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CHAPTER 23

Special Operations Forces as a Rapid Prototyping Laboratory

Leo Blanken and Philip Swintek

Introduction

The US military's once-secure technological lead is slipping away. Peer competitors have developed clever strategies to exploit the US lead, while making significant progress in their own right.[1] Further, the technology landscape is moving away from large, centralized research efforts toward small, diffused networks of technological innovation. The Department of Defense seems to be finally waking up to the fact that it needs to develop novel strategies for navigating the relationship between emerging technology and national security.[2]

We propose one such strategy in this chapter. In brief, we argue the unique nature of special operations forces (SOF) offers a rich opportunity to be leveraged as a "rapid prototyping laboratory" (RPL). This laboratory could serve the development of SOF-specific capabilities, as well as more wide-ranging capabilities that may be scaled up to the general-purpose forces.[3]

In an RPL construct, SOF units and activities could serve as a test bed for new technologies, concepts, and practices. These activities could easily be conducted by employing the logic of inductive inquiry, natural experimentation, and field experimentation to provide structure and rigor to the prototyping activities. The proposed innovation challenges for testing could be curated from across the joint force. Professional military education (PME) institutions are the perfect locations for the curation and refinement of such research questions, as well as for designing and executing the RPL processes.

SOF have many attractive qualities that make them ideal living laboratories for the rapid prototyping of innovation challenges. First, SOF forces are continuously distributed to the most operationally relevant locales around the globe. No matter the topic one is interested in—from peer competitors, nonstate threats, partner force operations, or any of a host of irregular challenges—SOF units are deployed to such an environment. Second, SOF forces are the most capable of weaving research activities into their operations. Through their careful selection and training processes and lean organizational design, SOF possess the cognitive and operational flexibility to integrate prototyping nimbly and responsibly. Through thoughtful planning that leverages a dedicated network of PME-based researchers and "customers," the joint force could fruitfully utilize SOF units as a global laboratory for innovation.

In this chapter, we first set the stage by discussing the Department of Defense's legacy system of innovation, and how it fit appropriately with the technological and strategic landscape of the Cold War through the example of the "Second Offset." We then sketch the current technological and strategic landscape, showing how the

Second Offset legacy innovation system can no longer keep pace with demands. Next, we explicate our argument in two steps: explaining the logic of rapid prototyping and showing its natural fit to a partnership between SOF and PME entities. Finally, we provide some concrete examples that deliver a robust "proof of concept" of SOF operators who have—through their own entrepreneurship—already started the rapid prototyping endeavor called for above. Our proposal seeks simply to scale up, systematize, and hyperenable such entrepreneurship.

Legacy System of the Cold War, and Why It No Longer Works

World War II taught the United States that success in modern warfare is inextricably linked to applied science and technological innovation.[4] The total nature of the conflict made clear that systems needed to be built to access expertise from across the entire society to produce the innovation necessary for the nation's security.[5] The system designed to generate innovation for US national security reflected the scale and centralization of the industrial-age warfare in which it was born[6] and proved to be a useful tool in offsetting the size advantage enjoyed by Warsaw Pact conventional forces throughout the Cold War.[7]

The centralized structure of innovation during the Cold War can be likened to a lighthouse: a tall vertical structure from which a single beam emanates at the top. In such a construct, the leadership at the top of the lighthouse surveys the strategic environment to drive innovation requirements. The leadership then, in turn, directs the subordinated structure of the lighthouse to provide the needed innovations.

This approach to innovation worked during the Cold War for a number of reasons. First, military and political leaders understood their opponent well. The United States well understood the force and bureaucratic structures, Warsaw Pact alliance, and political goals of the Soviet Union, as they largely mirrored those of the United States. This provided a useful framework from which force planning, intelligence, and doctrinal needs could be deduced.[8] Second, the US national security apparatus had a firm grasp of the trajectory and nature of the technologies that would be relevant on the battlefield. Nuclear weapons aside, all force structures during the Cold War were improved versions of the platforms and doctrine of World War II. In fact, the Cold War period maintained the uninterrupted track record of the US defense establishment driving the technological landscape, as every single major technological advance in the United States to that point had relied on Defense dollars for the basic research.[9] More specifically, to control technological innovation in this period, the Department of Defense funded universities, government laboratories, and the relevant units and organizations within the services.[10]

The crowning achievement of this era of US military innovation, the "Second Offset" wedded doctrine and technologies designed to prevent numerically superior Warsaw Pact forces from swamping NATO defenses in central Europe.[11] Through a carefully orchestrated combination of primary research, applied research, and field experimentation wedded with coevolved doctrinal concepts, the United States solved this problem. Stealth aircraft, advanced sensors, and precision-guided munitions were the technological innovations necessary to enable the AirLand Battle doctrine of the 1980s.[12] This series of technical achievements constituted an innovative solution to a well-understood and highly salient military scenario. In this case, the "lighthouse" discerned the strategic problem and effectively generated the innovations necessary to answer it.

None of the conditions that enabled the "lighthouse" to work during the Cold War holds true anymore. Rather than facing a single, well-understood threat, the United States faces a large number of heterogeneous and poorly understood challenges, which range from the enduring scourge of violent nonstate actors to emerging regional threats and peer competitors determined to contest the United States in asymmetric and nontraditional ways.[13] Further, the pace of technological change vastly outstrips that of the Cold War, and, for the first time in American history, basic technologies are being developed outside the control of the Department of Defense.[14] Finally, while the United States has been focused on its global war on terrorism, its chief rivals on the global stage—namely China and Russia—have begun to outpace US military innovation and technology.[15]

Therefore, the legacy "lighthouse" model of innovation is no longer sufficient. Future innovation efforts should look more like a "Christmas tree." In this metaphor, the bright star at the top of the Christmas tree would fulfill the function of the original lighthouse beam; it would focus on well-understood and agreed-upon requirements. The rest of the tree, however, is also strung with lights. These strings of Christmas lights represent innovation efforts diffused throughout the enterprise. Rather than innovation being compartmentalized in a reductionist division of labor, innovation efforts can be encouraged and enabled throughout the force. Further, given the inherent asymmetric and decentralized structure of SOF, these units are perfectly suited to the Christmas-tree model of innovation and could constitute the first string of lights on the tree.

What a Rapid Prototyping Laboratory Looks Like

The Secretary of Defense's advisory Defense Innovation Board (DIB) recommends the following changes to foster innovation:

> *Test various possibilities of employing different practices to seek out empirical evidence, . . . [to be] rapid, iterative, and risk-tolerant. Instead of giving processes pride of place . . . focus on outcomes, and how to get there most efficiently. These practices should be generalized, and not only to products and services, but potentially to strategies and operations as well.*[16]

There are a number of such voices calling for fast, iterative feedback loops between operational experiences on one hand and providers of material solutions on the other. Such an approach to military innovation can generally be labeled "rapid prototyping."[17] Actionable plans to instantiate rapid prototyping, however, remain lacking. Some refer to rapid prototyping as a "mindset" or "culture" that needs to be inculcated throughout the force.[18] Others seek to rely on nascent technologies to make the process work: "Immediate feedback will pour into a data lake where the latest methods in machine learning and artificial intelligence can improve operational effectiveness."[19] We propose a specific set of established methodologies, married to a specific set of operationally deployed units to implement rapid prototyping immediately and effectively.

The first task is to concretize "rapid prototyping," turning it from a buzzword to specific and well-established research techniques. We offer three such analytic tools that can be implemented readily: *field experimentation, natural experimentation,* and *inductive reasoning.*

Experiments are designed to establish control. In other words, experiments allow the researcher to isolate the independent effect of various factors upon some outcome. *Field experimentation* refers to conducting such research in "a naturalistic setting and manner . . . as a hedge against unforeseen threats to inference that arise when drawing generalizations from results obtained in laboratory settings."[20]

The common usage of "field experimentation" across the joint force does not fit this definition, as it usually refers to the observation of nascent technologies being demonstrated in an empty field on some US military base. Often, by the time innovations are actually integrated into field exercises for conventional forces, they have been acquired and integrated into force structure. Actual field experimentation would allow the researcher to contend with all the potential confounding factors created by *actual* encounters with opposing forces in the **actual** settings in which innovations are designed to operate,[21] which would require as many aspects of a "down range" setting as possible. Globally deployed SOF missions provide a perfect locale for such field fermentation.

Natural experiments can be considered a subset of field experiments. In these cases, control over potential confounding factors occur naturally in the environment. For example, if US forces are operating in two provinces of Afghanistan that are strikingly similar across a number of attributes, an innovation may be tested in only one of those provinces (rather than multiple iterations of costly tests in multiple areas). Such a design would not only be economical but also provide a large degree of control, thereby generating stronger inferences regarding the impact of the potential innovation under scrutiny. Given restrictions on "random assignment" within military operations, sensitivity to naturally occurring experimental opportunities is paramount in leveraging this logic.[22]

Finally, *inductive reasoning* refers to the process of inferring general laws or principles from the observation of particular instances (as opposed to relying on preexisting theory to derive conclusions, as is done through deductive reasoning).[23] In other words, inductive reasoning relies on discerning trends or patterns within naturally occurring data. Though this seems the simplest of the three methods discussed here—colloquially referred to as "lessons learned"—the US military has struggled to learn systematically from things that it has experienced and observed.[24] This is because of the inherently conservative inclinations of military organizations[25] but also their poor understanding of these two modes of reasoning.[26]

SOF are an attractive force of choice for implementing a model of this sort for the same reasons they are often selected for unique and high-risk missions—their maturity, education levels, and rigorous selection processes.[27] SOF units are often more comfortable with risk simply based on the nature of SOF missions.[28] Furthermore, SOF are also consistently deployed across the globe, with forces spread across each of the six geographic Combatant Commands. Finally, special operators conduct a wide array of missions—from near-peer competition, to direct-action counterterrorism and working closely with partner forces—ergo, they are postured to explore an equally wide range of innovation challenges.

Collaborative partners will be necessary to conduct rapid prototyping endeavors. While forward deployed SOF offer an ideal environment to conduct rapid prototyping, additional labor and expertise will be necessary to execute these activities. PME students may prove to be the ideal partners. As military professionals, they would understand the organizational, operational, and strategic contexts in which the protyping activities are nested. As graduate students, they could employ research techniques they are currently learning in the classroom. Finally, they could serve to connect the research to the relevant actors (academic, industry, and interagency) across the wider innovation ecosystem.[29] Through such a partnership, the professional development of PME students would be directly tied to the transformation of the force through operationally relevant research projects.[30]

In the following section we show some examples of specific innovations that have been prototyped by special operators. These "naturally occurring" innovation efforts show the untapped potential that our proposed endeavor seeks to harness.

SOF's Natural Affinity for Innovation Prototyping

In recent decades, US SOF has already demonstrated itself as an RPL for emerging technology, albeit an unintended one. The benefits of pairing SOF with the development, testing, and implementation of emerging or untested technology has been shown in a number of cases. We briefly survey three here. First is the use of Global Positioning Systems (GPS)–based technology and satellite communication (Satcom) during the initial invasions of Iraq and Afghanistan during both the Persian Gulf War and the war on terrorism, respectively. Second are the ongoing challenges around countering unmanned aerial systems (CUAS). Third is the development of the Android Tactical Assault Kit (ATAK), an innovation spearheaded by PME students, to enable collaboration with partner forces. We offer these three examples to show a latent rapid prototyping capability that could easily be systematized and expanded to great effect.

One of the most influential technological advances for the US military in recent memory has been the use of GPS technology across all aspects of the Department of Defense. GPS technology is not new. As early as the 1960s, the US military used a rudimentary version of the technology to guide both ships and aircraft. In 1978, the United States increased its GPS capabilities by launching the first Navstar satellite constellation, but the system was largely untested in combat until Operation Desert Storm, during which US SOF were vital to testing the system in the laboratory of combat.[31] Specifically, SOF deployed behind enemy lines used GPS technology to navigate across the barren desert, conducting special reconnaissance deep in enemy territory.[32]

Undoubtedly, mistakes were made while using a largely untested technology, but these mistakes were used to improve techniques and equipment. For example, after the Persian Gulf War, the Army dictated that all armored vehicles would carry GPS receivers, and the demand for handheld devices, which were primitive by today's standards, surged across the force.[33] This increase in demand and utility was partially based on the successful use of GPS technology during the ground and air wars waged by US forces during this short, but influential, conflict. With these lessons, among others, the implementation of GPS technology and its satellite constellation grew and improved, and the improved US GPS infrastructure greatly enabled SOF during the subsequent conflicts across Afghanistan and Iraq, paving the way for another RPL for GPS and SOF.

As detachments of US SOF waged unconventional warfare in the mountains of northern Afghanistan, their mission was to advise and assist the freedom fighters of the Northern Alliance struggling to resist the Taliban on their own. A key component of their mission was to increase the lethality and survivability of the Northern Alliance through combat-multiplying technologies such as GPS. Primarily, GPS served two purposes during the initial invasion of Afghanistan in 2001: map the front lines and provide guidance to smart bombs. US SOF and operatives from the Central Intelligence Agency (CIA) traveled along the scattered northern frontlines and used GPS to pinpoint friendly and enemy positions in conjunction with laser-guided bombs to mark high-value enemy targets for pilots flying overhead.[34] This data provided valuable intelligence to senior US officials as they planned the larger campaign to ouster the Taliban and defeat al-Qaeda. More important, it also demonstrated the combat power provided by a handful of secure portable handheld GPS devices to senior military leaders and policy makers. Today, handheld GPS technology is ubiquitous across the US military. Once again, SOF, and its partners in the interagency, served as an RPL to validate technology in a combat laboratory.

Just over a year later in Iraq, the US military used the same GPS technology during Operation Viking Hammer. As soldiers from the Tenth Special Forces Group (Airborne) blazed their way through Kurdistan and into northern Iraq, they relied heavily on GPS to coordinate their efforts.[35] SFOD-As from Tenth Special Forces Group (Airborne) were spread across the Iraqi frontier as they led their Kurdish partner forces to defeat

Saddam Hussein's army. This swift campaign required precise knowledge of friendly positions. Relying on handheld and vehicle-mounted GPS systems, commanders could see the positions of their subordinate units with high accuracy. While GPS technology supported a highly precise bombing campaign in Afghanistan, in Iraq, it increased the freedom of maneuver for friendly forces by supporting decentralized operations. Commanders understood the battlefield with a new level of clarity that supported the dispersion of forces across large geographic areas—further validating GPS as a combat multiplier via a SOF RPL.

Similar to GPS, SATCOM was not new technology during the invasions of Iraq and Afghanistan. Though widely used throughout the military prior to 2001, it was largely untested in combat prior to the war on terrorism. During the onset of combat operations in Afghanistan in 2001, SATCOM was pervasive as a form of communications across the battlefield. The SFOD-As and CIA operatives fighting alongside the Northern Alliance in Afghanistan utilized SATCOM to coordinate the efforts of their intricate bombing campaign with major ground offensives.[36] Using man-portable radios on their backs, US forces sent messages via satellites to their headquarters located on the other side of the globe. This space-based technology was undoubtedly a combat multiplier across the offensive in northern Afghanistan, as it directly supported decentralized operations with near-instantaneous global connectivity to execute a precision bombing campaign, once again validating technology in a combat laboratory via SOF.

In Iraq, the invasion also required constant communications to coordinate Operation Viking Hammer. SATCOM allowed US forces to coordinate the efforts of an intricate bombing campaign with the unconventional war they were waging on the ground.[37] SATCOM enabled small and isolated units to coordinate their efforts and synchronize combat power. It also allowed for greater geographic dispersion of forces across the battlefield, which proved vital as the United States invaded Iraq. During the invasions of both Afghanistan and Iraq, SATCOM enabled decentralized, lethal, and precise operations that minimized friendly casualties and helped define the new American way of war. The value of SATCOM and the operations it fostered was evident to leaders at the highest level thanks to an accidental RPL, with SOF leading the way.

Today, SOF continue to fill the role of an RPL for emerging technology across the globe. This has increasingly become the case as US operations have become more decentralized, with SOF often in the lead, facing technologically savvy enemies and adversaries, from extremist organizations with drones to near-peer competitors waging electronic warfare. SOF's value in the process of developing, testing, and fielding innovative and emerging technology has only increased in recent years.

While drones and unmanned aerial vehicles (UAVs) have played a key role in the last two decades of conflict across the globe, until recently, they consisted mostly of large drones used to drop munitions on remote targets or observe the battlefield. However, drone technology has improved, miniaturized, and become more pervasive across the globe, as have the threats posed by UAVs. As a result, US adversaries and enemies use commercial off-the-shelf UAVs to disrupt and attack US forces in remote corners of the globe. Typically, the forces facing these threats are SOF.

The emerging threat from UAVs has created a demand for counter-UAV (CUAV) technology to enable military and law-enforcement personnel to defeat UAV threats. Consequently, the market is flooded with CUAV solutions. While the companies touting these wares attest to their value and effectiveness, the testing is all limited to controlled scenarios often lacking real-world variables (meaning field experiments only). However, for the SOF units in Afghanistan, Syria, and elsewhere facing these threats, the threat is real and must be defeated. This paradigm has created a perfect SOF RPL, with units on the battlefield fielding and testing CUAV equipment, attesting to the validity of said equipment, and ordering more of the successful systems and avoiding the ineffective or overly expensive technological blunders. Meanwhile, large organizations such as Special Operations Command (SOCOM) or the Asymmetric Warfare Group (AWG) oversee the procurement of systems and programs of record to counter this threat. To conceptualize this with an earlier example, SOCOM and AWG are the light on top of the Christmas tree, guiding the overall process. The SOF detachments, on the other hand, are the Christmas lights strung around the tree, facing the threat and driving innovation toward the correct solution—an SOF RPL.

However, the CUAV example is missing an important piece of the model we developed. While there is an adequate amount of experimentation in the innovation of CUAV solutions, it needs to be tied into PME—into field experimentation shepherded by SOF professionals as part of their academic professional development. ATAK represents one such example. The ATAK is an Android-based operating system installed on tablets, cell phones, and other handheld devices that provides real-time awareness on the modern battlefield, fosters communication, leverages SATCOM, and uses GPS technology. It has proven to be an invaluable tool for SOF across the globe. Interestingly, given the ATAK's success and value, many SOF officers have looked to its further development, testing, and implementation while attending PME. Two such examples include supporting the development of remote advise-and-assist ATAKs for partner forces separated geographically from their American SOF advisors and ways to tie the ATAK better into joint-operations centers.[38]

Taking it one step further, the same SOF students have since completed PME and are now using the devices they helped improve on the battlefield, completing the cycle of innovation. The innovation and integration of the ATAK by SOF professionals—both on the battlefield and during PME—is an example of a successful SOF RPL that has supported combat success directly, from testing to field experimentation and natural experimentation.

Conclusions

We can now return to the Defense Innovation Board's recommendations and highlight the specific ways in which our proposed initiative satisfies their key points:

> *Test various possibilities of employing different practices to* ***seek out empirical evidence****, . . . [to be]* ***rapid, iterative, and risk-tolerant****. Instead of giving processes pride of place . . . focus on outcomes, and how to get there most* ***efficiently****. These practices should be generalized, and* ***not only to products and services, but potentially to strategies and operations as well***[39] *(emphasis added).*

By using SOF as the laboratory for rapid prototyping, our proposal leverages the military community most comfortable with the necessary rapidity, cognitive flexibility, and risk tolerance. Marrying the SOF laboratory with PME research teams produces gains in efficiency, as well as the required analytic rigor for valid empirical testing. Finally, these operators and military graduate students are fully capable of applying these techniques to endogenize strategic and operational concepts, not just the technological "shiny objects" that take precedent in most discussions around innovation.

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