

THE RAPID EQUIPPING FORCE: CUSTOMER-FOCUSED INNOVATION IN THE U.S. ARMY

*[The Rapid Equipping Force should be] married to the problem, not any proposed solution.
Invest to better understand the problem, then don't let it go until the user says it's solved.*

—Colonel Peter Newell, U.S. Army Rapid Equipping Force¹

The Rapid Equipping Force (REF) was a center of innovation within the U.S. Army. Its origins traced back to 2002, and by 2013 it had developed solutions to thousands of problems faced by soldiers in Afghanistan and Iraq. It addressed problems as varied as finding Taliban munitions hidden in caves and wells, identifying potential improvised explosive devices (IEDs), reducing the demand for fuel to run electrical generators at remote outposts, providing airborne surveillance, and preventing vehicles from being disabled by flat tires.

The REF had always worked closely with troops in the field, but under the directorship of Col. Peter Newell, beginning in July 2010, it had actively collaborated with academia, industry, and other organizations within the military. Newell's directorship ended in May 2013, at a time when the war in Iraq had ended, and the war in Afghanistan was winding down. Wartime funding, the source of most of REF's budget, would soon be ending; and overall military budgets were facing significant cuts.

Looking into the future, how could the army best utilize the capabilities the REF had developed, and the lessons it had learned? Could the REF's culture of innovation be scaled in a peacetime army? Could its unique attributes be preserved in a way that could be scaled the next time the army was called upon to go to war? Could it focus its efforts on supporting Special Operations in Africa and other regions of tension? Or was it doomed to extinction, as one general

¹ Presentation by Col. Peter Newell at the Stanford Graduate School of Business, February 5, 2013.

David Hoyt and Professors Hayagreeva Rao and Robert Sutton prepared this case as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

prophesied, saying “I think that we’ll get rid of the REF. I think the bureaucracy will eat the REF.”²

ORIGINS OF THE REF

Col. Bruce Jette was a man of many talents. He was an army armor officer, a scientist with a PhD in solid state materials science from the Massachusetts Institute of Technology (MIT), and a certified military acquisitions officer. On September 11, 2001, he was deputy director of an organization working on designing the future army. When the war in Afghanistan began, he also served as a consultant to the Vice Chief of Staff of the Army (VCSA),³ the army’s number two officer, in effect, its chief operating officer. Jette met weekly with the VCSA, who would assign problems that Jette would try to address with creative, innovative solutions.

It Started With a Bet

One day in the spring of 2002, Jette found a newspaper in the VCSA’s office, opened to a photo of a soldier throwing a grappling hook into a cave to clear booby traps. As Jette recalled, “the Vice says, ‘Look, Bruce, brave soldier.’ And I said, ‘Yes, sir. Brave soldier, stupid army.’” In addition to being a four-star general, and the second highest ranking officer in the service, the VCSA was also a large, physically imposing man. Jette continued, “He bristled and said, ‘What are you talking about?’ I said, ‘We can do better than that. They’ve been using that since the Peloponnesian War.’⁴ We could use something like robots.” The VCSA said that he had already checked with people in the Pentagon, who said it could not be done. Jette’s response challenged this belief, and “that’s when I made a bet I didn’t know I was making.” He replied, “Of course it can.” The VCSA told him to do it, and to come back in 90 days with results from Afghanistan.

The Taliban used mountain caves for protection and to store equipment. Clearing these caves was dangerous work for the U.S. Army—not only might they encounter armed Taliban, but the caves might be booby-trapped. When soldiers stood in the bright sun and looked into a dark cave, they could not see what was inside—but anyone inside could clearly see them. Despite advances in technology, they were using methods that had been used by armies from before Christ—before entering, they threw grappling hooks into a cave, then pulled them out to catch trip-wires and explode bombs.

This approach had many problems. It required the soldier to stand at the cave opening in order to throw the grappling hook, then quickly duck for cover after releasing it. The hook might not catch and could then trigger a booby-trap device. Soldiers had to enter the cave without knowing the cave’s layout, or what was inside. Many caves were filled with old Russian munitions, which had been left in the caves after the Afghan-Russian war when Afghans removed them from wooden crates in order to use the wood. Shrapnel from explosives triggered by a grappling hook might injure soldiers outside. The caves might be shallow, and a grenade thrown inside to clear the cave might bounce off the back wall and come back out, or might explode munitions near the cave entrance, again threatening the soldiers.

² Quotations are from interviews with the author (Hoyt), unless otherwise specified.

³ See **Exhibit 1** for a glossary of acronyms used in this case study.

⁴ The Peloponnesian War was fought from 431 to 404 BC.

In short, it would greatly benefit soldiers if they could see inside a cave, without having to personally enter it.

The First Project

When Jette made his bet, he had no office, program, money, staff... nor robots. With a big project, and little time, he borrowed people that he had worked with before, whom he trusted to work without close supervision. The army robot program, such as it was, consisted of one major, who had been a ranger before sustaining an injury. When the major reported for his next assignment, and was told to choose a desk, the best desk in the room was labeled “robotics”—thus, becoming the army’s robotics department. Fortunately for Jette, he happened to be a smart, effective member of the new team. The project became known as Rapid Integration of Robot Systems (RIRS).

With little time, a small team, and just \$750,000, Jette surveyed the available robotic programs. The Defense Advanced Research Projects Agency (DARPA) had done extensive work on robots that could work in many environments, offering a potential solution. However, the control electronics filled the bed of a pickup truck. This would not work in Afghanistan, where, in Jette’s words, “they drop you off at the back end of a helicopter and fly away. Wherever you’re going, you’re carrying everything you’ve got.” To get to each cave, soldiers had to climb up or down a mountain, then climb back, and repeat the process for each cave. Each team of soldiers could clear about two caves in a day. If they were to use a robot, it (and its control electronics) would have to be carried by soldiers up and down steep mountains in order to reach the Taliban caves.

Earlier in his career, Jette had been a manager in a program called Land Warrior, responsible for developing electronics that future soldiers would wear for navigation, communication, and other functions. When Jette was assigned to it, the program was far behind schedule and over budget. He turned the design over to an engineering and scientific consulting firm, Exponent, that quickly completed the Land Warrior electronics. When challenged to make compact electronics for the new robot, Jette again contracted with Exponent, which modified the land Warrior electronics to control the robot. The first version of the robot electronics was a wearable computer about four inches square and three inches thick, combined with a helmet display so that a soldier could drive and monitor the robot while keeping both hands on his weapon.

The team went to Afghanistan with its “PackBot,” intending to join units going on missions to clear caves. After some initial skepticism, the RIRS team was included on a mission, but told to stay out of the way until it was time to use the robots. They cleared five or six caves in the first mission, about double the normal number. The next time this unit went out, the leader called the team and said they could have some helicopter seats, as long as they brought the robots. They cleared about 15 caves in a day and a half. As Jette recalls the third mission, “they said, ‘Well, you can come along, but stay out of the way of the guys with our robots.’” On the fourth mission, the unit told the RIRS team that they were taking the robots on the mission, but did not have room on the helicopter for Jette and his men. Jette signed the robots over, and headed home to brief the VCSA—just beating the 90-day deadline.

In a short meeting with the VCSA after the robot project, Jette was given a new mission, which he recalled as, “You’re going to do this for the entire army, and anything that needs to get done for the soldier, you’ll do it.” Jette named the function the Rapid Equipping Force.

Becoming an Organization

In November 2002, the VSCA issued a directive officially forming the REF.⁵ While reporting directly to the VCSA, it was still a temporary organization, given one year to establish its value. Two critical issues were: speed in getting equipment to soldiers, and achieving an acceptable standard of equipment performance. The normal military procurement process was based on a detailed establishment of specifications, all of which had to be met. This, obviously, meant that it could be a long time, often many years, before the new equipment could be delivered to the field. Once in the system, however, the military could efficiently purchase large quantities at high quality.

For the REF, delivery time was the most important factor. While a delivery time was not specified, the operating philosophy was “hours and days, rather than weeks and months,” emphasizing the importance of speed. The performance standard for REF was specified as “acceptable”—the solution had to meet at least 51 percent of the performance requirements. Once the initial solution was being used, the army could learn about its usefulness and the areas in which improvements could be most effective.

As a temporary organization, the new REF faced challenges, particularly in staffing and funding. It did not have a reliable staffing source, and had to depend on volunteers, borrowed staff, and soldiers assigned on a short-term basis. It had no dependable funding and budget, as its funding was project-based. It used borrowed work space.

The people Jette had borrowed for the PackBot project had returned to their units after their trip to Afghanistan. He borrowed office space at Fort Belvoir, Virginia. He could only get soldiers on 90-day assignments—and initially had to take whomever he was given. However, in the early days of the Afghanistan war, soldiers were eager for combat assignments. The REF offered the chance to get combat experience, and the quality of soldiers in the REF improved. Jette described the role of his staff when in Afghanistan:

The idea was that you go out with the company, you talk to the company commanders, you talk to the NCOs [non-commissioned officers]. [The soldiers in the field] are not thinking about ‘how can I do this better.’ They’re there to do a mission with what they’ve got. So, you go out and say ‘I’m not going to be a load on you. I’ll help shoot people if you need me to, but you’re in command. I don’t care if I’m senior to you—I’m not going to take command of your unit. I’m just going to be here to think with you and we’ll talk about my thinking later when you don’t have anything stressing you.

⁵ Information on the formation of the REF organization is drawn from interviews and “TRADOC Generating Force Study: Innovation and Adaptation in Support to Operations,” TRADOC Pamphlet 525-8-1, Department of the Army, May 2010, pp. 75-77.

The result of these trips was feedback—an understanding of what soldiers needed in the field. The REF staff would come back from the field with immediate requirements that they could quickly implement and get back to the soldiers.

Exponent sent a PhD engineer to Afghanistan to support the deployed PackBots, and to serve as what Jette referred to as an “adventurer scientist.” In talking with soldiers, the Exponent engineer learned that the Taliban were also hiding explosives and weapons in wells. At the time, wells were searched by lowering soldiers into them with ropes. The engineer, Ken Zernach, quickly adapted a camera attached to a fishing rod, to explore wells. William Cohen, principal at Exponent, picked up the story:

On the very first mission, soldiers found this huge cache of weapons using the WellCam. It was in a well that had an offshoot further down the well to the side, that had actually been explored by a soldier being lowered down with a rope. So, that was the beginning of the idea that Exponent engineers could be in theater and work on things that were troubling soldiers. Bridging capability gaps. Find ways to integrate existing COTS [commercial off-the-shelf] material or GOTS [government-off-the-shelf], and get them to the field to solve some problem, whether it's a one-time thing or something that would be great for the entire force.

In August 2003, the Chief of Staff of the Army, the service’s most senior officer, gave Jette a more detailed mission statement, written on a napkin, which remained central to the REF’s mission ten years later in 2013 (see **Exhibit 2**): “I want you to equip, insert, and assess”—equip soldiers with new tools that would help them in the field; insert technologies that might be immature, but could be useful in a combat environment and further developed if they proved effective; and assess army practices and operational needs and provide feedback to senior leaders.

This was formalized into the following mission statement: “The Rapid Equipping Force harnesses current and emerging technologies to provide rapid solutions to the urgently required capabilities of U.S. Army forces employed globally.”⁶ After Newell arrived at the REF, the army’s vision for the REF expanded:⁷

- Be present: Maintain forward presence at the tactical edge of operations. Close the gap between the soldier and the scientist.
- Be predictive: Find emerging problems. Provide Senior Army Leaders “peripheral vision.”
- Be intuitive: Organize to quickly gain an understanding of a problem and the environment it exists in.
- Be inclusive: Form partnerships and look for multiple paths to solve problems. Help other army organizations and industry see, understand, and attack emerging gaps.
- Be aggressive: Push the acquisition envelope, but operate within the law. Negotiate solutions with the users. At REF, the speed of delivery will be slightly more important than effectiveness and cost. Use iterative development to improve effectiveness and reduce cost.

⁶ Rapid Equipping Force Website, “About Us,” <http://www.ref.army.mil/portal/aboutus.html> (accessed August 15, 2013).

⁷ Newell presentation, February 5, 2013.

Unlike the larger army organization, which had tight controls to prevent failures, the REF was experimental—it tried to get early, partial solutions into the hands of soldiers, from which it could learn. Jette said: “I didn’t care if we had failures. I cared if we had failures and didn’t learn from them.” This acceptance, even embracing, of failure as a necessary part of the innovation process and an opportunity for learning, would be retained to a greater or lesser extent by future REF directors. It could also lead to tension with conventional army organizations.

After the one-year trial period, the REF had proven its worth, and the VCSA and Assistant Secretary of the Army for Acquisition, Logistics, and Technology (ASA(ALT)) approved a draft REF charter and proposed organization and mission. However, negotiations over the details of reporting and other arrangements delayed final approval of the REF’s funded status until March 2005, to be effective in October of that year—three years after Jette first began working on robots to clear Afghan caves, and after he had left the REF. During Jette’s tenure, the REF had put about 250 different systems, with thousands of items, into the hands of soldiers in Afghanistan and Iraq. Some, such as the robots, became part of formal programs within the army acquisition system. When Jette left the REF, it had a staff of 56 people. While the REF then had funding as an organization, this funding was from Overseas Contingency Operations (OCO), tied to the ongoing war effort, not “base funding” that would continue after the Afghanistan and Iraq wars ended.

The REF as a Budgeted Organization

After it received a budget and staffing authority, the REF grew to a staff of about 130. This was divided into military personnel—headed by a colonel who served as director—civilian government employees, and civilian contractors. Military personnel served tours of duty in the REF that lasted between one and three years (although in the early days of the REF, they served temporary assignments of just 90-180 days). Civilian employees were typically retired military personnel, and once hired were difficult to replace due to civil service regulations. Contractors could be hired or replaced based on budget and contract considerations.

To rapidly supply solutions to soldiers’ needs, the REF was given essential capabilities. Two elements were needed for a military organization to purchase material—a formal requirement and funding. In the standard acquisition system, the requirement generation process could take several years. This process evolved over time to ensure that equipment was truly needed and that all considerations of use and support were incorporated. The military used a system called DOTMLPF to plan for new equipment: Doctrine (how the equipment would be used, and how it would impact operations); Organization (the type of unit that would use the equipment, for instance whether it impacted the organization at the squad level or division level); Training (how soldiers would be trained to use the equipment); Materiel (the physical equipment); Leadership development implications; Personnel; and Facilities implications.

During wartime, this process could be shortened through a process called Operational Needs Statement (ONS), but it still required a valid warfighter requirement. One rationale for this was described by Assistant Secretary of Defense of Operational Energy Plans and Programs Sharon Burke, “Everybody’s got a great idea about what’s gonna make life better, and you will see companies directly marketing to fielded forces. They get in theater, and they try to sell them on

things. It happens all the time.” The need for, and risks of, the ONS process could be illustrated by the MRAP (mine-resistant ambush protected) armored vehicle that was rapidly developed to protect soldiers in Iraq from IEDs. While the MRAP was an overall success, it was also the subject of criticism—several companies provided different models, resulting in criticism of the performance of some versions, maintenance difficulties, and high costs.

Funding for military purchases required congressional authorization (although items could be purchased if they were valued below established thresholds), which could not be obtained until there was a formal requirement. Obtaining authorization typically required another year or two. Once there was an approved requirement and authorized funding, the acquisition organization could begin the process of soliciting bids, choosing a supplier, and ordering the equipment.

The REF could shortcut this process in two ways. The REF director had the authority to approve requirements. Rather than the detailed requirements definition used by the conventional acquisition community, the REF developed a short form “ten-liner” that specified the critical aspects of the requirement. (See **Exhibit 3** for a description of the REF ten-liner.) The REF also had its own budget, which it could use to acquire equipment.

Actual purchases were made by authorized acquisition officers. One of Jette’s many attributes was that in addition to being a scientist and soldier, he was a certified acquisition officer. This was not the case with his successors. As a result, a full colonel was assigned to the REF to oversee acquisitions. The REF director was responsible for operations, while the acquisition professionals made the actual purchases (see **Exhibit 4** for REF organization chart under Newell). Depending on the attitude of the REF director, this raised the potential for tension. The acquisition officers were responsible for ensuring that purchases were consistent with all applicable laws, and were often biased toward eliminating any potential source of risk, while the REF director was primarily concerned with getting solutions to the field quickly as long as the purchase was made legally and ethically. The REF director was willing to take the risk that a solution might fail; the acquisition community was generally highly risk-averse. (See **Exhibit 5** for a description of the emerging REF paradigm, and the overlap between acquisition, operations, and technology management.)

By the end of 2007, the REF “had delivered more than 550 types of equipment and more than 75,000 individual items.”⁸ The average time from receiving a request from the field to delivering a solution to the soldiers was 111 days.⁹

The ability to self-approve requirements, fund acquisitions, work with all units in combat, and be backed by the VCSA, gave the REF director the opportunity to have a significant impact on the army. Some said that the REF director, if successful, could be the “most powerful colonel in the army.” In fact, in 2012, *DefenseNews* ranked Newell as number 83 on its list of the 100 most influential people in the U.S. defense community.¹⁰ Newell was the only colonel on the list,

⁸ “TRADOC Generating Force Study,” op. cit., p. 77.

⁹ Ibid.

¹⁰ “100 Most Influential People in U.S. Defense,” *DefenseNews*, December 17, 2012, <http://special.defensenews.com/people/full-list.php>, (accessed September 24, 2013).

which included cabinet secretaries and other top civilian officials, legislators, admirals and generals.

THE REF UNDER COL. PETER NEWELL

Newell became the REF's fourth director in July 2010. He was not a scientist, engineer, nor acquisition officer—he was an infantryman. Before taking over the REF, Newell had been a brigade commander in southern Iraq, leading about 5,000 soldiers and responsible for the area from the swamps on the Iran-Iraq border to the border of Saudi Arabia.

While in Iraq, Newell was notified that he would be the next REF director. He had never heard of the REF, and had to look it up online to find out what it was. As he said, "I'm a brigade commander in Iraq with significant challenges. There's this organization that's supposed to handle these kinds of things, and I'm googling the organization to figure out what it does. That's a really bad sign."

The REF When Newell Became Director

When he returned to the States, Newell met with the outgoing REF director, who showed him a large three-ring binder of:

... great things REF does. I got to about the third page and I literally got ready to throw that book out the window. My frustration was so great after coming back from Iraq with all these issues, trying to solve them, taking a lot of risk, and here is this guy with the holy grail of solutions, and I never saw him. I never heard from him, and quite honestly, I was angry.

The previous REF director had focused on responding quickly to requests from the field, relying on personal connections (which had not included Newell), and delivering immediate solutions with little coordination. One senior officer commented, "They were perceived as the 'Candy Man.'" If you want to get something, ask the Candy Man, ask the REF, and he'll give it to you right away. But small ball [that had no long-term impact]." He continued:

There wasn't a lot of coherence to it. It was a logistical nightmare. The stuff that one guy might ask for, the next guy coming into the same place might go 'I don't want that, I don't want A, I want B.' 'Okay. Let's get him B.' So you build a big portfolio of stuff that is just kind of random. No focus. A lot of it gets broken. We weren't using it anyway. Throw it in the CONEX [a modular shipping and storage container], never to be seen again. So it doesn't necessarily make an enduring impact.

The REF had also become isolated and inward looking. It had sought out few collaborations with other army organizations, academia, and industry, but made little use of, and did not share, what it learned. Furthermore, it had antagonized the army acquisition community. Major

General Harold Greene,¹¹ a senior acquisition officer observed: “I’m one of their advocates, but there are a whole lot of people who want to kill it because, ‘oh, that’s a rogue organization that we could never get to work with us.’ It created an institutional bias.”

Kurt Frulla, a retired lieutenant colonel who returned as a career army acquisition professional, described the effect of a poor relationship between the REF and the acquisition community:

REF can be 100 percent successful fielding a few items to a few units and coming back saying that the product worked. They can be 100 percent successful doing ‘buy, try, and decide,’ and never transitioning the product to a program of record. But in doing this, they are not influencing future capabilities and requirements like they are designed to do. You can work in the close tactical fight, and provide an 80 percent, 70, even a 90 percent material solution, and if you are not engaging your counterparts within that community, the solution will be rejected. Because you didn’t do it together. I think that’s just human nature. If you come in and tell me you got a better freakin’ mousetrap, I’m going to turn around and say, well, mine is pretty good anyway, thanks very much. In the early days of REF, the organization was seen as direct competition and crossing into traditional program management lanes.

However, if the REF had a good working relationship with the acquisition community, this could streamline part of the process of acquisition process. Lieutenant General Raymond Mason, the army’s deputy chief of staff responsible for logistics observed, “You can overcome a lot of the bureaucratic resistance to a new widget because you can say, ‘Look this thing has already been used in combat by soldiers and it was very effective.’ So, we’ve already decided it’s good; we just have to work the back end [maintenance, spares, etc.]. You get over a lot of the frontend work by REF already putting it out in the field.”

Thus, while the REF could meet short-term objectives, its lasting impact depended in large part on its relationship with the acquisition community.

Newell had a deep knowledge of problems facing soldiers, and he had close relationships with battlefield leaders. But acquisition, contracting, congressional relations, and many other aspects of his new job were totally foreign to him.

He began the learning process by talking to every group that interfaced with the REF, and learning what they did and what they thought of the organization. He recalled:

I did that for six months. I did nothing but walk around asking questions to these people—especially those that did not like the REF—and I even bounced ideas off them. The results of that first six months of talking to people helped me form a substantial support network of advisors and potential partners. I didn’t stop at the end of the six months, as I later expanded that ring into the technology field, the money world, and legislative world, and finally into groups that were trying to sell products.

¹¹ See the Glossary (**Exhibit 1**) for the hierarchy of general officer ranks in this case.

Newell Takes Charge

As he went through his learning process, Newell maintained a list of issues he uncovered. He recalled:

I had a dry erase board in the corner of my room and I just started visiting people, started asking questions, and every time I had an ‘Aha’ moment I started writing something on this board.... I called the list, “The Impediments to Innovation.”

I was very careful how I titled it because I didn’t want people to think this was what was wrong with the Rapid Equipping Force when I got there (or any other particular group). Everything I did afterward in terms of organizational changes and relationship building was directly related to something on this list.

The list consisted of the following notes:

- Users frequently do not know what they need (until they see it)
- Poor communication between users and developers and vice versa
- A lack of collaborative information and development environments
- A lack of understanding (the problem, the threat, the environment)
- A lack of will to accept risk in acquisition
- Inflexible funding and contracting strategies
- Stagnant solutions (no plan for an evolving threat)
- Outdated policies

The REF director had a significant impact on its operation and success, and the REF reflected the personality of its director. Those interviewed universally commented on Newell’s enthusiasm, leadership, and willingness to reach out to other organizations to build bridges. Greene observed, “Pete [Newell] was a breath of fresh air because when he came in, he wasn’t about fighting the system. He was about getting things done.”

When he had to fight to move projects forward, “Pete [Newell] tipped over some apple carts, which I think for those events was fine. But in the same vein he didn’t stick a finger in their eye doing it,” recalled Peter Palmer, a retired army general.¹²

Understanding Problems

Soldiers quickly learned to adapt to the situations they faced, using the tools at hand. They did not sit back and think deeply about the problems, and different ways they might be overcome. Similarly, companies focused on their own products. Newell believed the focus needed to be on understanding the problems, and that depending any product-oriented organization would lead to viewing problems with a bias toward its own solutions:

¹² Palmer went on to lead Edge Innovation Network, a private-sector organization that brought industry, academia, non-profits, and government together to collaborate on innovations that would help soldiers and first responders (<http://www.edge-innovation.com/>).

I said, ‘Stop talking to me about products. I’m not interested in product. I want you to talk to me about the problem.’ So I became problem-centric, and as soon as I did that, it didn’t matter what product you put out there, as I was only interested in what the soldier said about it later on. I said, ‘I didn’t care where the product came from. I don’t care if we did it. I don’t care if they did it. I don’t care who delivers the product, and I don’t care who gets credit for it.’ All I wanted was the problem solved, or if the problem was too big for us to solve, we could at least articulate the problem to the army in order to get a bigger group of people working on it. After this, REF work stopped being a competition.

As a result, the REF became, in Newell’s words, “married to the problem, not any proposed solution. Invest to better understand the problem, then don’t let it go until the user says it’s solved.”¹³

Solutions were often a tradeoff between three factors: time to deliver, performance, and cost. Given the imperative to help soldiers solve problems that impacted their safety or ability to perform their missions, Newell held speed of delivery as the most important variable. He was willing to accept higher costs or reduced performance in order to speed delivery. He knew that from the perspective of the soldier by the time a problem was identified, the solution was already too late. Performance of a reasonably successful solution could be improved with user feedback, and if the product was effective, costs could be brought down in the future. (See **Exhibit 6** for timelines of problem recognition and solution development.)

Early in Newell’s directorship, Exponent was brought back as the REF’s science and engineering consultant. Another firm had won the contract two years before, but that relationship had not succeeded. A critical benefit that Exponent brought, from the perspective of the REF, was that it had technical expertise without the bias that having a product to sell would entail.¹⁴ Exponent could design solutions to problems, but those designs belonged to the army, which could purchase the items from any supplier. Sometimes Exponent made the first few pieces, with other suppliers making larger quantities.

The REF had long ago established laboratories in Iraq and Afghanistan, where they could make parts to address problems soldiers faced. In 2010, prior to Exponent’s return, there were two such labs in Afghanistan, one each at large bases in Bagram and Kandahar. However, these REF labs had become isolated. The staff at the REF labs did not interface with the staff in the larger base labs, and were not open to interactions with soldiers stationed at the bases. Furthermore, the REF labs were duplicating capability that was available from the much larger base facilities. Newell encouraged lab personnel to work with the other base labs, and commissioned mobile laboratories (designed with the help of Exponent, and built by Applied Minds, Inc.) to be developed that could be airlifted to forward operating bases. These labs included conventional fabrication equipment as well as 3-D printers that could be used for rapid prototyping. In addition to the army personnel that staffed the labs, two Exponent engineers were based at Bagram and two at Kandahar, frequently visiting front-line troops to understand the problems

¹³ Newell presentation, February 5, 2013. Emphasis in the original.

¹⁴ Exponent’s expertise was as a failure analysis company, not a product manufacturer.

they faced. The Exponent personnel benefitted from being able to call upon the expertise of about 650 scientists and engineers in the larger Exponent organization in the States.

Once problems were understood, Newell grouped them into prioritized categories. This avoided the “Candy Man” approach, striving instead to address problems, and create solutions, that would have broad, lasting benefit. The top four items on the REF Integrated Priority List (RIPL) accounted for two-thirds of REF requirements: dismounted IED defeat;¹⁵ dismounted operations support; intelligence, surveillance, and reconnaissance (ISR) support in environmentally inhospitable operating environments; and small COP/PB (combat outpost/patrol base) force protection and sustainment (see **Exhibit 7**).¹⁶

The impact of the RIPL on dismounted IED defeat was noted by Greene:

It allowed people to put some focus on it and look at the larger problem, rather than dealing with the requests one at a time in a haphazard fashion. [Previously, after the first request], the next guy would ask for something a little different, and they’d go get that for him, and all of a sudden you’ve got a logistical nightmare, you have a training nightmare, and you may or may not have any enduring capability worth talking about.

Communication Between Users and Developers

The standard process for evaluating needs, and the effectiveness of equipment, was a survey given to troops when they returned home from deployment. However, after arriving home from a long deployment, troops had little interest in completing a long survey, and often could not even remember details related to new equipment. Newell observed:

The developers aren’t in theater watching the problem, the user can’t remember what the problem was, and quite honestly, if you were out of theater for six months, what you remember is irrelevant because things have changed so fast. So what we really want to do is get somebody on the spot who is drawing that out of people as it’s happening [as was Jette’s original vision].

Having mobile laboratories, opening labs to soldiers on the bases, and deploying skilled engineers helped to quickly comprehend problems and get feedback on potential solutions. As Newell noted:

When you very quickly place something in somebody’s hands, that’s when you start having an honest conversation about what the problem is. So the faster you place that first, best, 60 percent solution in a soldier’s hand, the faster you’re really going to have an honest discussion about what the problem really was. And that’s really what we were after.

While there were many examples of dramatic solutions that resulted from understanding problems facing soldiers, a seemingly simple issue illustrated the power of having

¹⁵ Dismounted troops are those travelling on foot rather than in a vehicle.

¹⁶ Newell presentation, February 5, 2013.

knowledgeable experts in the field. Transportation in Afghanistan was difficult, with convoys frequently driving through riverbeds and other rough terrain. Tires on army vehicles had inflation-protection systems, but were unable to maintain pressure if their valve stems were broken off. As described by a sergeant in a forward support company, “When you go through the wadis [riverbeds] and dig in, those valve stems have no protection.”¹⁷ When a valve stem broke, it forced the vehicle, and the entire convoy, to stop. This delayed the mission, left soldiers vulnerable, and sometimes required another convoy to be dispatched to bring the stricken vehicle back. In just a year, more than 50 MRAPs had suffered broken valve stems. The sergeant brought the problem to a REF mobile lab attached to a forward base, where Exponent engineers and REF machinists immediately began prototyping solutions. Soon, REF valve stem protective covers were installed on MRAPs. The army was working on a permanent solution, expected to be available in about a year. In the meantime, the REF lab fabricated parts to protect the vehicles.¹⁸ (See **Exhibit 8** for a list of selected REF solutions.)

Being married to the problem also revealed instances in which the solution was not a physical device, but rather improved training or procedures. For instance, forward outposts generated their own electricity. Fuel to run the generators was brought in by convoy, or as was more often the case in Afghanistan, by helicopter. Bringing fuel to these outposts was both expensive and dangerous, so it was highly beneficial to reduce fuel consumption; Newell cited estimates that “for every 20 convoys that roll across the harsh terrain, one soldier dies.”¹⁹ One problem was that units used generators at well below their optimum capacity; a generator operating at 20 percent capacity used more fuel than one operating at full capacity, and was more prone to failure. To reduce the fuel demand and improve performance, REF scientists partnered with the army’s program manager for mobile electric power. Together, they developed a suite of solutions that dramatically reduced fuel consumption, decreasing both cost and the need for refueling missions. These solutions were implemented by army personnel trained to serve as energy advisors assisting the forward bases. Burke noted:

[The REF] really deserves a lot of credit for diagnosing that [training] was a big part of the problem. [Others had recognized that this was a problem] but, it was the REF that really went in and did something about it... part of the effort that they engaged in with all these program managers was to put an energy advisor in at the brigade level... By all accounts he [the energy advisor] did more good for deployed forces than all of the technology efforts combined.

Collaboration

Newell started an aggressive collaboration program, with military and government organizations, and with academia and industry. This was an essential part of the culture that Newell tried to instill in the REF. He wanted to collaborate with soldiers to anticipate their problems, with industry to understand what was available, and with academia to understand what was possible.

¹⁷ Spc. Mark VanGerpen, “Rapid Solutions Improve Soldiers’ Capabilities,” Defense Video and Imagery Distribution System, May 12, 2013, http://www.dvidshub.net/news/106804/rapid-solutions-improve-soldiers-capabilities#.UkBhXj_57IE (accessed September 4, 2013).

¹⁸ Ibid.

¹⁹ Deborah Zabarenko, “Sipping, Not Guzzling, Fuel on Afghanistan’s Frontlines,” Reuters, May 10, 2012, <http://www.reuters.com/article/2012/05/10/us-afghanistan-usa-fuel-idUSBRE84907Z20120510> (accessed June 7, 2013).

(See **Exhibit 9** for a description of the culture Newell tried to instill in the REF, and **Exhibit 10** for the personality attributes he believed were essential to the REF's success.)

As Mason observed:

[Newell] didn't have to own it to leverage it. And he would go out and partner with lots of different people to try to get things done. [The REF] was a relatively small organization. He had a fair amount of money, though, which was attractive to other people. But he needed other people to help him, so I think he was very good at building coalitions and partnerships.

To build relationships with the acquisition community and others in the military establishment, Newell initiated a board of directors that would oversee REF's activities. Rather than fostering a culture of isolation and self-reliance, he actively sought out partners throughout the military, as well as instilling an atmosphere of transparency. The board consisted of senior representatives of the organizations responsible for requirements, acquisition, and training (see organization chart in **Exhibit 4**).

Improving the REF's relationship with the acquisition community was essential to having a long-term impact on the army. There was a natural tension between the REF and the acquisition community. One observer noted that, "The acquisition folks don't like the REF in general. Because one, they think it's their job, and two, they think the REF is pushing envelopes." However, Newell's outreach to the acquisition community generated mutually beneficial results.

In stark contrast to previous practice, Newell involved the acquisition community in REF projects from the beginning. This helped transfer knowledge about potential new equipment that might be used throughout the army as a whole, and helped speed the formal requirements-generation process. It also passed on knowledge of what had already been tried, but had not worked as well as expected.

One effect of improved relations meant that the REF helped define requirements that the conventional acquisition organizations were working on. Frulla described the help that the REF and its scientists provided to a project of PEO Soldier, the organization responsible for all equipment that soldiers wore or carried. The project was addressing mild traumatic brain injury (MTBI).

We are doing a future program where REF engineers are reviewing our statement of work and performance parameters within the contract, to ensure that lessons learned in MTBI and in blast sensors are incorporated into future products. Those guys actually are influencing the future product on the big army side by helping review performance work statements. I think that's a direct tie back to Newell, because that has not happened before. And we sure as hell didn't invite him. It just happened by force of personality and us talking together. He wanted to review the stuff. And it makes absolute sense, so, that's a positive change that I think you can tie straight back to Pete [Newell]. [Previously, if the REF] ever asked us that, I guarantee he wouldn't have gotten it. And that comes from a trusting relationship.

Newell travelled widely, seeking out individuals and organizations that could help the REF grow its capabilities as well as collaborate on solving problems. He developed partnerships with universities such as Stanford and the Massachusetts Institute of Technology, design studios such as IDEO, and innovative companies such as Local Motors. He promoted the concept of co-creation, in which soldiers in the field could identify problems, and have a broad network of support to quickly find solutions. The collaboration with Local Motors, announced in February 2013, was illustrative. The company was co-founded by a marine, and utilized both internal designers and a crowd-sourced community of collaborators (“co-creation”), combined with micro-manufacturing to rapidly design and produce innovative vehicles. The combination of collaborative design and rapid manufacturing provided the capability to “innovate at the speed of conversation.”²⁰

Commenting on the need for outside feedback and opinions, Newell said:

When REF stopped talking to people and started getting resistant to feedback and pushback from people, they started missing all of the rich context that comes from the discourse. I revel in it. If somebody has a problem with something I’m doing, I would love to see that guy standing in front of me. Out of that conversation I’d get some pretty good stuff, and it would help us do a better job of delivering what we’re supposed to.

Collaboration worked both ways, in both finding important problems and in developing solutions. Burke noted that shortly after joining the Department of Defense:

One of my early office calls with Pete [Newell]. He heard me out and said they were interested in this area, although it’s always hard to say with those sorts of conversations when there’s a genuine interest and when it’s just what I call “affable noncompliance” associated with my rank. In any case, I never told them what to do, but we exchanged information and talked about the opportunities. That was really helpful, and it also laid the groundwork for future collaboration.

The Improvised Explosive Device (IED) Problem in Afghanistan

The REF’s focus on the problem of IED attacks on dismounted troops in Afghanistan illustrates the impact focusing attention on key priorities, rather than providing uncoordinated responses to individual requests. Shortly after he came to the REF, Newell visited Afghanistan. As a former brigade commander, he had personal relationships with the commanders in Afghanistan, and could get “brutally honest” responses to his questions. As he recalled, “[I talked to] four guys who I have tremendous respect for, and the first words out of their mouths were, ‘If you do nothing else, solve the IED attacks against our dismounted soldiers walking around on the battlefield.’” By October 2010, hundreds of soldiers were being killed and wounded by IEDs every month in Afghanistan.

²⁰ Local Motors Press Release, “Local Motors Announces Partnership with U.S. Army Rapid Equipping Force,” February 3, 2013, <http://localmotors.com/press/releases/local-motors-announces-partnership-with-us-army-rapid-equipping-force/> (accessed September 23, 2013). An army co-creation website, <https://armycocreate.com/> was launched on October 23, 2013.

Earlier, IEDs had been a significant problem in Iraq, which had eventually been substantially alleviated by significantly improving the armor on vehicles. In fact, the REF under Jette had provided an “up-armor” solution to increase the protective capabilities of Humvees in Iraq. Movement in Iraq, however, was vastly different than in Afghanistan. In Iraq, troops moved by road. By 2010, the army had spent billions of dollars to supply large armored vehicles to Iraq, specially equipped to protect occupants, and to detect and defeat IEDs. There were special procedures for clearing roads so that convoys could safely pass.

There were few roads in Afghanistan. Ground travel outside the major cities was by trail or over open ground. Using large armored vehicles, even when it was physically possible, isolated troops from the Afghan people they needed to work with to defeat the Taliban. So, most work was done by small patrols of soldiers on foot, which were highly vulnerable to IEDs. While the REF developed its three-ring binder of great deeds, it had not been effectively addressing this problem. Neither had the Joint IED Defeat Organization (JIEDDO), a multi-billion dollar Department of Defense effort.

The IED problem illustrated one of the challenges facing the REF, and the reason for its emphasis on bringing solutions rapidly to the soldier. Indeed, by the time a problem was recognized, the solution was already too late. In October 2010, when Newell learned of the IED danger to dismounted troops in Afghanistan, there were about 600 attacks per month. Every day that passed without an effective solution—one that worked and was being actively used by soldiers in the field—more troops were being killed and wounded. The spike in IED attacks against dismounted troops had actually begun ten months earlier, when marines went into Helmand Valley in southern Iraq to eradicate poppy fields. IED attacks exceeded 300 per month every month thereafter, jumping to nearly 600 in October and 900 in November.²¹

The REF initiated at least ten projects addressing the problem, attacking the problem from many angles. These included handheld IED detectors, a rocket launched explosive line that could be carried by a soldier and clear a section of trail, and several types of robots. One robot, the Sand Flea, had been developed by DARPA. Sand Flea was a small, 10-pound robot that could jump over walls, allowing soldiers to inspect an area without having to knock down walls or climb over them while wearing 100-pound packs, leaving them vulnerable to ambush and IED attack. The REF began by shipping ten Sand Flea robots to Afghanistan for soldiers to test. No additional units were purchased, but lessons learned informed future robot designs. Another robot was even smaller, 1.3 pounds, and could be thrown by soldiers, then driven to inspect for threats—after the initial tests of this robot, several thousand were ordered. Still a third was designed to operate in difficult environments such as high grass, or under mud and water in canals.²²

These and other tools helped reduce the number of IED attacks against dismounted troops. The effectiveness of each project varied, but even those that were ineffective provided valuable

²¹ Data from presentation by Col. Peter Newell at Stanford Graduate School of Business, February 5, 2013.

²² Michael Hoffman, “Leaping Sand Flea Robot Heading to Afghanistan,” *Marinecorpstimes.com*, November 12, 2011, <http://www.marinecorpstimes.com/article/20111112/NEWS/111120315/Leaping-Sand-Flea-robot-heading-Afghanistan> (accessed August 14, 2013). Information on subsequent actions on the Sand Flea and 1.3 pound robot from Newell, e-mail communication with the author).

feedback for future solutions. Some solutions, such as the hand-thrown robot, were immediately expanded upon by the Joint IED Defeat Organization, which coordinated all Department of Defense efforts regarding IEDs.

Opportunities for Continued Improvement

While the REF made a substantial contribution to the welfare of soldiers and their ability to complete their missions during Newell's tenure as director, there were areas in which observers saw missed opportunities. David Markowitz, the direct supervisor of the REF director, and the U.S. Army's G-3 (Operations) representative to the REF Board of Directors, noted that "For a lot of the innovative ideas that REF did, few of them displaced other army programs of record [standard acquisition programs] the way one would have expected given REF's success." Markowitz cited both institutional bureaucracy as well as the perception that the capability gaps the REF addressed were unique to Afghanistan, and not applicable to the army of the future, as causes for the traditional system not rapidly addressing warfighter concerns.

A continual issue for the REF was training and support of its solutions. This had been a significant problem prior to Newell's arrival, as products had been delivered to units that requested them, but either did not solve the problems, or were no longer used once the original unit returned from deployment. Newly deployed troops either did not want the equipment, or did not know what to do with it, or were so poorly trained on the use of the equipment by the unit they replaced that they were completely ineffective. Many people interviewed described REF material that was relegated to the CONEX. Newell tried to address this by training troops prior to deployment, and improving documentation, but this was a continuing challenge.

Mason observed that one of the reasons the conventional system took many years to develop equipment was the need for determining failure rates, planning repair parts and maintenance, training of support personnel, and related DOTMLPF tasks needed to "build the tail that goes with that widget." Mason said: "There are a lot of times I would get calls from the field saying, 'Hey, I've got this new piece of equipment here, and it's broken, and I can't get anybody to fix it, and I don't know where to order my repair parts.' It's somewhat a cost of doing business based on the urgency of the need in theater, and I don't know how we could have done it a lot better." However, he suggested that some additional effort and direct involvement by logistics support specialists early on in the REF process might have resulted in more sustainable solutions. He also suggested that allocating some small number of the new REF equipment to training facilities/bases, rather than sending them all to theater, would have helped with training soldiers how to properly operate and maintain this new equipment before they deployed; they basically learned on the fly in Iraq or Afghanistan.

Newell's limited term as director was also cited as the cause of missed, or endangered, opportunities. Newell had a steep learning curve as director, as he began with no background in many essential aspects of the REF's operations, and with the need to develop new relationships, and rebuild previously burned bridges. As a result, not all of his initiatives could be institutionalized by the time his three-year term expired. Some would need ongoing efforts on the part of his successor before they could have a lasting impact.

Another concern was preparation for postwar financial realities. The REF was created and funded to address a critical wartime need. In the postwar world, it would need to compete for funding with a well-established army bureaucracy. One criticism of the REF during Newell's directorship was that it did not transition its successes quickly enough to other organizations, and had not decreased its size to a sustainable level. Greene, a member of the REF board of directors, observed, "The base budget's²³ is going down, the army is getting smaller, the amount of money in R&D is getting smaller, and the R&D budgets are going to take a disproportionate hit because there are some other things we can't bring down as fast as we like as we bring down the [larger army] structure. So that money is precious." Greene continued, saying that the army had to decide how much innovation it could afford in the future, "as we don't have the forcing function that comes from having guys in conflict."

THE FUTURE OF THE REF

Newell left the REF in May 2013, retiring from the army shortly thereafter. Conscious of the challenges of his transition to the REF, he had arranged for an MIT professor and a former Intel executive to shadow him, taking notes on how Newell operated, and setting up the training program for his successor: what he needed to know, in what order, and why things worked the way they did.²⁴

As Newell left the REF, the organization faced an uncertain future. The war in Iraq had ended, and the war in Afghanistan was winding down. Wartime funding would soon end, and military budgets were being cut.

The REF had served an important function in wartime, but many had questions about its proper size and role in peacetime. Some questioned its ability to survive budget cuts and the resulting competition for funding. As Greene observed, "You start to get pushback [from REF funding requests], and the natural response is: 'We don't need these guys at all.' Well, I think you do want some of that. It's a question not of 'do you need it,' but 'how much can you afford.'" He continued,

So, how do you make that organization flexible enough that as the demand from conflict comes down, you keep a core of capability tied to some reasonable quantity of funds to pay the core expenses, and build partnerships with others to leverage their resources and keep that incubator going, albeit at a lower level? And be ready when the next conflict comes.

Another general, who had commanded troops in Afghanistan and benefitted from the REF's efforts, was a strong advocate of preserving the REF's capabilities in peacetime, but pessimistic about its future, saying "I think that we'll get rid of the REF. I think the bureaucracy will eat the REF."

²³ The "base budget" was the army's ongoing budget, outside wartime supplemental funding.

²⁴ This team had been hired to study the REF's processes and help streamline them, as well as to document the effectiveness of Newell's efforts to change the REF. The training function was added when it became clear that there would not be an overlap between Newell and his replacement.

There were several questions that had to be answered about the REF in a postwar army: how large would it be; who would it report to; what would its acquisition authority be; how would it be funded; and what type of requirements authority would it have (would the REF retain the 10-liner, REF-authorized, requirements definition)?

Lieutenant General Keith Walker, the Training and Doctrine Command (TRADOC) Deputy Commanding General, Futures, and the director of the Army Capabilities Integration Center, said:

It's essential we maintain the REF capability. However, we need to do so in a way that keeps the best of it, which means you get the stuff fast, but mitigates the shortcomings, which means a full assessment of the training implications and life cycle sustainment costs. I think there's goodness in maintaining an organization that can adapt so that when the nation needs them, they could expand to whatever they need to be. We don't want to have to do this from scratch again.

Walker advocated making the REF part of TRADOC, reporting directly to a four-star general. TRADOC was responsible for capturing lessons learned and incorporating them into standard army practices. In 2011, it added, as an independent organization, the Asymmetric Warfare Group (AWG). The AWG had been formed in 2004 to rapidly respond to a changing environment, and disseminated knowledge related to fighting terrorists, insurgents, and other irregular troops. The commander of the AWG reported directly to the commander of TRADOC. The AWG developed rapid capabilities with a non-material focus, while the REF developed rapid capabilities with a material focus. In the postwar world, without special wartime funding, the two seemed to be a natural fit.

One challenge in maintaining the REF's problem-solving capability after the war in Afghanistan wound down was having a laboratory in which problems could be uncovered and solutions tested. Iraq and Afghanistan had provided real-world laboratories. After leaving Afghanistan and Iraq, there were several possible venues for experimentation. One was in army Combat Training Centers (CTC), where soldiers could be trained to use new equipment developed by the REF; however, the CTCs would be unlikely to provide the full range of input on problems, and feedback on potential solutions that was a critical part of the REF's innovation process.

A second possibility was the Brigade Modernization Command (BMC), a unit of TRADOC that conducted operational evaluations of equipment as part of exercises at Fort Bliss, El Paso, Texas, every six months. BMC had the advantage of having capability evaluations across the DOTMLPF as its mission. As Walker pointed out, "The Second Brigade, First Armored Division, is attached to BMC to conduct capabilities evaluations in an operational environment. This is not a test brigade. It's a regular brigade. The only difference is that they try out new stuff. They ask [soldiers] more specific questions, but very broadly: 'What are the implications of this new capability? Would you want to take it to war tomorrow?'"

Another factor was the changing nature of the military with respect to innovation. In World War II and during the Cold War, the military was a significant driver of technology development. These periods were characterized by the development of major weapons systems that required large investments and new technologies. By the 2000s, the nature of military purchases had

shifted. There was still a need for fighter jets, armored vehicles, and other expensive equipment that had no civilian use. Innovation for this equipment would continue to be driven by military requirements. However, the military was increasingly relying on communications, computer, and networking technologies, where military needs were just a small segment of the overall market, and innovation was driven by commercial demand. As Markowitz observed:

A more strategic question for army acquisition or DOD is how much are we an innovator of technology versus an innovator of available technology that's coming from the private sector? I think that that mix is changing and we are slow to realize it. And I think REF is the best example, because it never developed a piece of technology. [It innovated solutions by adapting existing technology.]

Newell was adamant that the REF was essential to the future army. He noted that “combat development is done in combat. Who’s in combat in 2015? [Special operations forces] guys still in Afghanistan. SOF guys in Africa. SOF guys in the Pacific. Regionally aligned forces... REF has been working with [Special Operations Command] more and more as the conventional guys draw down.”²⁵ He continued, saying “Other people can do what the REF does, but virtually no one can do it the way the REF does it at the forward edge of the battlefield. The [mobile] labs become the focal point.”

STUDY QUESTIONS

1. What REF capabilities should the army should preserve or expand as it transitions to peacetime?
2. What is the most effective way to preserve or expand these capabilities?
3. How can the army scale the lessons learned from the REF? What obstacles does it face in scaling these lessons, and how can these be overcome?

²⁵ Paul McLeary, “Rapid Equipping Force Shifts Focus to Postwar,” *Army Times*, June 20, 2013.

Exhibit 1 Glossary

The following are used in both the text and exhibits.

AAE: Army Acquisition Executive
ACA: Army Component Commands
ACQ: Acquisition
ASA(ALT): Assistant Secretary of the Army for Acquisition, Logistics and Technology
BMC: Brigade Modernization Command
COP: Combat Outpost
COTS: Commercial Off-the-Shelf
CTC: Combat Training Center
DAG3: Department of the Army, G3 (leads operations synchronization within the Army)
DARPA: Defense Advanced Research Projects Agency
DOTMLPF: Doctrine, Organization, Training, Materiel, Leadership, Personnel, Facilities
ECP: Entry Control Point (checkpoint)
G3/5/7: Operations (at division or higher level)
GOTS: Government Off-the-Shelf
IED: Improvised Explosive Device
ISR: Intelligence, Surveillance, Reconnaissance
JCIDS: Joint Capabilities Integration Development System
JIEDDO: Joint IED Defeat Organization
MDA: Milestone Decision Authority
MRAP: Mine-Resistant Ambush Protected [armored vehicle]
MTOE: Modified Table of Organization Equipment
MTBI: Mild Traumatic Brain Injury
NCO: Non-Commissioned Officer
OCO: Overseas Contingency Operations
OE: Operating Environment
OMA: Operations and Maintenance, Army
ONS: Operational Needs Statement
OPA: Other Procurement, Army (funds purchase of single items of less than \$250,000)
PB: Patrol Base
PM: Program Manager
RDTE: Research, Development, Test, and Evaluation
REF: Rapid Equipping Force
RIPL: REF Integrated Priority List
RIRS: Rapid Integration of Robot Systems (the predecessor of the REF)
RPG: Rocket Propelled Grenade
S1: Personnel (at battalion and brigade level)
S2: Intelligence (at battalion and brigade level)
S3: Operations and Training (at battalion and brigade level)
S4: Supply/Logistics (at battalion and brigade level)
SAF: Small Arms Fire
SOF: Special Operations Forces

TRADOC: Training and Doctrine Command
VCSA: Vice Chief of Staff of the Army

General Officer Ranks

Brig. Gen. – Brigadier General (one star)
Maj. Gen. – Major General (two stars)
Lt. Gen. – Lieutenant General (three stars)

Exhibit 2 The REF Mission

The following slide describes the REF's mission to "equip, insert, assess," as interpreted by Newell in 2013.



The US. Army Rapid Equipping Force (REF) was established in 2003 to combine and integrate functions that cross several Army staff elements and Army Component Commands (ACC) for the purpose of accelerating material solutions and technology insertion to forces committed in the Global War on Terror. In 2005, the CSA further refined REF's mission to include the following three broad functions.

1. Provide the Army's rapid response capability to develop, prototype, acquire and integrate commercial and government off-the-shelf solutions to meet urgent combat requirements for deployed forces. *"The Army's Insurance Policy"*
2. Develop and insert selected future force technologies, capabilities and surrogate material solutions into committed, deploying and transformational forces for operational evaluation, assessment and spiral development. *"Direct support to ARCIC, BMC, MBL"*
3. Plan and execute assessments and studies of Army practices and issues concerning operational needs, desired future force capabilities and relevant Army business practices to provide feedback to Senior Army Leaders *"Cross-domain firefighting"*

Source: Newell slide presentation dated February 13, 2013, provided by e-mail.

Exhibit 3 The REF Ten-Liner

One of the powerful tools of the REF was the “10-liner,” a simplified requirements definition document. Once approved by the REF director, the 10-liner became an official acquisition requirement. This replaced a detailed Joint Capabilities Integration Development System (JCIDS) process in the conventional acquisition procedure, which could take a year or more to develop.

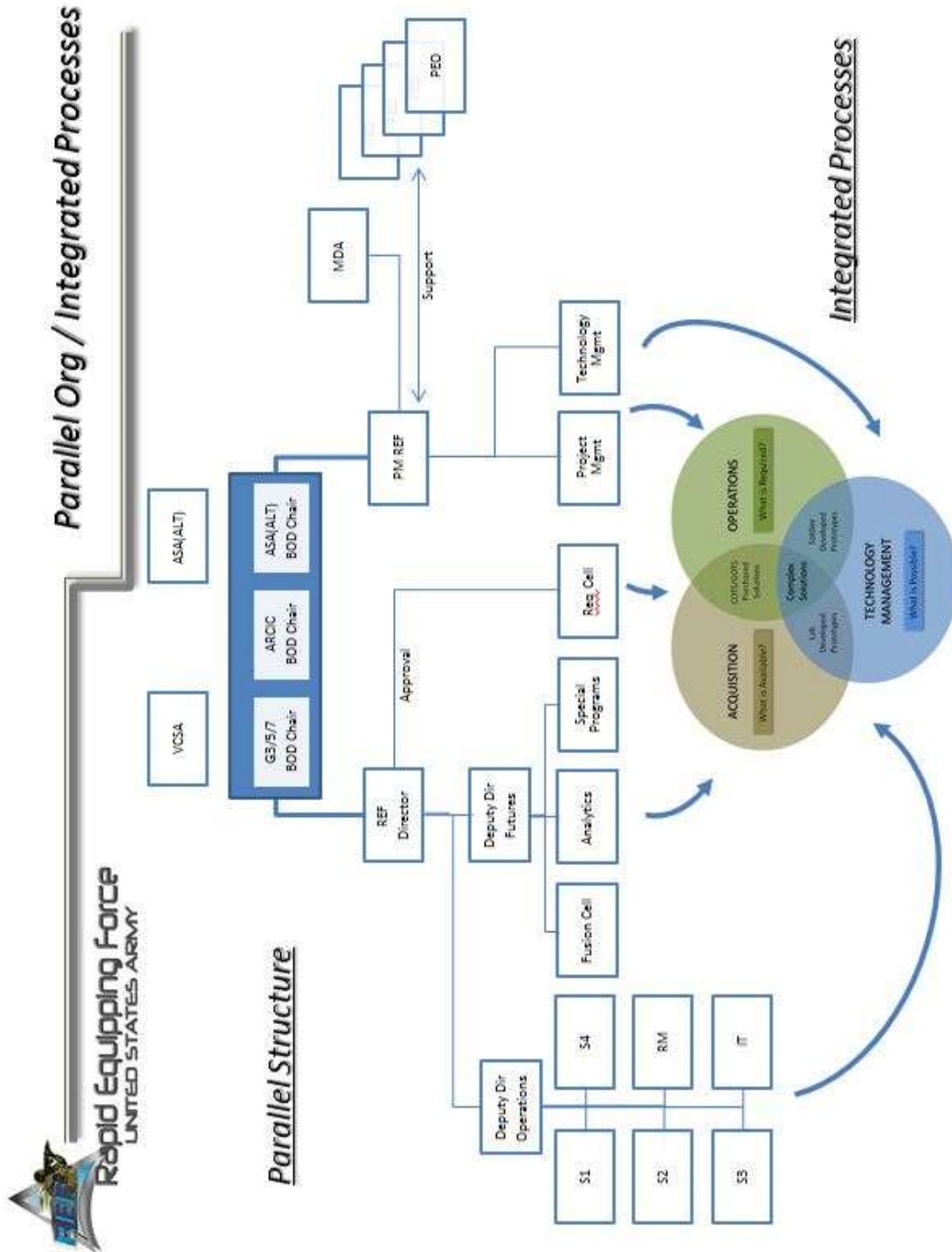
The 10-liner consisted of the following items:²⁶

- Problem
- Justification
- System characteristics
- Operational concept
- Organizational concept
- Procurement objective
- Support requirements
- Availability
- Recommendation
- Coordination accomplished

²⁶ “Report of the Defense Science Board Task Force on the Fulfillment of Urgent Operational Needs,” Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, July 2009, p. 13, <http://www.acq.osd.mil/dsb/reports/ADA503382.pdf> (accessed September 20, 2013).

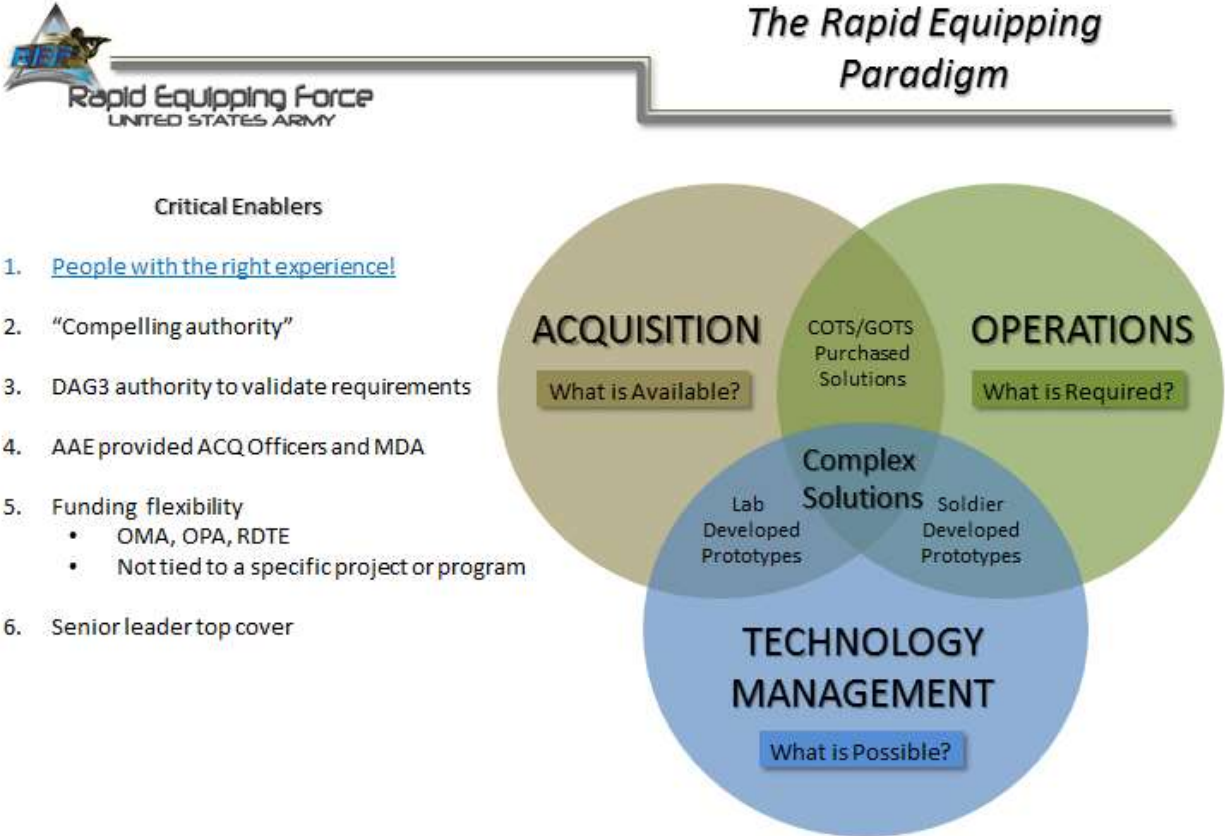
Exhibit 4 REF Organization

(See Exhibit 5 for larger view of Integrated Processes diagram.)



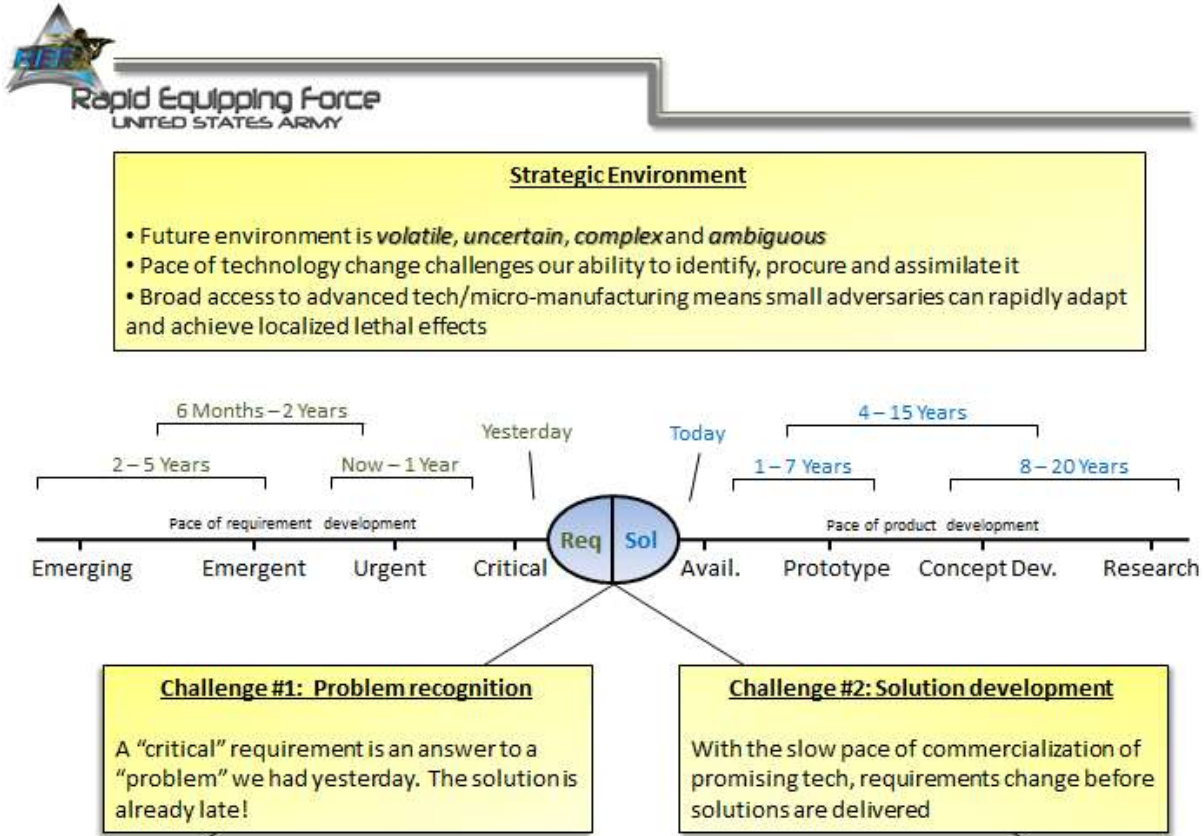
Source: Newell slide presentation, February 13, 2013.

Exhibit 5 The Rapid Equipping Paradigm



Source: Newell Presentation, February 13, 2013.

Exhibit 6 Challenges and Timelines for Army Problems and Solutions



Source: Newell slide presentation, February 13, 2013.

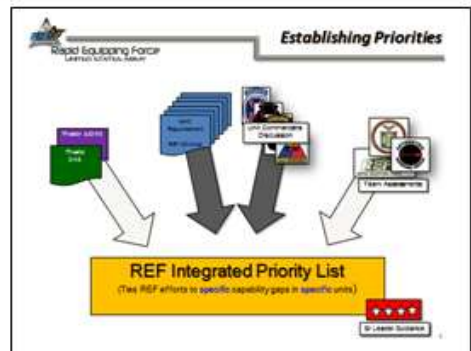
Exhibit 7 REF Integrated Priority List

Newell initiated the REF Integrated Priority List, identifying important areas of focus, and enabling coordination of solutions.



- | | |
|---|--------------------------------|
| <ol style="list-style-type: none">1 Dismounted IED Defeat2 Dismounted Operations Support3 ISR Shortfalls in Environmentally Inhospitable OE's4 Small COP/PB Force Protection and Sustainment | 66% of REF Requirements |
|---|--------------------------------|

- 5 Dismounted Blue Force Tracking and Mission Command
- 6 Counter Ambush (precision against SAF and RPG)
- 7 Advanced Escalation of Force and Non-Lethal Messaging
- 8 ECP Operations and Vehicle Search Operations
- 9 Route Clearance Support
- 10 Other



Source: Newell slide presentation, February 13, 2013.

Exhibit 8 Selected REF Solutions

A few of the thousands of solutions developed by the REF include:

- PackBot: Portable robot for clearing caves.
- SUGV (Small unmanned ground vehicle): Lightweight, rugged robot with a camera mounted on an arm for intelligence, surveillance, and reconnaissance mission. SUGV can climb stairs, and enter dangerous locations. (1)
- Sand Flea: Lightweight robot that can leap up to 8 meters (26 feet) to investigate rooftops, inside buildings, or jump over walls. (1)
- Minotaur: Robot that detects and clears IEDs. (1)
- IBESS (Integrated Blast Effect Sensor System): Sensors worn by soldiers and mounted in vehicles to collect data that can be used to improve future designs and evaluate long-term health impacts of explosions. (1)
- Valve stem covers: Prevent tire deflation when traversing rough terrain. (2)
- Wallboard panels that improved insulation and decreased energy use in remote outposts. (3)
- Hybrid power system that stores excess electricity generation in batteries, reducing generator fuel consumption at small outposts. (3)
- Solar array for power generation. (3)
- Wellcam video system for searching wells. (4)
- Lock Shims: lock picking devices so that soldiers could enter buildings to conduct searches without breaking the door. (4)
- Hand-held thermal viewer. (4)
- Electronic countermeasures for HumVees, to jam frequencies monitored by enemies. (4)
- Strobe/laser to force approaching drivers to stop at checkpoints. (5)
- Small Tactical Multi-Payload Aerostat System: Portable aerial balloon that can be used for 24-hour surveillance, replacing the need for helicopter operations. (6)
- Mine Hound and Gizmo: Hand-held IED detectors. (7)
- Man Portable Line Charge: Lightweight, rocket launched explosive line for clearing mined or trip-wire explosives. (8)

Sources:

1. REF Website (<http://www.ref.army.mil/portal/challenge.html>, accessed September 25, 2013).
2. VanGerpen, loc. cit.
3. Zabarenko, loc. cit.
4. Heike Hasenauer, "Faster Equipping of U.S. Forces," *Soldiers Magazine*, August 23, 2005, <http://www.ref.army.mil/pdfs/FasterEquippingofUSForces.pdf> (accessed April 10, 2013).
5. Mario Loyola, "MacGuyvers in the Desert," *National Review*, October 15, 2007.
6. Alison Sanders, "U.S. Army Rapid Equipping Force Looks to Small Business Innovation in Aerostat Technology," Department of the Army Office of Small Business website, <http://www.sellintoarmy.info/content/us-army-rapid-equipping-force-looks-small-business-innovation-aerostat-technology> (accessed September 25, 2013).
7. Sgt. Christopher McCullough, "Counter-IED Teams Locate Roadside Bombs Using 'Metal Detectors on Steroids,'" U.S. Army Website, July 6, 2012, <http://www.army.mil/article/83170/> (accessed September 25, 2013).
8. Spc. John G. Martinez, "SecArmy Commends REF on Innovative Solutions," U.S. Army Website, January 15, 2013, http://www.army.mil/article/94347/SecArmy_commends_REF_on_innovative_solutions/ (accessed September 25, 2013).

Exhibit 9 REF Culture, under Col. Peter Newell



- Collaborative, transparent and inclusive of different opinions. Partnerships built outside REF focused on specific problems
- Married to the problem, not any proposed solution...invest to better understand the problem, then don't let it go until the user says its solved
- Negotiate performance and cost, not time to deliver. Incremental development used to improve performance and reduce cost . Refine emerging requirements and potential solutions before the Army makes a major investment
- Lean forward
 - With Soldiers to better anticipate their problems
 - With Industry to better understand what's available
 - With Academia to better predict what's possible

Source: Newell slide presentation, February 13, 2013.

Exhibit 10 REF Officer's Personality



Rapid Equipping Force
UNITED STATES ARMY

Personality

CREATIVE CONFIDENCE

- Aggressively curious – asks questions to learn
 - Empathetic – works hard to understand a problem from the users perspective
 - Able to connect/align ideas – strives for a cross-domain understanding of problems & potential solutions to include down-stream effects
 - Unafraid - willing to take risk & try something different in order to learn more
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- Active peripheral scanner – constantly looks for emerging threats and opportunities
 - Able to tell a good story – can portray the emotion behind a problem
 - Humble – knows that there is always somebody smarter & whom has a better idea; constantly looks for them

Source: Newell slide presentation, February 13, 2013.