



MTAPP POSITION PAPER

**The Department of Defense Improvised Explosive Devices (IED) Defeat
Efforts and Potential Small Business Role**





IED Defeat – Urgent DoD Priority, Small Business Opportunity?

Why MTAPP covers this topic?

Like viruses adapting to outlive antibiotics, insurgents in Iraq have consistently outmaneuvered Allied efforts to address the rising death toll associated with Improvised Explosive Devices (IED).

In the terrorist attacks in Madrid and London, those devices were the plotters' weapons of choice. Counter terrorism experts believe that it is only a matter of time before we face the same types of IED attacks in the US.

In an effort to provide better detection, avoidance and survivability from the IED threat, the Department of Defense (DoD) has invested over \$3 billion through focused research and rapid deployment efforts.

The challenge for many small businesses interested in participating in addressing this urgent challenge is in identifying the organizational component pieces that represent integration opportunities.

Unlike other more established programs or fields, IED Defeat is both relatively new in its structure and undefined in its execution. As Time Magazine recently pointed out:

“Efforts to coordinate Administration plans to deal with the danger have stalled in part because of inexperienced leadership and bureaucratic infighting. The Bush Administration created a national IED Task Force, but it has met only once--last November in Washington--and provided no clear steps forward.”

What this report presents?

This report provides subject background and a high level market analysis of the various opportunities for small businesses (SB) within IED Defeat efforts.

DoD IED Defeat Small Business Opportunities

What MTAPP found:

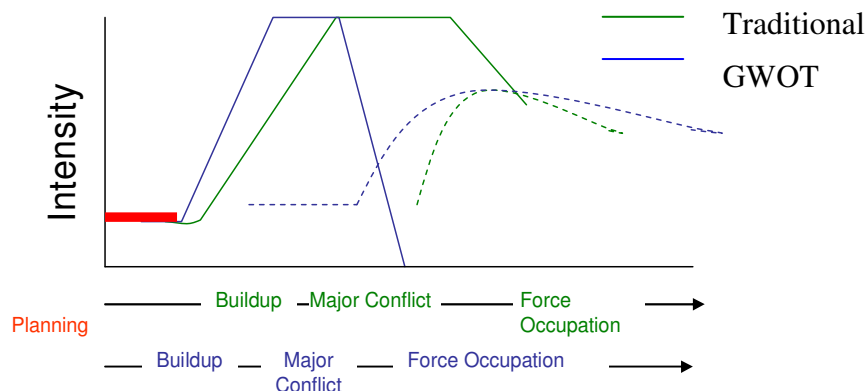
- In Iraq, IEDs have caused more than half of the 2,700 U.S. troop deaths.
- DoD IED Defeat efforts have evolved from a single Army office to a joint task force with 360 dedicated personnel.
- Budget funding for IED defeat has grown to over \$3 billion since FY 2004.
- Efforts to address IEDs are categorized along five general categories:
 - (1) Predict,
 - (2) Detect,
 - (3) Prevent,
 - (4) Mitigate, and
 - (5) Neutralize.
- Currently mitigation of IEDs through the use of Robotics is the more mature solution in place but R&D efforts are focused heavily in the other areas.
- Terrorism experts stress that the IED defeat efforts and the urgency being placed on these is not just for the war in Iraq but just as importantly for future terrorism attacks on US soil.
- In order to participate within this DoD program, small businesses should begin by targeting engineering and technology-based firms that are nearing the prototype phase of their efforts. The strategy for participation should be built on partnering or teaming.

The Changing Face of the Enemy

In a study encompassing five decades of counter insurgency research, the Rand Corporation concluded that “As part of the global war on terror (GWOT), Operations Enduring Freedom and Iraqi Freedom showcased the dazzling technological capability and professional prowess of the U.S. military in conventional operations. Yet the subsequent challenges posed by insurgency and instability in both Afghanistan and Iraq have proved much more difficult to surmount for both the military and civilian agencies. Further, this difficulty in coping with insurgency may embolden future opponents to embrace insurgency as the only viable means of combating the United States. Thus, both the current and future conduct of the war on terror demand that the United States improve its ability to conduct counterinsurgency (COIN) operations.”

As this and other widely publicized accounts have demonstrated, the warfighter realities within GWOT (**Exhibit 1**) have forced a change in DoD priority, moving “Stabilization and Reconstruction” capabilities to the forefront of policy initiatives.

EXHIBIT 1 Changing Requirements for the Warfighter



This shift in the very nature of warfare has stressed not only the logistics community supporting the ongoing operations, but has also placed enormous pressure on those responsible for the design, development and commercialization of technologies. There is no area with a higher level of urgency and dedicated resources than that targeted at defeating Improvised Explosive Devices (IED). IEDs are the leading insurgent weapon of death and injury causing about half of all the American combat casualties in Iraq, both killed-in-action and wounded. The Iraqi insurgents make videos of exploding U.S. vehicles and dead Americans and distribute them via the Internet to win new supporters.

Outside Iraq, foreign radicals see the images as confirmation that the Americans are vulnerable. IEDs are also killing hundreds of Iraqis as insurgents also strike police stations, markets, and mosques. The latest innovation involves the aggressive use of vehicular bombs, two-thirds of which are driven by suicide bombers.

The success of the DoD's efforts to address these challenges and reduce the number of IED casualties has been placed as a top two priority by Defense Secretary Donald Rumsfeld. In addition, Congress remains vigilant in keeping the priority of the DoD and its acquisition community focused on this challenge. The Defense Appropriations Committee's language in the FY 2007 bill included the following statement: "In particular, this legislation sends a clear signal that force protection remains this committee's top priority."

Improvised Explosive Devices (IED) Overview

There is no concise definition of Improvised Explosive Devices (IEDs) beyond the general notion that they may be fabricated from war surplus ordnance, triggered via homemade means, and placed at fixed locations in anticipation that the intended target will eventually pass within range. Device placement is generally based on ease of concealment, and the likelihood that an appropriate target (frequently a US military vehicle) will pass close by. For devices that are detonated upon remote command, the ease with which the target area can be observed is also a critical consideration. The devices are sometimes quite sophisticated: Tripwires, pressure plates, suicide bombers or remote triggers can set them off. And car bombs are another way to deliver IED attacks.

Insurgents have constructed IEDs powerful enough to kill soldiers inside 22-ton Bradley Fighting Vehicles. In one incident in 2004, after a Bradley ran over a large IED, the armored bottom plate of the vehicle was reportedly found some 60 yards from the site of the explosion. In contrast, military units equipped with the 19-ton Stryker medium weight armored vehicle, have reportedly suffered a lower number of catastrophic vehicle losses due to enemy attack. With a maximum speed of more than 60 mph, the Stryker can dash past ambushes and roadside IEDs that might catch the slower moving Abrams tank and Bradley. Between December 2003 and October 2004, news reports show that Strykers deployed in Iraq have successfully withstood 56 attacks by IEDs. Even when vehicles

were rendered inoperable by the attacks, there was reportedly no loss of life among the Stryker crews.

Triggering methods for IEDs may include using a cell phone, a garage door opener, or a child's remote-control toy, or may even be as simple as running over a rubber hose to produce enough air pressure to activate a switch for a mine. At other times, the insurgent may remain concealed and trigger an IED manually. The following techniques describe how insurgents can design and deploy IEDs to amplify the damage:

- **Coupling.** Coupling is a method of linking one mine or explosive device to another, usually with detonating cord. This technique is often used to defeat countermeasure equipment. A heavy mine roller will pass over the initial, unfused device and set off the second fused device. This in turn detonates the over passed device underneath the clearing vehicle.
- **Boosting.** Buried mines, or other explosive devices are stacked on top of one another. The topmost explosives are non-metal, and only the device buried deepest from the surface is fused. This reduces the probability of detection, and it increases the force of the blast.
- **Daisy chaining.** IEDs may be linked together along a roadway with trip wire or detonating cord. When the initial mine is detonated, the other mines also detonate.
- **Shaped Charges.** A cylindrical container is closed off at one end, packed with explosive, and capped by a conical piece of metal that becomes a molten projectile when the device is detonated. The shaped charge concentrates blast energy to punch through armor plating, and then propels the molten metal into the vehicle's cabin.

Improvised Explosive Device Countermeasures

In an effort to provide better detection, avoidance and survivability from the IED threat, the DoD has invested over \$3 billion through focused research and rapid deployment efforts. While the logical

first step in addressing this challenge would be to increase the armor of our vehicles, early strategies to address the IED issue included increasing the quality of armor used for vehicles in Iraq, including up-armorizing the High-Mobility Multi-Purpose Wheeled Vehicles (HMMWV, or Humvees). However, as an apparent response to use of more heavily armored vehicles, insurgents have developed even more powerful IEDs, along with more sophisticated methods for deploying and triggering them.

At present, the framework utilized by the DoD in IED Defeat efforts focuses on:

- (1) Predict,
- (2) Detect,
- (3) Prevent,
- (4) Mitigate, and
- (5) Neutralize.

Predict:

The prediction tenet of IED Defeat strategy focuses on activities that contribute to detection and prevention through forecast of specific enemy operations. Objectives within these efforts are focused on preventing IED production, emplacement through the forensic analysis of IED incidents.

Prevent:

Prevention of the use of IEDs can occur via disruption of mechanisms and structures that support enemy operations. These efforts include infiltration and disruption of insurgent networks and operations. Because insurgents in Iraq continue to quickly adapt their tactics to avoid new U.S. countermeasures, the group will also study ways to eliminate sites where IEDs are manufactured in Iraq.

Detect:

Some experts believe that a more effective IED countermeasure might be achieved through technology that can detect IEDs from afar, and create a pulse of electromagnetic energy to prematurely detonate them, or burn out and destroy their circuitry. Researchers at the Naval Surface Warfare Center's Dahlgren Laboratory in Virginia are working on such a solution, called Neutralizing

Improvised Explosive Devices with Radio Frequency (NIRF). The Pentagon reportedly will deploy NIRF in Iraq later this year. Military contractors are also working on a ways to create a protective area around moving convoys. A Pentagon microwave project, code-named PING, is already deployed in Iraq, and reportedly has been successful at helping locate insurgent weapons caches. The machine, which fits inside a Humvee, sends out electromagnetic waves that can penetrate a building's interior to detect IEDs.

A second method of IED detection involves "change detection" Deputy Under Secretary of Defense for Intelligence Lieutenant General William Boykin describes this need: "As you look at the task to defeat Improvised Explosive Devices (IED), change detection could make a world of difference. If you have a sophisticated change detection system, it could indicate that there is something there that wasn't there hours ago, or even minutes ago - it could be an IED. Change detection, part of Measurements and Signature Intelligence, is a very critical capability. GEOINT is very much a part of this subject and will play a critical role."

Mitigate:

The "Talon" is a bomb-disposal Unmanned Ground Vehicle (UGV), or robot, that comes equipped with a mechanical arm to pick up and inspect dangerous objects, such as suspected IEDs. More than a hundred of the remote-control robots are now being used in Iraq and Afghanistan, with an equal amount on order. Another robot, called the "PackBot" has also been used by the Army to clear bombs and explore suspected terrorist hideouts.

[Note: this topic has been covered extensively in another MTAPP paper – "Small Business Opportunities in the Robotics Value Chain"]

Neutralize:

The Pentagon is also searching for new technologies to help find and neutralize IEDs. Microwave blasts, radio-frequency jammers, and chemical sensors are among the different methods being explored and deployed in this effort. Examples of electronic jamming systems mounted on military vehicles include the IED Countermeasures Equipment (ICE) and the Warlock, which use low-power radio frequency energy to block the signals of radio controlled explosives initiators, such as cell phones, satellite phones, and long range cordless telephones. The Army has recently ordered

thousands of these radio-frequency jammer devices. However, experts reportedly caution that the jammers may only be partially effective because they must be set to operate within the right frequency range in order to stop an IED. Exhibit 2 provides a detailed framework for the DoD approach to IED Defeat.

EXHIBIT 2

IED Countermeasure Strategic Research Vision

Research Thrusts: Game Theory, Multivariate Analysis

| STAGE | Prevention / Prediction | Detection / Surveillance | Countermeasure / Protect | Respond / Put Perpetrators at Risk | Forensics |
|------------------|--|--|---|---|--|
| CAPABILITIES | <ul style="list-style-type: none"> • HUMINT • PSY OPS • Behavioral Pattern Recognition • Source Location • Decoys | <ul style="list-style-type: none"> • Sensors • Stand-off Detection • False Alarm Reduction • Behavioral Pattern Recognition • Unmanned Vehicles | <ul style="list-style-type: none"> • Jamming • Neutralization • Premature Detonation • Unmanned Vehicles • Blast Resistance • Blast Containment | <ul style="list-style-type: none"> • Tagging • Premature Detonation • Interdiction | <ul style="list-style-type: none"> • Backtracking to Source Location • Explosive Characterization • Operational Characterization • Attribution |
| RESEARCH THRUSTS | <ul style="list-style-type: none"> • Psychology and Sociology of Terror • Information Management • Pattern Recognition • Risk Analyses • Artificial Intelligence | <ul style="list-style-type: none"> • Sensor Technologies • Signal Processing • Data Fusion • Pattern Recognition • Autonomous System Control | <ul style="list-style-type: none"> • RF Communications • Energy-based Weapons • Autonomous System Control • Protective Structures • Blast Resistant Materials | <ul style="list-style-type: none"> • Taggants • Energy-based Weapons • Non-Lethal Weapons • Risk Analyses • Information Management | <ul style="list-style-type: none"> • Information Management • Materials • Modeling • Artificial Intelligence |

Finally, at a recent press briefing an Army Colonel offered the following first hand experience on detection: “That's no surprise. That's been the most common way that the insurgents use to inflict casualties on us. We have seen different variations on the types of IEDs they use; they adapt, as you know, to our countermeasures. But from my perspective as a commander, we seem to be gaining on their innovations, because this month as I track our statistics we're at about a 60-percent rate of discovering the IEDs before they're able to be blown up, which is a much greater improvement than six months ago when we first came into theater. So, as they adapt, we readapt; action, reaction, counter-reaction. Right now I think we've got an edge, but we're going to stay watching the situation and adapting as we go.”

DoD IED Defeat Program Structures

While IEDs have been a reality of warfighter efforts since WWII, the current strategic importance of the IED defeat as described above has resulted in a massive increase in the resources committed to “IED Defeat” solutions. DoD has initiated a focused program to address the IED threat. The focal point for this activity is the Joint Improvised Explosive Device Defeat (JIEDD) Task Force. The Joint Improvised Explosive Device Defeat Task Force (JIEDD-TF) was established as a focused complement to the US Army Rapid Equipping Force (REF). JIEDD-TF objective is to provide urgently needed state-of-the-art technology to soldiers in the field to meet and defeat the threat from Improvised Explosive Devices (IEDs). The task force grew out of an Army effort begun soon after soldiers began taking casualties from these homemade bombs in Iraq.

The JIEDD-TF works with Combatant Commanders and soldiers in Iraq and Afghanistan to formulate solutions to identified IEDs and rapidly field solution to deployed units to defeat the IED threat. The JIEDD-TF solutions are a rapid response to the evolving, adaptable and changing IED threats. JIEDD-TF evaluates, utilizes or adapts available COTS/GOTS items, which generally have not been type-classified for Army-wide use but are available and adaptable to the current Combatant Operational Commander's needs. At present, the JIEDD-TF lists the following as its major strategic objectives:

- Identifying key industry partners that can help DoD meet the IED threat;
- Provide industry current information on the IED threat;
- Identify technical approaches and initial industry feedback and recommendations on possible approaches to address the multiple aspects of this threat; and
- Lay the groundwork to establish an effective mechanism for the continuous exchange of information with industry on IEDs and an effective response to the threat.

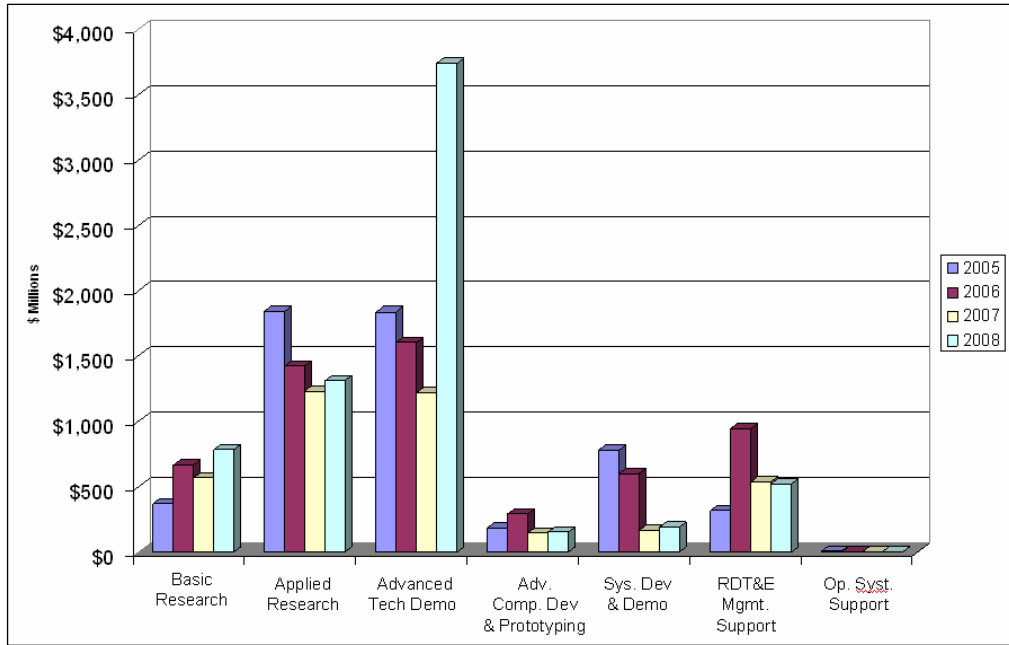
Funding for the JIEDD began with the FY06 Defense Appropriations Bill. The bill set up a transfer account that allowed the Joint Improvised Explosive Device Defeat Organization to “investigate, develop and provide equipment, supplies, services, training, facilities, personnel and funds to assist U.S. forces in the defeat of improvised explosive devices,” (IEDs) with a report to the congressional defense committees required within 90 days of enactment on DOD’s plans. The bill allocated \$1.958 billion to this new account.

The FY07 Defense Appropriations Bill made explicit the continuing commitment from Congress to rapidly address IEDs: “The committee believes strongly that the Department of Defense must not focus on long-term military capabilities at the expense of resetting and recapitalizing the warfighting force that is serving the United States so well in current operations. In particular, this legislation sends a clear signal that force protection remains this committee’s top priority. Through oversight hearings, briefings and numerous trips to Iraq and Afghanistan, committee members continue to follow the significant threat to our soldiers and marines from improvised explosive devices (IEDs), or makeshift road-side bombs. H.R. 5122 reflects the committee’s initiative to ‘take back the roads’ and provide the best available IED jamming devices and persistent surveillance capability this includes \$109.7 million for jamming devices that will prevent the radio-initiation of road-side bombs, which currently cause the majority of U.S. casualties in Iraq and Afghanistan, and \$100 million for at least 10 manned persistent surveillance aircraft to patrol road segments and other areas where IED activity is the greatest.”

Counter IED: \$1.9 billion is provided for the Joint IED Defeat Organization of the Department of Defense in order to test and field new jammers to counter improvised explosive devices (IEDs) employed by our enemies in Iraq and Afghanistan.

Despite its large funding pool and the urgency of the efforts to deploy the technologies that may eliminate some of the IED threat, the majority of funding is still taking place within the early phases of the DoD’s contracting cycles. **(Exhibit 3)**

EXHIBIT 3



IED Defeat – Challenges Remain

Despite the resources, obstacles remain that could be overcome by small businesses. Threat data about IEDs, including technical details on how insurgents build the devices, is tightly controlled by DOD. Also, proprietary rights must be protected for those companies who produce IED countermeasures, which limits the distribution to other companies of some reports that evaluate the effectiveness of anti-IED systems in battle and during testing. As a result, some industry observers say they are not getting access to all the information they need to find solutions to counter IEDs. Some observers also complain that if information on how enemies build IEDs is released, other insurgents could possibly learn how to construct even more of the devices. But others say there is also a strong likelihood that release of technical information will prompt industry to find more solutions that will make the IED weapons less deadly.

Participating in the IED Efforts – Acquisition Opportunities by Service

At present, JIEDDO's budget exceeds \$3 billion and it employs 360 people. It serves as a funding agency for academic, industrial, and government entities, who submit proposals to the various boards for evaluation and approval. Science and technology projects are funded through the so-called OXR agencies (AFOSR, ARO, ONR, DARPA, DoD).

Army

According to press reports, approximately 10,000 Humvees now in Iraq that were not armored for combat conditions are currently re-enforced using steel plates that might not withstand the increasingly powerful explosives being used by the insurgents. A recent GAO report also indicated that acquisition delays may have increased the vulnerability of U.S. forces to the IEDs threat, stating "... specific problems delayed DOD's acquisition of three important items we reviewed (Interceptor body armor, lithium batteries, and up-armored High-Mobility Multi-Purpose Wheeled Vehicles). DOD's acquisition decision did not maximize available capacity to produce up-armored High-Mobility Multi-Purpose Wheeled Vehicles and add-on armor kits nor did it give Congress visibility over the basis for its acquisition solution. These acquisition challenges impeded DOD's ability to respond to rapidly increasing demands. To minimize acquisition delays in the future, we recommend the Army and Defense Logistics Agency assess the industrial-base's capacity to meet updated requirements for critical items within the time frames required by operational plans and provide visibility to Congress over acquisition of critical items that emerge during contingencies.

The Army has also implemented a "Rapid Fielding Initiative" (RFI) to ensure that soldiers have the latest available equipment. Information on the acquisition of critical go-to-war items is reported to Congress annually through the Industrial Capabilities Report to Congress. On April 30, 2005, the Army was granted "rapid acquisition authority" by Defense Secretary Donald Rumsfeld, meaning that the traditional DOD acquisition process could be set aside, allowing a manufacturer of a special, man-portable IEDS jammer device to be chosen within only a 15 day time period. The Pentagon plans to purchase 10,000 of the devices, at \$1,000 each. On May 24, 2005, Congress approved a transfer of \$129.7 million from the Iraqi Freedom Fund to purchase mobile, multiband Warlock jammers which can detect threats concealed on people and in vehicles, and to support R&D and deployment for other anti-IEDs devices. On July 13, 2005, a reprogramming action transferred \$10 million out of Iraqi Freedom Fund for two new anti-IEDs systems: \$3.5 million for 50 Small, Lightweight Advanced Modular Digital Electronic Protection Systems (SLAM-DEP), which incorporates existing jammer technology into a wearable vest, and \$6.5 million to purchase 187 low-cost, expendable robots designed for explosive ordnance disposal.

Navy/Marines

The Naval IED Defeat Technology Integrated Product Team (NIEDDT-IPT) was chartered by the Navy's representative to the JIEDDO, Rear Admiral A.M. Macy, Commander, Naval Surface Warfare Center, and Brigadier General R. D. Alles, Commanding General of the Marine Corps Warfighting Laboratory in December 2005 to help focus and coordinate the resources, technologies, and capabilities held by the entire Naval Research Enterprise. The Homeland and Force Protection Product Area Directorate at the Naval Surface Warfare Center, Dahlgren Division in Virginia serves as a home base for the NIEDDT-IPT and hosts monthly meetings of the senior representatives of this team, under the leadership of Mr. G.A. (Drew) Koban.

The Office of Naval Research established its own counter-IED basic research program in 2004, with the intent of "moving up the kill chain." Many, although not all, of the funded projects have a 15- to 20-year time frame. The agency established funding for research designed to find ways to predict, detect, prevent, neutralize, and mitigate explosive devices as early as possible in the process, long before they present a danger to military or civilian persons.

ONR continues to administer this program, but its efforts are coordinated with the larger umbrella organizations, as well as with the President's Science Advisor, National Science Foundation, and international programs. Early in the program, ONR established funding for various academic research programs and made grants through its SBIR program. Interest continued to build, and last summer, ONR sought ideas from the broader academic and industrial community by issuing a Broad Agency Announcement (BAA). In response, ONR received 435 white papers, from which 41 full proposals were requested, and 18 were funded.

Rear Admiral William Landay, Chief of Naval Research, explained ONR's role in the overall effort in his testimony before the House Armed Services Committee last March. Landay stated, "Our primary goal is to examine the IED delivery/kill chain to develop systematic countermeasures along the entire chain, not just at the device. This involves funding a variety of IED prediction efforts involving the dynamics of terrorist movements, analysis of human activity associated with placement, uncovering IED support networks, tracking IED factory locations and events, IED bio-forensic profiling for tracing place or origin, and dynamic analysis of suicide bombings. The House and the

Senate both included \$1.5 billion for JIEDD in their versions of a proposed “bridge” supplemental for FY07, which will help pay for operations in Afghanistan and Iraq.

SBIR

The following summary of an SBIR Phase I project awarded in 2005 provides excellent context for where the current efforts of the DoD are focused:

TITLE: Technologies to Defeat Improvised Explosive Devices (IEDs)

TECHNOLOGY AREA: Weapons; Countermine/Mines

ACQUISITION SPONSOR: Marine Corps Systems Command

OBJECTIVE: Improvised Explosive Devices (IEDs) continue to threaten US forces as they conduct overseas operations. This solicitation seeks to identify new ideas for detecting the presence of such devices and/or negating their effectiveness.

DESCRIPTION: This solicitation seeks novel technical approaches toward any of the following general concepts, including but not limited to:

- Field collection and analysis of forensic and biometric evidence associated with IED fabrication and/or use
- Detection of the act of IED placement
- Detection of monitoring activities associated with potential IED locations
- Pre-characterization of an area in a manner that makes subtle changes associated with IED placement more readily detectable
- Detection of unique chemical signatures IEDs
- Disrupting the triggering mechanism within the IED
- Activating the triggering mechanism within the IED for pre-detonation
- Electromagnetic jamming or
- Electromagnetic emulation of wireless detonation commands
- Destruction of electronic components associated with IED triggering or the transmission of detonation commands via directed energy

PHASE I: Demonstrate feasibility of the salient physical principal of the proposed approach in a laboratory environment. Conduct a theoretical effectiveness analysis of the proposed concept modeling the probability that the proposed concept could achieve its claimed benefits (or portions thereof) given the pertinent uncertainties of a realistic operational environment.

PHASE II: Design and construct an engineering prototype to be demonstrated at the end of this phase. The prototype will be sufficiently refined so that effectiveness of the embodied concept toward countering IEDs can be evaluated in simulated encounters with representative surrogate IEDs or components. During this phase, the theoretical concept effectiveness analysis from phase I would be refined into a prototype effectiveness analysis using measured performance parameters of the prototype device.

PHASE III: Refine the prototype developed in phase II so that it can be fabricated and evaluated in small numbers by operational forces. At this point the prototype should be sufficiently representative of the final product that all operational benefits, consequences and tradeoffs associated with full deployment can be clearly quantified via field trials. During this phase, limited numbers would be fielded with operational forces for evaluation and feedback. Prior to the completion of this phase, the prototype effectiveness analysis from phase II would be further refined into an operational effectiveness analysis by incorporating the pertinent observations and variables derived from field trials. These field trials would constitute the basis for additional modifications as well as any subsequent procurement decision.

Conclusions:

Based on the guidance of our research, MTAPP believes that there is some opportunity for small business manufacturers within the area of IED defeat, but mostly as a bridge facilitator between the R&D phases and commercialization. As technologies mature within a Phase III SBIR environment, MTAPP companies could provide critical manufacturing knowledge in the refinement of prototypes and fabrication of the initial solutions. This would then provide them with access to the production level contracts. With \$3 billion being invested within IED Defeat, it is too large an opportunity for small businesses to ignore. Establishing relationships ahead of manufacturing requirements and teaming with technology-focused organizations will be the key to success.