



MTAPP POSITION PAPER

Small Business Support of Air Force and Department of Defense

Small Business Opportunities in the Robotics Value Chain





*DoD Robotics
Low Tech Needs in
High Tech Sector*

Why MTAPP covers this topic?

Beginning with the creation of the Joint Robotics Program (JRP) in 1989 and now with the reorganization of the program to become the Joint Ground Robotics Enterprise (JGRE), efforts to design and deploy Unmanned Ground Vehicles (UGV) have garnered both congressional and DoD support within the efforts broadly categorized as C4ISR¹.

While the C4ISR solution space is immense, there are specific opportunities for Small Businesses within its components. One area where both demand drivers and supply chain realities point to growing SB opportunity is in the area of UGV.

The challenge for many SBs is in identifying the component pieces that represent marketing opportunities. This requires both a macro understanding of the DoD requirements and a micro understanding of the individual supplier requirements within the supply chain. As we found out during the research for this report C4ISR information can be difficult to attain as specific sources of information are not available to the general public.

What this report presents?

This report provides a market analysis of the various opportunities for Small Businesses within robotics including applications outside of the planned programs within FCS and UAVs.

¹ Command, control, communications, computers, intelligence surveillance, and reconnaissance.

DoD Robotics Identifying SB Opportunities

What MTAPP found:

- The Services have recognized a critical warfighting role for both current and future unmanned ground systems.
- The shift to less traditional warfare, a declining pool of available military personnel, increasing costs of military personnel, and political ramifications of personnel casualties are driving the military to develop alternatives to its human-capital resources.
- Each service has developed a conceptual approach and program infrastructure for use of robotics:
 - **Army – Future Force:** Future Combat Systems (FCS)
 - **Marines:** Gladiator Tactical Unmanned Ground Vehicle (TUGV)
 - **Air Force – Air Expeditionary Warfare:** Robotics for Agile Combat Support and the Airborne Explosive Ordnance Disposal Concept
- The Army is working with multiple contractors to further develop robotic prototypes for the FCS multifunction utility/logistics equipment and soldier UGV components.
- R&D in the area of increased use of robotics expands well beyond unmanned vehicles.
- Despite the majority of investments in this area coming in RDT&E budget lines, small businesses can realize opportunities today as suppliers to leading robotics development contractors.

DoD Demand Drivers for Robotics

Historically, the acquisition of military systems has been driven by two activities: development of new technologies that apply to military missions (technology push); and definition of new battlefield requirements by operational users (requirements pull). In the field of Robotics, both technology push and requirements pull are being applied and expedited especially in the field of unmanned vehicles as a key enabler of increases in force effectiveness, protection, and economy. This combination of demand drivers has been forced on the services by the current urgency of addressing real time warfighter threats in both Iraq and Afghanistan.

Even prior to the current challenges presented by the Global War on Terror (GWOT), the Department of Defense (DoD) had laid out an aggressive vision for the use of robotics in support of the warfighter's mission.

H.R.4205 National Defense Authorization Act for Fiscal Year 2001 contained the following statement regarding the use of unmanned vehicles:

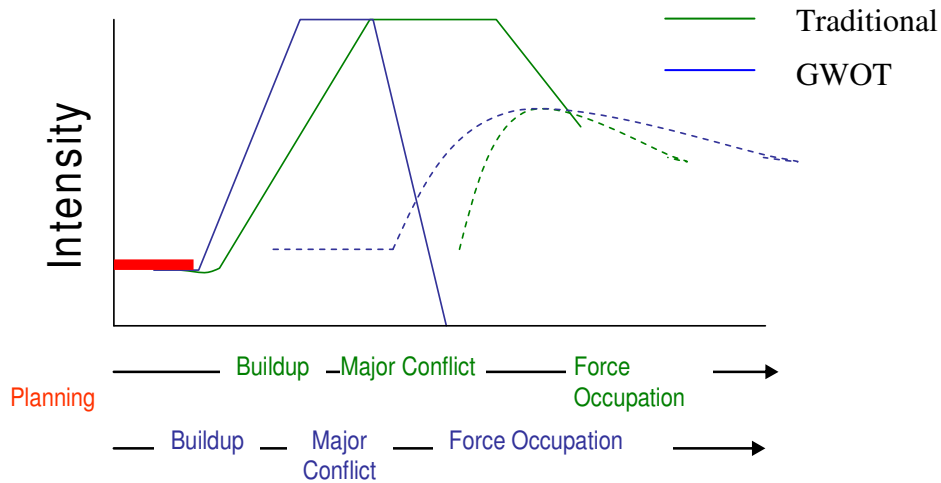
SEC. 217. UNMANNED ADVANCED CAPABILITY AIRCRAFT AND GROUND COMBAT VEHICLES.

(a) GOAL- It shall be a goal of the Armed Forces to achieve the fielding of unmanned, remotely controlled technology such that--

- (1) by 2010, one-third of the operational deep strike aircraft of the Armed Forces are unmanned; and
- (2) by 2015, one-third of the operational ground combat vehicles of the Armed Forces are unmanned.

This stated objective was made prior to the recognition of the DoD that a change in the nature of warfare would require additional thought to the role of Robotics. As 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



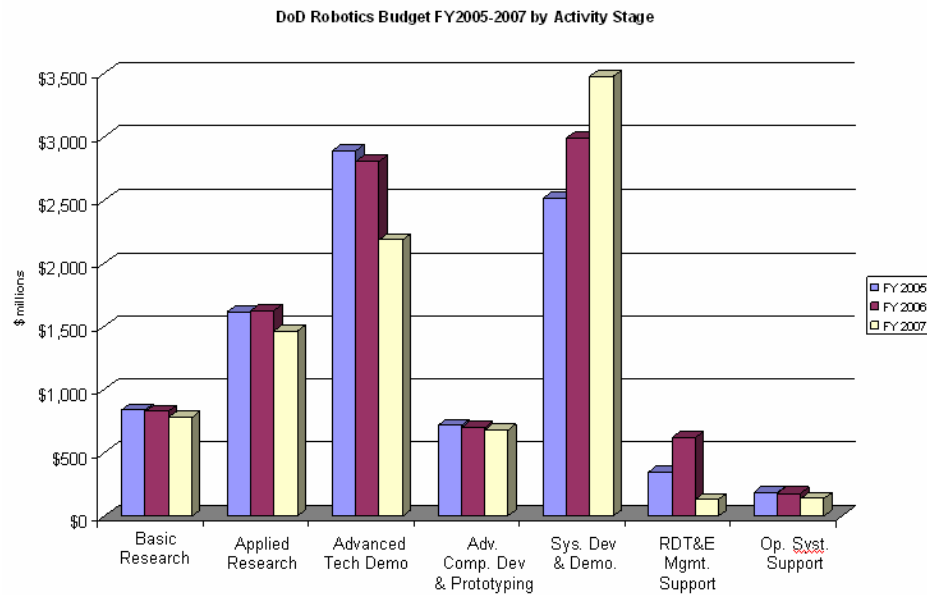
This shift in the very nature of warfare has stressed not only the logistics community supporting the ongoing operations, but has also placed enormous pressure on those responsible for the design, development and commercialization of technologies.

As a result of this compression of both time lines for innovation and deployment, and the urgency of supporting already deployed new robotic systems, opportunities for small businesses (SB) within Robotics exist across the life-cycle of DoD procurement phases. For this report, MTAPP looked at the current and potential role for SB manufacturers in each of the following DoD program life-cycle segments:

- 01- Basic Research
- 02- Applied Research
- 03- Advanced Technology Demonstration
- 04- Advanced Component Development and Prototyping
- 05- System Development & Demonstration
- 06- RDT&E Management Support
- 07- Operational Systems Support

Not surprisingly, this analysis found that the DoD is already seeking additional manufacturing sources to address the sustainment needs of those robotics systems already deployed in Iraq and Afghanistan (**Exhibit 2**).

EXHIBIT 2 DoD Budget Trends for Robotics FY2005-FY2007



In addition, major primes and OEMs like General Dynamics, Northrop Grumman, and iRobot are assessing their own supply base to determine the long term requirements of sustaining their deployed systems. MTAPP believes that opportunities are available both within the area of prototype development and sustainment for our SB manufacturing member base.

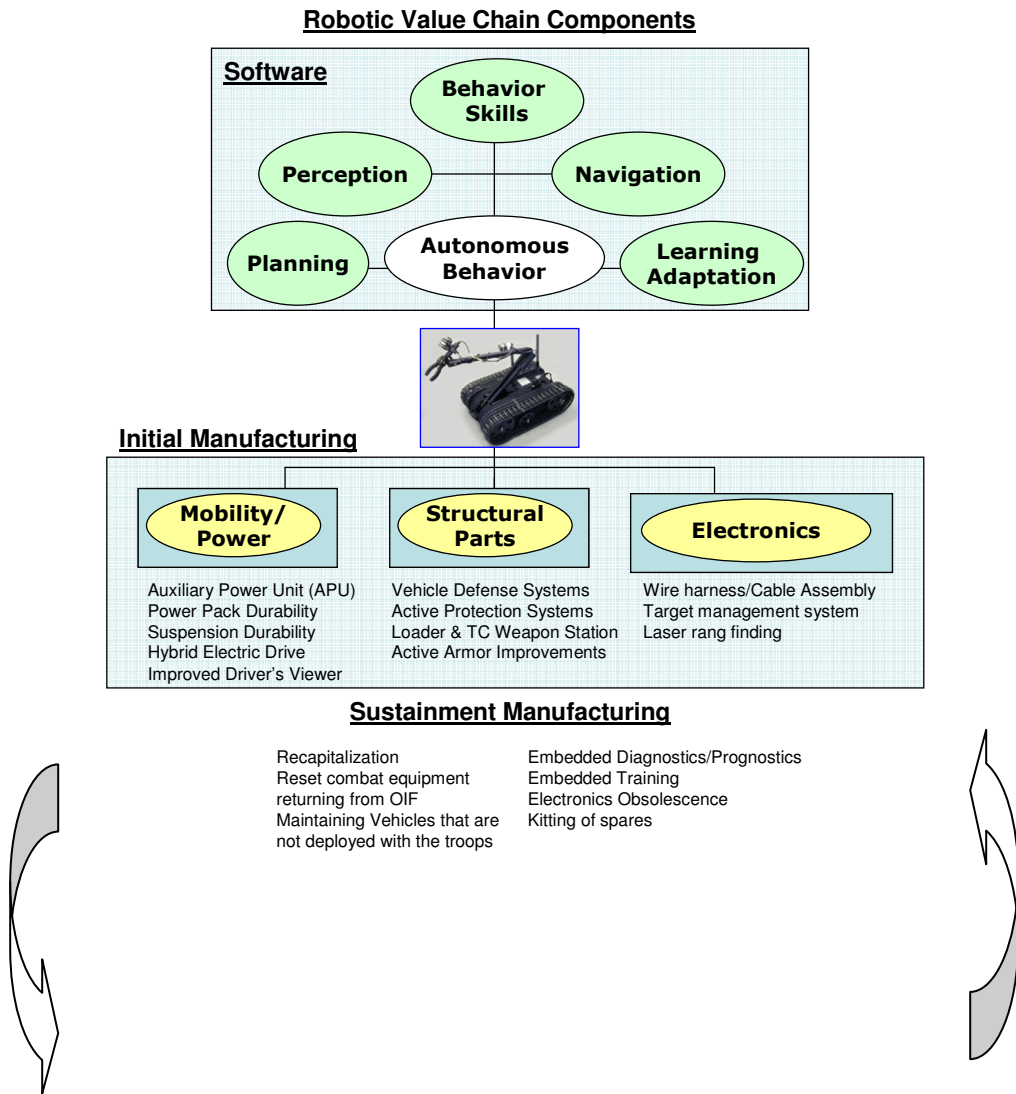
While the integration of robotic systems into the military is in its beginning phases, the opportunities to become active within the manufacturing phase of the robotics value chain are already advancing to make this an attractive SB segment.

The Robotics Value Chain

The manufacturing requirements for robotics and unmanned vehicle systems do not materially differ from current SB manufacturing activities. Early market leaders and established primes are both outsourcing the majority of manufacturing requirements on these systems while investing more

heavily in the core capabilities of software system design and development and prototyping. The value chain components within the robotics supply chain can be categorized both as intelligence (software) and mechanical (structural) as follows (**Exhibit 3**)

EXHIBIT 3 Robotics Value Chain Focus Areas for SB



SB manufacturers are most likely to find success in marketing to either established prime contractors with deployed systems as a sustainment supply chain partner, or as a development partner for organizations prototyping these systems.

DoD Robotics Program Structure and Budget Responsibility

OSD - Joint Ground Robotics Enterprise (JGRE)

Currently, much of the responsibility for the R&D, design, prototyping and ultimate procurement of the many warfighter solutions that will depend heavily on robotics is managed centrally by the OSD. Beginning with the FY1990 Appropriations Bill all Unmanned Ground Vehicle (UGV) programs were consolidated and OSD was tasked to provide oversight over the robotics technology area. In response to this tasking, OSD created the Joint Robotics Program (JRP) and assigned this office the following objectives:

- Continue to achieve the Congressional mandate
- Fund, promote, and mature robotic enablers
- Act as Departmental Proponent for ground robotics
- Serve as clearinghouse for prioritization of robotic technology needs

In early 2006, the JRP was reorganized and renamed the Joint Ground Robotics Enterprise (JGRE). The JGRE mission is to advance Departmental ground robotics initiatives, focus ground robotics technologies on warfighter capability needs, and assess/mature selected ground robotics technologies to meet identified capability gaps. The changes within the JGRE and within DoD robotics development and execution come in part to accommodate the DoD's strategic shift to increasingly rely on unmanned warfighting capability as defined and executed under the C4ISR² joint directive. In addition, and more relevant to SBs seeking short term opportunities, this reorganization represents an increased urgency to expedite the development of robotics solutions to address current warfighter needs.

The urgency with which the changing needs of the warfighter are being addressed can be seen in the rate at which the funding that Congress provides to JGRE has increased. The following table shows

² Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance

the requested amount for OSD Joint Robotics Program funding and the additional congressional funding given to the program.

FY	Requested	Congress Add
2004	\$15.2	\$12.7
2005	\$20.8	\$31.5
2006	\$27.4	\$20.5

*(\$M)

This program element supports the advanced technology development activities of the Joint Robotics Program (JRP). Projects deliver advanced technology to support enhanced warfighters' capabilities that have been identified during operational assessments and field feedback of current unmanned systems. The program ensures Joint Service coordination and provides for interoperability and commonality among unmanned systems. Through key annual key stakeholder reviews (PM's, user, tech base) critical technologies necessary to meet evolving user requirements are identified. These critical technologies form the basis for investment decisions in the areas of mobility, power, and manipulation, system health maintenance, advanced materials, communication, human-robot interaction, autonomous operations, perception, precision location, data fusion, autonomous tactical behaviors, and collaborative operations.

DoD Small Business Innovation Research (SBIR)

As with most emerging innovation based imperatives, the DoD is funding both applied research and system development funds to Robotics through the SBIR. The following table shows the levels invested by service from FY 2003 – FY 2005.

Agency	Phase I	Phase II	Total
ARMY	\$ 3.40	\$ 24.08	\$ 27.48
AIR FORCE	\$ 2.49	\$ 5.32	\$ 7.81
NAVY	\$ 1.08	\$ 4.63	\$ 5.71
DARPA	\$ 0.98	\$ 3.98	\$ 4.96
Other	\$ 0.40	\$ 0.75	\$ 1.15
Grand Total	\$ 8.34	\$ 8.34	\$ 16.69

MTAPP believes that because of the speed with which robotics based solution are being deployed and the existing production ready systems being manufactured SBIR is an attractive target business source only for those SB manufacturers with established prototyping business.

Service Based Weapons System Program Offices

Air Force

The Air Forces' Robotics efforts are being led by the AFMC/AFRL *Robotics Research and Development Group* Currently, this team conducts research and development of advanced robotic technologies and unmanned ground systems to protect, support, and augment the warfighter in the accomplishment of “dirty, dull, dangerous, and impossible missions.”

This AFRL team is focused on the following systems:

All-Purpose Remote Transport System (ARTS): provides a remote stand-off solution to operational needs to locate, remove, and neutralize unexploded ordnance (UXO) and improvised explosive devices (IED). Development and integration of advanced payloads and tools is an on-going focus of research.

Next Generation Explosive Ordnance Disposal Technologies: The Next Generation Force Protection System is an effort devoted to the development of the future robotic platform or platforms needed to support the growing needs for unmanned force protection systems.


Army

The Army's robotics efforts are managed by a Joint Program Office with the Marines. The following graphic shows the “non FCS” (Future Combat Systems) programs. FCS related opportunities are covered in the MTAPP position paper “SB Roles and Opportunities within the FCS Program”.

JPO Robotic Systems (Non FCS)


Program Executive Office
Ground Combat Systems

Joint Force




- IED Defeat Systems
- In Theater Log
- Joint Facility

USMC




- Lethal / Non-lethal Fire
- RSTA
- NBC Detection

Assault Breaching Vehicle




- M1 Chassis
- Mine Plow, Lane Marking
- MICLIC

Dragon Runner




- FIDO Explosives Sniffer
- Disrupter
- Dump Bed

Army




- AP Mine Neutralization
- Wire Obstacle Breaching
- Engineer Missions

Mini Flail



- Mine Neutralization
- Contingency Systems
- Europe / OIF / OEF

Panther



**Joint Robotics Program Office -
Non FCS Funding**

	USMC	OSD	Army
FY 05	\$ 4.5	\$ 21.3	\$ 18.0
FY 06	\$ 25.7	\$ 17.9	\$ 55.0
FY 07	\$ 16.6	\$ 13.9	\$ 70.5
FY 08	\$ 11.5	\$ 7.8	\$ 56.8

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Commercial Robotics Programs – OEM and Tier 2+ Opportunities

Major Prime Contractor and OEM Opportunities

In recognition of the worldwide need for security and the transformation of the US military commercial contractors operating in the defense and government sector have invested heavily in increasing capability around automated robotic and unmanned systems.

As detailed above, the war on terrorism has resulted in urgent and compelling requirements for unmanned vehicles utilizing robotic technologies. The various DoD based program offices are responding to these requirements by rapidly deploying unmanned countermine, explosive ordnance disposal (EOD), and reconnaissance systems to support the warfighter. Multiple types of these vehicles developed and manufactured by commercial subcontractors are in use today. Fielded robotic systems and prototype systems have proven their worth as essential tools in completing dangerous support missions such as force protection and countermine operations throughout the Central Command area.

One outcome of this urgent effort, has been the innovative use of All-Purpose Remote Transport Systems (ARTS), Remote Ordnance Neutralization Systems (RONS), mine-clearing flails, DOK-ING mine-clearance machines, Panthers, other prototypes, and an impressive number of

Commercial Off-the-Shelf (COTS) systems, to field over 700 UGVs will be available to the services by the end of FY2005, and the number continues to grow. Increasing Service demand and direct feedback from operational users have validated the importance of the continuing efforts of JRP to build an agile and responsive supply chain to integrate feedback from field based operators and developers. This area of rapid responsiveness and key operational insights execution provides small business manufacturers with a strong competitive position within the efforts to get solutions to the field as quickly as possible.

The front running prime contractors and OEMs that have deployed systems already and present manufacturing opportunity targets are summarized in the table below:

Contractor	Robotics Group	Outsourcing Requirement/Opportunity
General Dynamics	General Dynamics Robotic Systems (GDRS) is the world leader in tactical autonomous robotics and the command and control technology that manages autonomous systems. GDRS designs and manufactures complex electro-mechanical and advanced automated systems for military, government, and commercial clients.	<p>GDRS maintains one of the largest machine shops in the mid-Atlantic region, GDRS works with virtually all metals and plastics, including aluminum alloys, Kovar, Inconel, Titanium steel, and exotic materials in creating extrusions, castings, and forgings.</p> <ul style="list-style-type: none"> • Precision machining and sheet metal fabrication • Certified welding and assembly • Electro-mechanical system production and testing • Electro-mechanical system development • Contract manufacturing of customer-developed components and systems <p>www.gdrs.com</p>
Northrop Grumman	Remotec is a subsidiary of Northrop Grumman and is part of Northrop Grumman Land Combat Systems within the Electric Sensor and Systems Sector.	<p>Remotec is a world leader in providing mobile robot systems for use in hazardous duty operations by military organizations, The robotic technology developed and deployed by Remotec is fast becoming the standard for hazardous-duty robots. Remotec has a 75,000 square foot manufacturing facility based in TN.</p> <p>http://www.es.northropgrumman.com/remotec/</p>

Oshkosh Truck	Oshkosh TerraMax is based on the Medium Tactical Vehicle Replacement (MTVR) truck platform built by Oshkosh Truck for the Marine Corps. It operates without a driver or remote controls, using a guidance system based on standard, yet ruggedized navigational computers	Oshkosh Truck Corporation [NYSE: OSK] announced the Defense Advanced Research Projects Agency (DARPA) has awarded the company a contract to further develop unmanned ground vehicle technology in preparation for the third DARPA robotic competition, the Urban Challenge. DARPA granted the technology development award based on the merits of an extensive team proposal. The contract is valued up to \$1 million. http://www.terramax.com
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Contractor	Robotics Group	Outsourcing Requirement/Opportunity
iRobot	iRobot PackBot EOD is a rugged, lightweight robot designed to assist with Explosive Ordnance Disposal (EOD), HAZMAT, search-and-surveillance, hostage rescue and other vital law enforcement tasks for Bomb Squads, SWAT teams, military units and other authorities seeking to meet the security challenges of the 21st century.	<p>iRobot and John Deere unveiled the Military R-Gator™, an intelligent unmanned ground vehicle that will use off-the-shelf technology to autonomously perform dangerous and taxing missions. Until now, autonomous ground vehicles have been developed and built using custom technology on an individual basis, which can be a time-consuming and costly process. Using available systems, iRobot and John Deere plan to begin pilot production of the R-Gator by mid-2005, with full production slated to begin by 2006.</p> <p>Strategic alliances are an important part of iRobot's product development and distribution strategies. We rely on strategic alliances to provide technology, complementary product offerings and speedier access to markets. We seek to form relationships with entities that can provide best-in-class technology or complementary market advantages that will help establish iRobot technology in new market segments.</p> <p>www.irobot.com</p>
Foster Miller	TALON® robots are powerful, durable, lightweight tracked vehicles that are widely used for explosive ordnance disposal (EOD), reconnaissance, communications, sensing, security, defense and rescue. They have all-weather, day/night and amphibious capabilities and can navigate virtually any terrain.	<p>Foster-Miller has been awarded a \$133 million contract for TALON™ robot spare parts and service, bringing its total current award for TALON™ EOD (explosive ordnance disposal) robots to \$257 million through 2012.</p> <p>This contract represents the third component of a three-part award that began in September 2002 with a \$27 million contract for TALON™ EOD robots from the Man Transportable Robotic System (MTRS) program managed for all service branches by the Naval Surface Warfare Center (NAVSEA) in Indian Head, MD.</p> <p>www.foster-miller.com</p>

Non DoD Government Sources of Opportunities

The National Center for Defense Robotics (NCDR)

The National Center for Defense Robotics (NCDR) is a Congressionally-funded initiative of The Technology Collaborative, a non-profit, technology-based economic development organization based in Pittsburgh, PA. The mission of the NCDR is to benefit our nation's defenders and help develop a national 'agile robotics' industry by accelerating the pragmatic development, integration, & utilization of unmanned systems technologies for military and related homeland defense applications. The NCDR accomplishes this by administering a nation-wide alliance of universities, technology companies, defense manufacturers, and government organizations with an interest in advanced robotics systems and enabling technologies, by fostering collaborative relationships and forging partnerships and joint ventures among alliance members, and by funding and managing technology development projects undertaken by alliance members that meet identified, otherwise unmet government needs.

MTAPP Conclusions

In June 2006, as part of a House-Senate conference committee on emergency war and hurricane relief spending bill session, \$2 billion was committed to fighting roadside bombs or IEDs, the top killer of our troops in Iraq. As part of this package, iRobot Corporation was awarded a \$64.3 million contract for spare parts and training for their PackBot bomb disposal robot on station in Iraq and Afghanistan through May 2008. The funding of robotic-based systems and the stated goal of the DoD that:

- (1) by 2010, one-third of the operational deep strike aircraft of the Armed Forces are unmanned; and
- (2) by 2015, one-third of the operational ground combat vehicles of the Armed Forces are unmanned.

Removes any doubt that the area of unmanned vehicles and robotics will represent an attractive market opportunity for years to come. Further, many of the leading contract award recipients are not

core manufacturing firms. As these companies make the decisions to solidify their supply chains ahead of growing orders, they will be considering that any interruption in the manufacture of products will result in delays in shipment, lost sales and revenue and damage to their reputation in the market.

MTAPP believes that our small business members must research this area and determine whether they are positioned to provide useful supply chain support to the many prime contractors, OEMs and sub tier suppliers who will require outsourced manufacturing capability. The challenge is identifying the correct avenues to market to these entities. In order to determine the attractiveness of and target these opportunities for your own business, you must first understand the program management functions within the procurement process.