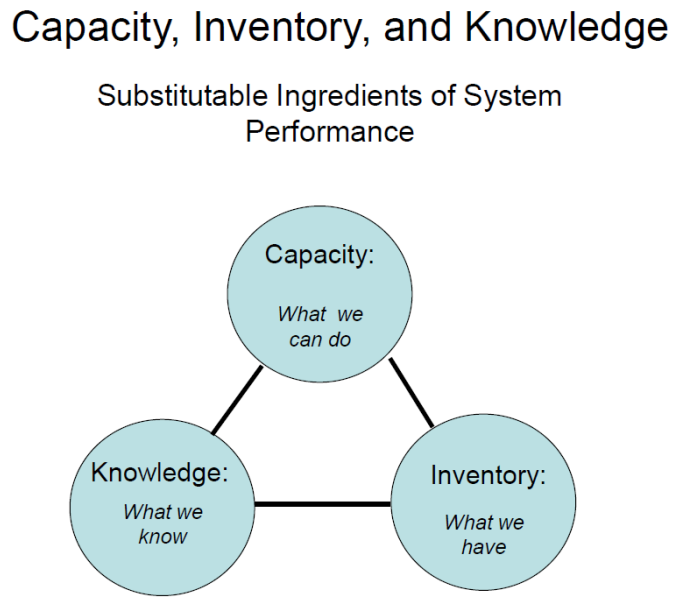
Military organizations, especially successful ones, are renowned for their strong cultures. Yet the long history of military innovation reveals those cultures can also become impediments to organizational adaptation when failure looms. Organizational change has always provoked resistance, especially in large bureaucracies that require conformity. And, of course, our collective human nature tends to procrastinate until crises are upon us. To overcome both bureaucratic inertia and paralysis induced by disruptive chaos, cultures must have sources of innovation they can embrace. Some mechanism, or methodology, is needed to challenge the underlying logic of current practices, and to also demonstrate better ways ahead that will accommodate graceful transitions rather than catastrophic or slow-motion failures. “Strategic Analytics” can provide such an architecture.

Although scientific advancements continue to amaze us, we must better understand how technology, management, and policy interact in our complex socio-technical enterprise systems. Management innovation often lags technology advances, yet is essential to fully capitalize on rapidly growing big data opportunities. This new Strategic Analytics framework aligns the “ends-ways-means” strategy paradigm with corresponding prescriptive, predictive, and descriptive analytics domains, focusing on the ultimate purpose for which an

organization exists. Descriptive analyses segment problems, diagnose structural disorders, and identify enabling remedies and potential "catalysts for innovation" ("means"). Next, a system-wide integrating perspective–synthesis–addresses the attainment of enterprise goals and objectives (desired "ends") using prescriptive analytics. Finally, the design and evaluation phase provides comprehensive roadmaps using predictive analytics to create "analytical architectures" ("ways") to measure progress and guide transformation. Another guiding principle inherent in Strategic Analytics is portrayed in Figure 1. The three quantities shown (inventory, capacity, and knowledge) are substitutes in the following sense: if more of one is available, then less of one or both of the others is necessary for the same level of system performance. This trade-off suggests a fundamental truth: if the amount and timeliness of useful data and good information for actionable decisions improves (i.e., increased knowledge or "what we know"), then with the same capacity ("what we can do") as before, it now becomes possible to improve system performance with fewer resources ("what we have").

Figure 1

Capacity, Inventory, and Knowledge



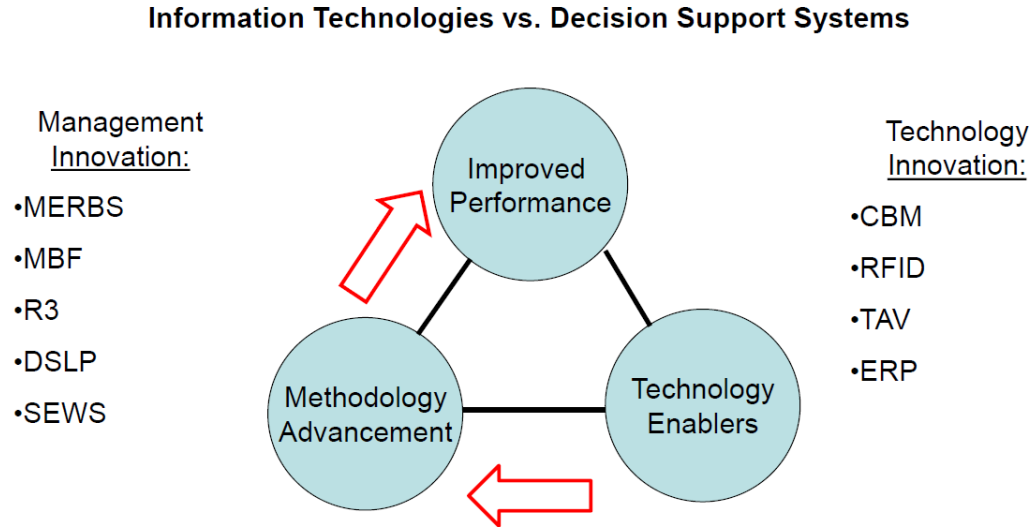
Building Blocks for Strategic Analytics

Among the enabling disciplines, capabilities, and methods for Strategic Analytics are decision support methods, engineering systems, dynamic strategic planning, and "engines for innovation" to enable rapid experimentation, generate insight, climb steep learning curves, and develop strategies around new concepts and technologies. Although so-called "IT solutions" have ubiquitous appeal and enormous investment levels, we need to include analytical architecture for enterprise challenges. Without the integrative power of OR to focus process re-engineering on desired outcomes, this obsession can result in growing complexity, overwhelming the interpretive capacities of organizations. Ultimately, it is

management innovation that will enable better decisions from the growing amounts of information and improved situational awareness made available by advances in information technologies (see Figure 2). The goal should be effective integration of analytics into management policies by incorporating relevant analytical tools (OR) with the appropriate IT. Acknowledging these needs and developing the capacity to address them represent first steps toward Strategic Analytics.

Figure 2

Information Technologies vs. Decision Support Systems



Many of our systems seem fragile and vulnerable, increasingly subject to catastrophic failure due to age and decay, human error, or what is known as "tight-coupling" in complex systems. And, while traditional engineering methods optimize performance based upon design specifications within assumed operating

environments, experience and history reveal that these systems, and how they are used, change over time often in unanticipated ways. This recognition is now leading to new design and management concepts where flexibility across a range of future possibilities, rather than optimizing to a specific assumed environment, is needed to accommodate inevitable change. Thus, a capacity for adaptation must be "built in" to create a resilient system that can adjust as needed.

Just as nanotechnology is increasing our understanding of very small-scale structures, the evolving discipline of Engineering Systems is expanding our macroscopic understanding of very large-scale enterprise systems defined by their technical, managerial, and social complexity. Engineering Systems represents the next epoch of scientific innovation beyond inventions and complex systems. This new and evolving approach represents a new paradigm in systems design by shifting from the traditional focus on fixed specifications, or "requirements", toward the active management of uncertainty in the implementation of socio-technical systems (deWeck, Roos, & Magee, 2011).

Most system design methods generate a precise, "optimized" solution based on a set of very specific conditions, assumptions, and forecasts. However, these methods are rarely valid over longer planning horizons as strategic designs for technological systems. In contrast, Dynamic Strategic Planning (DSP) instead presumes forecasts to be inherently inaccurate and therefore generates flexibility as part of the design process. This method incorporates optimization techniques and

decision analysis methods, and has evolved by adapting "options analysis" from financial engineering to the design process. DSP allows for the optimal policy, which cannot be preordained at the beginning of the undertaking, to reveal itself over time as conditions unfold that, even when anticipated, cannot be predicted with certainty.

Engines for Innovation

How, then, can innovation be better understood and accelerated in a controlled way to minimize the debilitating effects of disruption? An "engine for innovation" (EfI), or virtual test bed, is needed to provide a synthetic, non-intrusive environment for experimentation and evaluation of creative ideas and concepts. This synthetic environment, or micro-world, transforms theoretical knowledge into practical applications by catalyzing innovation often found at the seams between disciplines, technologies, and institutions. Thus, an EfI generates technological and managerial initiatives consistent with the organization's vision, "incubates" and rigorously analyzes them within a non-intrusive test bed, then rapidly transitions into actual practice those selected as most promising. The functional design for an EfI includes three organizational components that comprise core competencies (mission essential tasks) as illuminated in Figure 3:

- An R&D model and supporting framework to function as a generator, magnet, conduit, clearinghouse, and database for "good ideas."

- A modeling, simulation, and analysis component that contains a rigorous analytical capacity to evaluate and assess the improved performance, contributions, and associated costs that promising "good ideas" might have on the enterprise.
- An implementation component to accelerate the transition of promising concepts into existing organizations, agencies, and companies by providing training, education, technical support, risk reduction and mitigation methods during transformational phases.

Feedback loops accommodate better understanding as knowledge is generated, and for subsequent model refinement and calibration. These three components do the following:

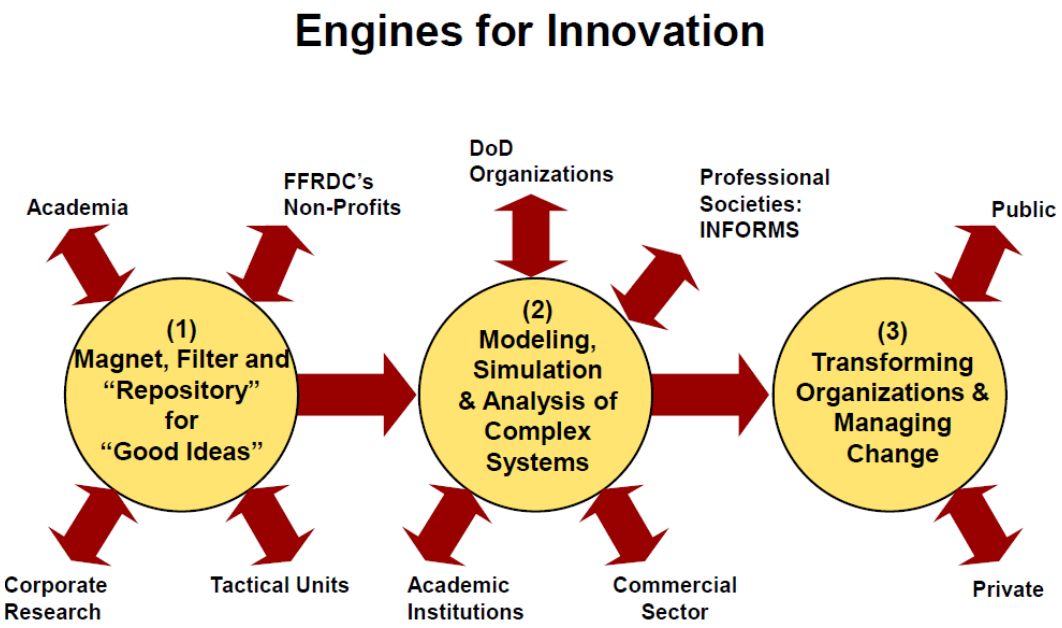
- Encourage and capture a wide variety of "inventions."
- "Incubate" those great ideas and concepts within virtual organizations to test, evaluate, refine, and assess their potential costs, system effects, and contributions in a nonintrusive manner.
- Rapidly transition those most promising into actual commercial or governmental practice.

An EfI can help guide project planning and execution by providing a "crawl-walk-run" sequence from engineering analysis, then to analytical demonstrations, then to field testing with appropriate feedback loops to accommodate better understanding as knowledge is generated, and for subsequent

model refinement and calibration. The purpose of this deliberative, cyclical discovery process is to sustain continuous improvement through experimentation, prototyping, field testing, and rigorous analysis.

Figure 3

Engines for Innovation



Applications and Attributes of Strategic Analytics

In recent years, the application of Strategic Analytics to several Army enterprise challenges has shown these "engines for innovation" can be a valuable organizational mechanism for successfully pursuing transformational strategies. Central to these endeavors was the extensive application of Operations Research, data sciences, and management innovation for improved performance. Although

their fundamental natures were vastly different–defense resource planning, sustaining our All-Volunteer Force, and materiel supply chain transformation–they all required an ability to organize, manage, lead, and develop highly talented multi-disciplinary teams (Parlier, 2020). These concepts and methods for Strategic Analytics should now be extended and applied more broadly across many other national security challenges as well.

At its inception 85 years ago, Operations Research was unique in its multi-disciplinary origins which combined both inductive and deductive reasoning. More recently, the convergence of systems thinking, ubiquitous data, and computational advances has made OR an enabling technology for a wide variety of applications. To date, these particular applications of Strategic Analytics not only fully capitalize on the integrative features of OR but also reveal structural similarities, common attributes and characteristics, among these vastly different enterprise challenges. Consequently, they provide a solid foundation for a general theory and framework for Strategic Analytics as a methodology for the design, analysis, and management of socio-technical enterprise systems where improved performance and ultimate success require an understanding of both technical innovation and human behavior; technological and *social* ingenuity. The remainder of this section describes a few of these attributes: resilient designs, early warning for enterprise systems, social ingenuity for innovation, 'ends' vs. 'ways', and 'systems of *teams'*.

Dynamic Strategic Planning enables resilient designs by building flexibility into the project to enable adaptability to changing circumstances that inevitably prevail. This flexibility accommodates inevitable change over time by adapting to a range of future possibilities. This built-in flexibility creates additional value for the system, which in many cases can be quantified. This "optimal" solution will inevitably change over time due to an inability to perfectly forecast future conditions or the consequences of past decisions–often irrevocable–that do not always reveal the results expected. And, no doubt, opportunities provided by adaptation and modification will materialize that require new decisions. This capacity for adaptation enables a resilient enterprise that can adjust gracefully as needed rather than suffer slow-motion or catastrophic failure.

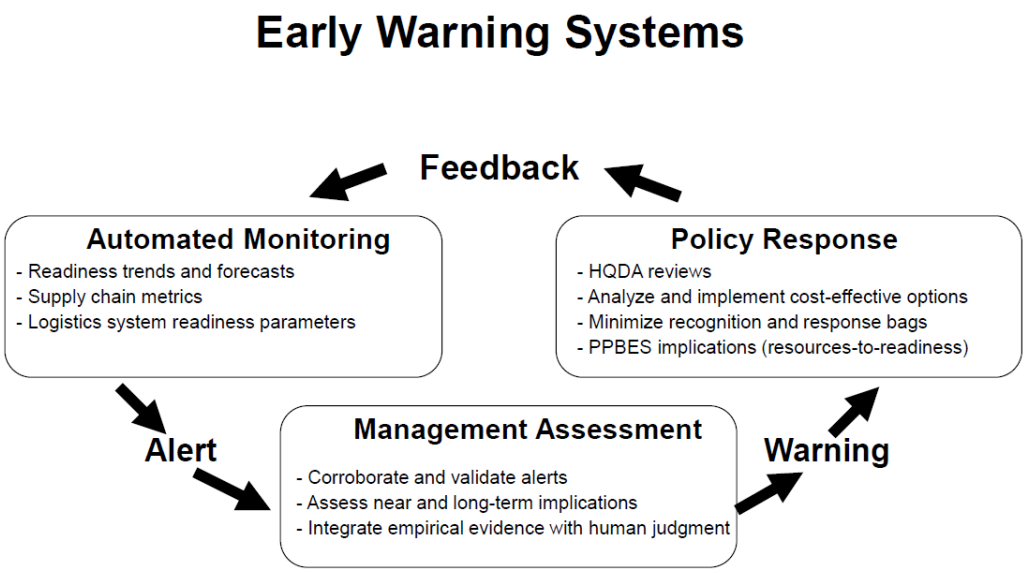
In practical application to the Army's materiel sustainment enterprise, Dynamic Strategic *Logistics* Planning (DSLP) generates an efficient, increasingly effective, yet resilient global military supply chain network. By applying *resilient* design principles, a supply chain operating a large-scale (global), demand-driven ("pull") system under stable and predictable demand can quickly adapt to support localized requirements (e.g., overseas deployment scenario) that may involve considerable uncertainty. From a global enterprise perspective, these resilient concepts emphasize "building in" flexibility. Taking, as input, both the empirical evidence of ongoing operations (real-world results) and new contributions derived from experimental results and operational testing, DSLP then guides enterprise

transformation toward strategic supply chain goals for effectiveness, efficiency, and resilience.

"Early Warning", another attribute of Strategic Analytics, provides an ability to anticipate, recognize, understand, and then pre-empt future enterprise system degradation through proactive, preventive management actions. Today, the Internet of Things (IoT) offers another disruptive opportunity for OR to integrate new technologies into enterprise systems. Defined as networks of devices, objects, and people, IoT reflects the convergence of multiple technologies, including real time analytics, machine learning, sensors, embedded systems including wireless networks, micro-control systems, and automation. The next wave of the IT revolution is integrating human with machine intelligence by connecting digital and physical worlds to improve performance through greater automation and sensor-based analytics. IoT is also enabling a variety of prognostic early warning systems which capitalize on predictive analytics to anticipate change, then pre-empt system degradation or failure through proactive management interventions in large-scale enterprise systems (see Figure 4). Two such Strategic Analytics applications for defense enterprise systems are "connecting" Condition-Based Maintenance (CBM+) to military supply chains for a Sustainment Early Warning System, and the Enlisted Early Warning System to support the Army recruiting enterprise for the All-Volunteer Force.

Figure 4

Internet of Things Enabled Early Warning Systems



While institutional adaptation requires a culture of innovation, inertia remains a powerful force within bureaucratic organizations. And the pace of technological change is not always compatible with organizational capacity to accommodate change since social stability and cohesion depends more on relationships and habits than on efficient arrangements or policies. Furthermore, our collective human nature tends to procrastinate, postponing necessary changes–especially if they require sacrifice–until crises are upon us. To overcome both bureaucratic inertia and paralysis induced by disruptive chaos, cultures must have sources of innovation they can embrace. Innovation engines (EfIs) accelerate the experimentation process while also minimizing the debilitating effects of disruption.

They provide sources for socio-technical innovation to expand organizational capacity for *social ingenuity*. They illuminate likely impacts, quantify cost-effectiveness of alternatives, then guide and accelerate transformative change along cost-effective paths integrating and focusing what otherwise would be disparate initiatives and fragmented research efforts. EfIs identify implementation issues *before* they are adopted as policy and institutionalized across the enterprise. They accelerate organizational learning while encouraging both technological and social ingenuity as foundations upon which American innovation and national power can be generated and sustained in the future. Of course, "connecting the dots" among key bureaucratic elements is as essential as it is painstaking. These "dots" include senior policy officials responsible for regulatory guidance, program directors who control funding, test and evaluation agencies that rigorously assess plausible alternatives, and of course operators who "own" the problem but are constrained by insufficient authority and in- adequate resources to pursue better options. They all must be "connected" and synchronized to effect innovation.

Another recurring observation from applying Strategic Analytics to several enterprise challenges is that confusion between "ends" (goals to be achieved) and "ways" (how they are achieved) can be uncovered and resolved. One particularly striking example of this confusion, and its persistence, is exemplified by our current military manpower system–the All-Volunteer Force (AVF). In 2018, for the fifth time in five decades, the Army substantially failed its enlisted recruiting mission.

Now, in 2022, Army recruiting again appears to be on the precipice of "imminent catastrophic failure," imposing a strategic constraint on the use of American power. We must recognize the AVF, in its current form, has become unsustainable. While our national military manpower system should align with the requirements of defense strategy and our foreign policy objectives, the current AVF is but one of several military manpower systems ("ways") that can be considered to reconcile means with ends. Since the end of World War II, the United States has actually implemented or seriously considered at least five different military recruitment systems. By broadening our perspective to also include domestic challenges to national security, we could improve social cohesion and better develop human capital to provide for the common defense and *ensure domestic tranquility* for ourselves *and our posterity*.

The current market-oriented, "rational choice" recruitment system views military service as an occupation requiring that government pay the market rate for military personnel. But this market rate fluctuates subject to economic conditions, creating a regrettable countercyclical pattern during the past five decades where the health of the AVF is inversely proportional to the health of the U.S. economy. This has been a persistent impediment to sustaining the AVF, and has periodically created worrisome strategy-manpower mismatches. For example, the U.S. originally adopted the current AVF in 1973 due to domestic conditions during the 1960s that led to fulfilling a presidential campaign promise, rather than manpower

levels derived from defense strategy. Soon after, during the recruiting crisis in the late 1970s, a "hollow force" developed and later, during both the Persian Gulf War and the early years of the Global War on Terror, a "back-door draft" was invoked. Indeed, in the late 1990s, recruiting failure became a binding strategic constraint on the use of American power.

Ideally, whatever military manpower system is selected should constitute both a cultural as well as economic institution in our society. By linking civic virtue to national purpose, cultural cohesion within generations can be improved and bonds of mutual loyalty across generations can be strengthened. It is now an open question whether the AVF can again be sufficiently re-engineered to meet current constraints and endure for perhaps another decade, or whether an alternative system will better serve our Nation. Importantly, it is *not* the existing recruitment system we should venerate, especially if it has been prone to failure and is now failing again. Strategic Analytics can be used to illuminate a better "way" ahead for military recruiting–perhaps uniquely American.

A final, recurring attribute is the remarkable similarities between the emerging "collaborative enterprise" and the original purpose and organizational forms that created OR during the early years of World War II. As noted in the beginning of this essay, the idea for implementing a "system of *teams*" with expertise across multiple scientific and military disciplines represented a unique advancement in military decision-making. Using empirical evidence from ongoing

military operations in conjunction with mathematical and statistical models for rapid learning, these early "combat scientists" earned the trust of high-level commanders and government leaders by responsively advising them while operating under extraordinary pressures. We can learn from–we *must* fully capitalize on–the promise of our own heritage.

There is another, broader historical perspective as well. To the extent that Strategic Analytics is adopted, refined, and implemented, we have demonstrated that significant savings can be generated in each of these enterprise applications. These savings can then be internally transferred and reinvested to improve readiness across our operating forces, increase force structure where required, accelerate innovation and modernization to improve future capabilities during a period of growing international unrest, rising competitors, and increasing regional friction, thereby precluding re-emergence of a "hollow force." In the past, this condition has been a consequence of the deleterious effects of the U.S. Army's inevitable "boom and bust" cycle caused by precipitous draw downs in force levels during immediate post-war periods. Regrettably, this tragic phenomenon has been an all-too-persistent, yet increasingly dangerous pattern in American history.

Final Thoughts

For over half a century, from the early 1940s to the late 1990s, Operations Research was *the* enabling competency for defense innovation. Today, however, as numerous recent studies cited earlier illuminate, the current "unprecedentedly weak

defense innovation base is a stunning departure from its illustrious history as a daunting bastion of innovation" (Letts & Rodriguez, 2021, p. 17). With its distinctively rigorous problem-solving paradigm that emphasizes identifying, formulating, and understanding the fundamental nature of any challenge, OR can provide the “glue” to coordinate, orchestrate, and pull defense organizations together to keep them focused, continuously improving and learning while under increasingly greater pressure, precluding chaos and decline during disruptive eras. A powerful byproduct of this approach has been a unique ability to differentiate between *issues* that can - at best - be managed and *problems* that can genuinely be solved.

In conclusion, Operations Research can provide a crucial, indeed unique, source of American power. Our national security enterprise, especially the U.S. Army, should renew and restore Operations Research as a core competency for military innovation, operations analysis, defense strategy, and international security policy. Strategic Analytics should also be widely adopted and used to illuminate better “ways” ahead for defense modernization, encourage imagination, confront conventional wisdom, and better reconcile ends with means in the face of major national security challenges. This analytic framework incorporates imaginative and creative ways to address the many persisting problems and seemingly intractable national and global challenges that confront us. Strategic Analytics can provide *the* crucial innovation enabler for government, academic, and industry leaders to better

integrate our intellectual capacities, considerable strategic planning acumen, diverse analytical capabilities, and bring them all to bear on formidable national defense and international security challenges of our time.

"Come my friends,
'tis not too late to seek a newer world…
… strong in will
To strive, to seek, to find, and not to yield."
Tennyson, 1842

References

Army Acquisition Review Panel. (2011). *Implementing acquisition reform: The Decker-Wagner Army acquisition review*. https://api.army.mil/e2/c/downloads/213466.pdf

Defense Science Board Task Force. (2005, September). *Institutionalizing stability operations within DoD*. Office of the Secretary of Defense. https://dsb.cto.mil/reports/2000s/ADA441078.pdf

Defense Science Board Task Force. (2009a, March). *Understanding human dynamics.* Office of the Secretary of Defense for Acquisition, Technology, and Logistics. https://dsb.cto.mil/reports/2000s/ADA495025.pdf

Defense Science Board Task Force. (2009b, July). *Fulfillment of urgent operational needs*. Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. https://dsb.cto.mil/reports/2000s/ADA503382.pdf

deWeck, O. L., Roos, D., & Magee, C. L. (2011). *Engineering systems: Meeting human needs in a complex technological world*. The MIT Press. https://mitpress.mit.edu/books/engineering-systems

Letts, O. & Rodriguez, S. (2021, November). Revitalize Defense Investment. *Army Magazine,* 71, 17. Association of the United States Army.

National Defense Strategy Commission. (2018). *Providing for the common defense: The assessment and recommendations of the national defense*

strategy commission. United States Institute of Peace. https://www.usip.org/sites/default/files/2018-11/providing-for-the-common-defense.pdf

National Research Council (NRC) of the National Academies. (2014). *Force Multiplying Technologies for Logistics Support to Military Operations*, The National Academies Press. http://www.nap.edu/catalog/18832/force-multiplying-technologies-for- logistics-support-to- military-operations

National Research Council (NRC) of the National Academies. (2022). *Assessing the Feasibility of the Strategic Long Range Cannon.* https://www.nationalacademies.org/our-work/assessing-the-feasibility-of-the-strategic-long-range-cannon

Parlier, G. H. (2010, 25 February). *Operations research and the counter-IED battle: A perspective from Combined Joint Task Force TROY, CJTF TROY, US Forces-Iraq.* U.S. Army Military History Institute. (Available upon request from the author.)

Parlier, G. H. (2015, January). *Operations research and the United States Army: A 75th anniversary perspective* (Land Warfare Paper #105W). Association of the United States Army. https://www.ausa.org/sites/default/files/LWP-105-Operations-Research-and-the-United-States-Army-a-75th-Anniversary-Perspective.pdf

Parlier, G. H. (2019, 18 January). *Operations research for the US Army*

recruiting enterprise: Past, present, and future challenges. Independent assessment for Under Secretary of the Army. (Available upon request from the author.)

Parlier, G. H. (2020). Chapter 20: Strategic analytics and the future of military operations research. In Scala, N. M., & Howard, J. P. (Eds). *Handbook of Defense and Military Operations Research*. CRC Press. https://www.crcpress.com/Handbook-of-Military-and-Defense-Operations- Research/Scala-II/p/book/9781138607330