INDUSTRY STUDIES 2000

Land Combat

ABSTRACT

The land combat vehicle industry is characterized by contrast. While growth is foreseen for some sectors, others are in decline. Specifically, the tracked armored vehicle sector, with scant production orders, modernization, and re-capitalization programs, is in decline. Wheeled armored vehicles, however, in particular the medium- and lightweight categories, hold much promise for the short term, given U.S. Army plans to outfit its Brigade Combat Teams with Interim Armored Vehicles. Long-term prospects for these two sectors will depend greatly on the shape and form of the Army's Future Combat System. Major challenges include excess capacity and competition for capital and human resources; yet, opportunities are presented by initiatives such as the "Army Vision" as articulated by General Eric K. Shinseki, Chief of Staff. Focused research and development is essential to ensure that the United States maintains its competitive advantage on the battlefield, and foreign military sales are essential to industry vitality.

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PLACES VISITED

Domestic

AM General Corporation, Mishawaka, IN

Detroit Diesel Corporation, Detroit, MI

General Dynamics, Land Systems Division, Sterling Heights, MI

General Motors Defense, London, Ontario, Canada

Lima Army Tank Plant, Lima, OH

Oshkosh Truck Corporation, Oshkosh, WI

Stewart & Stevenson, Tactical Vehicle Systems, Sealy, TX

U.S. Army Developmental Test Command, Aberdeen Proving Ground, MD

U.S. Army Research Laboratory, Aberdeen Proving Ground, MD

U.S. Army Tank-Automotive, Armaments Command, Warren, MI

U.S. Marine Corps Advanced Amphibious Assault Vehicle Program Office, Woodbridge, VA

United Defense Limited Partnership, York, PA

International

British Aerospace, Royal Ordnance, Nottingham, United Kingdom

Giat Industries, Roanne, France

IVECO Industrial Vehicle Corporation, Ulm, Germany

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Office of Defense Cooperation, U.S. Embassy, London, United Kingdom

Steyr-Daimler-Puch Spezialfahrzeug, Vienna, Austria

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INTRODUCTION

To a large extent, the technical adequacy and supply of a wide variety of combat systems determines the success of the U.S. armed forces. Because the United States relies heavily on technology to ensure a decisive advantage in all operations and eventual battlefield dominance, it is only fitting to study the structure, health, and challenges of the industrial base that supplies those systems.

Many challenges face the land combat vehicle (LCV) sector of the land combat systems industry, in particular the following:

- The impact of the new Army Vision
- The ability to draw capital in a period when high-growth information (dot-com) companies are attracting investment
- The excess capacity of the industry
- The issue of contractor-supplied versus organic logistics support

By successfully dealing with these challenges, the United States may retain the industrial base necessary to provide the LCVs needed to project power and ensure national security.

THE LAND COMBAT SYSTEMS INDUSTRY DEFINED

Small arms, land mines, command-and-control systems, personnel armor, unmanned vehicles, towed and tracked artillery, tactical trucks, tanks—all constitute land combat systems. Prominent among such systems are tracked and wheeled armored vehicles and tactical wheeled vehicles.

Tracked Armored Vehicles. Tracked vehicles are designed to operate in almost any terrain and to survive many known and potential threats within reasonable risk limits. General Dynamics and United Defense Limited Partnership are the prime domestic contractors or integrators for tracked

vehicles. Vehicles produced by these two companies include M1-series Abrams Tanks, M2/3-series Bradley Fighting Vehicles, M109-series Paladin Self-Propelled Howitzers, M88-series Recovery Vehicles, M9 Armored Combat Earthmovers, the M113 family of vehicles, the Multiple Launch Rocket System, and the Marine Corps Amphibious Assault Vehicle. Other systems under development include the Crusader Artillery System (XM2001 and XM 2002) and the Marine Corps Advanced Amphibious Assault Vehicle. The Grizzly Obstacle Breacher and the Wolverine Heavy Assault Bridge, also in development, are derivative vehicles built on the M1 chassis.

Wheeled Armored Vehicles. Like the tracked armored vehicles, wheeled armored vehicles are designed to operate in almost any terrain. Lacking the heavy armor typical of tracked vehicles, however, they are much more mobile. Because of their rather light weight, these vehicles are easily transported to and within the theater of operations. They also operate effectively in towns, villages, and other areas in which larger vehicles cannot. Wheeled vehicles can be armed with cannons (including a 105-millimeter gun), machine guns, and missile launchers. General Motors of Canada produces the Light Armored Vehicle III (LAV III) family of vehicles. Textron Marine and Land Systems produces its own family of LAVs and Armored Security Vehicles (ASVs), including the LAV–150, LAV–300, LAV–600, and ASV–50. General Dynamics, together with Steyr-Daimler-Puch Spezialfahrzeug have established AV Technology, a joint venture company, which offers the PANDUR 6×6.

Tactical Wheeled Vehicles. In addition to transporting personnel, equipment, and supplies in support of military operations, some tactical wheeled vehicles serve as platforms for command, control, and communications equipment, as well as weapons (e.g., cannons, machine guns, and missile launchers). Such vehicles must traverse the same terrain and distances as the combat forces that they support. Although the survivability requirements for tactical wheeled vehicles continue to be less stringent than those for armored vehicles, the requirement for off-road tactical mobility, reliability, and ease of maintenance and operation remains fundamental to the support of military operations. AM General, Stewart & Stevenson Corporation, Freightliner, General Motors, and the Oshkosh Truck Company are the prime contractors or manufacturers of tactical wheeled vehicles.

Tactical wheeled vehicles fall into three main platform categories, light, medium, and heavy, according to their load-bearing capacity. Vehicles typical of these categories include the following:

Light (less than 2.5 tons): the High-Mobility Multipurpose Wheeled Vehicle (HMMWV, or Humvee), Commercial Utility Cargo Vehicles, and other commercially based tactical trucks

Medium (2.5 to 7 tons): the Army's Family of Medium Tactical Vehicles (FMTV) and the Marine Corps' Medium Tactical Vehicle Replacement (MTVR)
.

Heavy (more than 7 tons): the Heavy Equipment Transporter (HET), the Heavy Expanded Mobility Tactical Truck (HEMTT), the Palletized Load System (PLS), and the Marine Corps' Logistics Vehicle System (LVS)

CURRENT CONDITION

Global Market

The market is divided into three general areas: tracked armored vehicle, wheeled armored vehicles, and tactical wheeled vehicles.

Tracked Armored Vehicles. The market for tracked armored vehicles is highly competitive. With the end of the Cold War and the expansion of non-war missions for the armed forces, the overall requirement and demand for such vehicles has decreased significantly. The existing inventory from high-volume Cold War production rates and arms transfers generated by the Conventional Forces in Europe Treaty have created an excess supply for much of the market. The market is clearly a "buyer's market," as the major manufacturers in the United States and Europe engage in fierce competition for sales to interested governments. Potential customers for tanks include Turkey, Greece, Qatar, Argentina, South Africa, Saudi Arabia, the United Arab Emirates, South Korea, and Finland.[i] Even with these potential customers, the inventory glut and excess production capacity indicate a continued fierce competition by firms in a very competitive market.

Wheeled Armored Vehicles. The light wheeled armored vehicle sector is also a buyer's' market; an unprecedented number of suppliers are chasing the available customer base.[ii] Sales of some 21,000 units are anticipated, representing a market value of $8.8 billion.[iii] A number of "off-the-shelf" wheeled armored vehicles have been evaluated by the U.S. Army as part of its effort to increase the mobility of its forces. The Army plans to outfit as many as five Brigade Combat Teams with Interim Armored Vehicles (IAVs) beginning in 2001. The industry, recognizing the potential sales opportunity, was eager to provide vehicles to the U.S. Army for the evaluation.

Tactical Wheeled Vehicles. The tactical wheeled vehicle industry is also a buyer's market. A number of domestic and foreign manufacturers offer vehicles from the light to the heavy weight range.

U.S. Industry Trends

Established during the Cold War to produce the vehicles needed to engage the Soviet Union and the Warsaw Pact, the LCV industrial complex is now characterized by significant overcapacity. The absence of a perceived threat and changing requirements have resulted in ever-decreasing budgets for the procurement of new vehicles and the modernization of existing vehicles. Even so, production, modernization, and upgrade programs are under way. The current fleet of vehicles, designed for an operational life of 20 years, may be modified and extended to operate two or three times as long. Modernization, remanufacture, re-capitalization, and upgrade programs are vital to keeping certain production facilities and skilled workers operating today. With production of Abrams tanks for the U.S. Army complete, General Dynamics Land Systems, for example, is engaged in upgrading the M1 and M1A2 vehicles with the M1A2 System Enhancement Package, and overhauling M1A1 tanks

With the shrinking demand, many companies have found it necessary to take serious actions to ensure their survival. Some have consolidated their operations. These companies have determined their core competencies—i.e., those skills and capabilities that provide them with the necessary competitive advantage—and shed other skills that are available elsewhere at a lower cost. Mergers, partnerships, and joint ventures provide companies with an opportunity to improve their competitive position as a team; they can leverage the best people and facilities of each company. Mergers or partnerships with foreign companies also provide opportunities for, and access to, new markets. Some recent partnerships include the General Dynamics–General Motors Corporation partnership in the competition for the U.S. Army Intermediate Armored Vehicle, and the General Dynamics–Styer-Daimler-Puch Spezialfahrzeug joint venture for the marketing and production of the PANDUR 6×6 vehicle.

Some companies, such as AM General, the Oshkosh Truck Company, and Freightliner, produce commercial and military products on the same production line. Product diversification of this sort enables the firms to adjust to increases and decreases in demand for military vehicles without significant effect on their short-term viability. This integrated production line is most prominent in the tactical wheeled vehicle sector, because these vehicles are more similar to commercial vehicles than are tracked vehicles. This similarity provides three distinct advantages for the industry and its customers: (1) it facilitates the incorporation of new, commercially developed technologies into the tactical wheeled vehicles; (2) it makes these vehicles prime candidates for the use of commercial off-the-shelf technologies and practices; and (3) it enhances the ability of the industry to surge when necessary.

European Industry Trends

The LCV industry in Europe today is to a large degree still national in orientation. In many places, the battle tank is perceived specifically as a symbol of national defense, and soldiers identify it with their country.[iv] Additionally, the aim of most European countries with regard to security, economy, and technology is to maintain defenses commensurate with perceptions of the military importance of the country, its obligations to alliances, and its economic situation.[v] In Europe, there are 37 systems companies capable of producing armored fighting vehicles.[vi] With the collapse of the Soviet Union, which had posed the only credible threat, the European defense industry has had to confront many of the same challenges as its U.S. counterpart. However, where the U.S. industry has vigorously pursued consolidation during this period, the European companies have not. There have been only a few national and international defense consolidations in the European land combat systems industry. Factors such as national interests, state subsidies, cutbacks in personnel, and cost reduction measures have all kept companies working above the critical survival threshold.[vii] However, as Europe continues to establish itself as a political union, consolidation of the defense sectors, including the LCV sector, can be expected.

CHALLENGES AND OPPORTUNITIES

Significant challenges face the LCV industry, including the impact of the Army Vision; the health of the industry, including the ability to attract capital and a professional workforce; and the capacity for surge production if and when required.

Army Vision

General Eric K. Shinseki, Chief of Staff, U.S. Army, has articulated a promising vision for the transformation of the U.S. Army. The Army, he has stated, “will provide to the Nation an array of deployable, agile, versatile, lethal, survivable, and sustainable formations, which are affordable and capable of reversing the conditions of human suffering and resolving conflicts decisively.”[viii] The plan is to outfit Brigade Combat Teams with lighter, more mobile IAVs and then proceed with Future Combat System development. These efforts present challenges and opportunities to the industry. (One of the essays at the end of this chapter further explores the U.S. Army’s prospective transformation.)

Industry Health

From the 1960s to the early 1990s, the defense industry represented the cutting edge for the development of many new technologies. Top-notch engineers and scientists sought employment with defense firms, and investors saw the industry as a good investment. In the current environment, however, with the proliferation of dot-com and e-companies, it is increasingly difficult for the defense industry to secure essential capital or professional expertise. Price-to-earnings ratios, a reflection of investors' confidence in future earnings, are a derisory 6.8 to 9.5 for the major defense contractors. By comparison, the average company in the Standard & Poor's 500 currently trades at 30 times earnings.[ix] These conditions may cause companies to make short-term decisions that have long-term consequences, such as cutting back on research and development (R&D) and cutting out the engineering talent.[x]

Given that the opportunities available in the information technology industry are significantly better than those in the LCV industry, the difficulty in attracting the necessary engineers and scientists is likely to get even worse. Industry representatives, concerned with maintaining their design capability and developing a cadre of competent designers for the foreseeable future, acknowledge a critical shortage of mechanical engineers, and attribute it to the preference of many college students for degrees in computer and electrical engineering.

Surge Capabilities

Depicted in Figure 1 is the basis for a potential crisis in surge capability for the land combat systems industry: the continuing significant gap between utilization and capacity. The figure shows that, although somewhat reduced since 1985, excess capacity is still significant, and the capacity–utilization gap will remain sizable for the foreseeable future. The downsizing occasioned by lower defense budgets and reduced procurements of combat vehicles following the fall of the Berlin Wall and the end of the Cold War is in large part responsible for this situation. It has resulted in a much smaller, and aging, workforce. Absent effective recruitment programs and experienced professionals to train the next generation of journeymen, specialized skills and knowledge may be lost forever. While systems integrators have maintained the excess capacity, chances are the subtier suppliers have not. The ability to surge will depend on the availability and the desire of the subtier suppliers, also adversely affected by the paucity of skilled workers, to provide the parts and components needed to fabricate a large number of these vehicles quickly-.

Figure 1: Overall Land Combat Systems Industry—Capacity and Utilization

OUTLOOK

It is most instructive to examine the outlook for the LCV industry for two periods: the present through 2005 (the short term) and 2005 through 2020 (the long term).

Short Term

Tracked Armored Vehicles. With few new procurements on the horizon, the tracked armored vehicle segment of the industry is in decline. Upgrades to the M1A1 Abrams tank and the M1A2 System Enhancement Package should keep the Lima, Ohio, plant operating through 2005. The Lima facility is also projected to produce 465 Heavy Assault Bridges. Similarly, upgrades of the M2 Bradley Fighting Vehicle to the M2A3 configuration should sustain United Defense Limited Partnership's ground systems facility in York, Pennsylvania, through 2008. These programs require but a fraction of the production capacity available at each facility. Internationally, the producers of tracked armored vehicles face a similar situation: European manufacturers are operating their plants well below capacity, and, with the exception of Giat, which is state-owned, see the foreign sales and upgrades as essential to their survival.

Wheeled Armored Vehicles. The Army's plan to procure wheeled armored vehicles to outfit as many as five brigades with IAVs (331 vehicles per brigade) presents a tremendous short-term opportunity. The Army has reserved the right to make up to two awards for the production of these vehicles. Also, because these vehicles are an interim fix until the Army can deploy its Future Combat System in 2012, the Army is encouraging innovative solutions to reduce the integrated logistics support burden. This appears to be an additional opportunity for the contractors, as it suggests that they could provide the maintenance and other logistics support rather than having the Army develop it organically. The remainder of this industry sector—i.e., the companies that do not win contracts for the IAVs—will continue to compete for sales in foreign markets.

Tactical Wheeled Vehicles. As the tactical wheeled vehicles sector of the industry continues to grow, the medium and light categories offer the greatest opportunities. Stewart & Stevenson has been awarded an Army contract for 7,800 FMTV A1 vehicles plus trailers, scheduled for fabrication through 2003 under a $1.4 billion contract, and the Oshkosh Truck Company, a 5-year contract for 5,666 to 8,168 Marine Corps MTVRs. Currently under discussion by the Army is a second-source or follow-on contract for additional FMTVs. The industry will also benefit from the continued re-capitalization and modernization of HEMTT and PLS vehicles. Finally, the Army is considering the addition of Commercially Based Tactical Truck vehicles to the lightweight fleet by 2003 or 2004. These vehicles are considered off-road versions of the Ford F–350 and Dodge 2500 Ram pick-up trucks and the Humvee.

The United Kingdom's plan to modernize its fleet of tactical trucks (500–600 vehicles) also offers opportunities for this sector of the industry.[xi] A contract for 120 HETs is scheduled for award in December 2000, with deliveries planned for April 2002.[xii]

Long Term

Tracked Armored Vehicles. The world market should continue to be characterized by excess capacity and reduced demand over the period 2005–2020. Continued improvement and upgrade programs, coupled with scant new procurements, are to be expected. Budget projections call for certain new procurements, including the purchase of a revised quantity of 480 Crusaders and 1,013 Advanced Amphibious Assault Vehicles. Procurements of the Grizzly Obstacle Breacher, Wolverine Heavy Assault Bridge, and Hercules Heavy Recovery Vehicle are also possible during this period. Funding for the Future Scout Cavalry System is expected to be restored, and low-rate initial production is scheduled to begin in fiscal year 2006, with full-rate production beginning in fiscal year 2008. The Army's Future Combat System, which may consist of a manned command-and-control vehicle that controls other firing and sensor platforms, is scheduled to begin low-rate initial production in fiscal year 2010 and enter full-rate production by fiscal year 2012. Both the Future Scout Cavalry System and the Future Combat System represent significant development and production opportunities for the industry.

Wheeled Armored Vehicles. Growth in the wheeled armored sector over the long term (through 2008) will depend on whether the Army decides to outfit additional brigades (beyond the five originally proposed by the Army) with IAVs. As with the tracked armored vehicle sector, the long-term outlook for wheeled armored vehicles will depend largely on development of the Army's Future Combat System and the nature of the platforms supporting that system.

Tactical Wheeled Vehicles. The long-term outlook for medium- and lightweight tactical wheeled vehicles is much less certain. By 2005, the new procurements of MTVRs and FMTVs should be complete. However, modernization, refurbishment, and overhaul of these and the HEMTT, HET, and PLS fleets should be expected. Re-capitalization of the Humvee or the development of a follow-on to this vehicle is expected. The Marine Corps will be developing a new heavyweight vehicle to replace the LVS, which has been in its truck fleet since 1985. The LVS Replacement, a procurement of from 2,000–3,000 vehicles, will have to be in production by 2005 or 2006.[xiii]

GOVERNMENT GOALS AND ROLE

Acquisition Reform

Government, as the only buyer of many of these systems, also shapes the land combat systems industry through the policies, rules, and regulations that it decrees and enforces. In an austere fiscal environment, contractors and the government are forced to reduce costs as much as possible. The government has taken on the challenge of acquisition reform through many measures, including reducing its dependence on military specifications and standards, forming industry–government teams to streamline the acquisition process, and developing virtual databases to share knowledge and facilitate the design process. The Marine Corps has employed many of these techniques to facilitate development of the Advanced Amphibious Assault Vehicle, but it will still take 10 years (fiscal years 1995–2005) before initial operating capability is reached. Acquisition reform efforts must be pursued further, not only to reduce cost, but also to shorten the development cycle.

Research and Development

Since World War II, the United States has relied on technologically superior weapons systems to ensure an advantage over its adversaries. For many of the major systems, the nation procures a limited number of expensive, high-quality, state-of-the-art systems rather than large quantities of low-cost, mediocre systems. The technologically superior systems fielded today exist because of the R&D performed yesterday. In order to maintain superiority on the future battlefield, the United States will have to invest in technologies that improve the lethality, mobility, and survivability of the LCV. (One of the essays at the end of this chapter addresses R&D challenges and opportunities.)

Foreign Military Sales

An active, aggressive foreign military sales effort can be an effective way of maintaining domestic industrial capabilities. It can provide the bridge necessary between the completion of one system and development of the next. However, the U.S. bureaucracy in this area is more cumbersome and time-consuming than that of its foreign competitors, whose governments actively support and subsidize the export of their military products. While it is generally agreed that U.S. industries should not be directly subsidized or state-owned, the competitive environment is such as to commend a review of the rules and regulations regarding the sale of U.S. military hardware and pursuit of policies that facilitate the export of LCV systems. Specifically, a reduction of the administrative fee (currently 2.5 percent) levied by the government on all foreign military sales should be considered. The Administration should also initiate an interagency review of the export license process to identify inefficiencies.

CONCLUSION

The LCV industry is an industry in contrast; growth is foreseen for some sectors and decline for others. The tracked armored vehicle sector, with scant new production orders and only modernization and overhaul programs in prospect for the foreseeable future, is in decline. More promising is the outlook for wheeled armored vehicles, particularly for the short term, as the Army plans to outfit its Brigade Combat Teams with lighter, more mobile IAVs. Prospects in the long term for the tracked and wheeled armored vehicle sectors will depend greatly on development of the Army's Future Combat System and the types of platforms developed. The short-term outlook for the medium- and lightweight categories of tactical wheeled vehicles appears promising, as contracts for large numbers of new vehicles and for overhaul and modernization programs have been awarded. Much less certain are the long-term prospects, though fleet modernization and overhaul efforts should be expected. For the heavyweight sector of tactical wheeled vehicles, there are few new procurements or overhaul and modernization programs.

Overall, the industry is faced with many challenges, including dealing with significant overcapacity and competing with information technology companies for capital and human resources. The Army's initiative to lighten its brigades, making them more mobile and flexible, presents both challenges and opportunities for the industry.

The government should continue sponsoring and subsidizing the R&D needed to develop the next generation of tracked and wheeled armored vehicles. Research should be focused specifically on increasing the lethality, mobility, and survivability of the vehicles. With respect to tactical wheeled vehicles, the government should partner with industry to develop systems to increase fuel efficiency, reduce toxic emissions, and improve vehicle handling, safety, and maintenance requirements.

Foreign military sales contribute to a viable military industrial base. In some cases, foreign sales will provide a critical bridge between the end of one production cycle and the start of another years later. Therefore, the rules and regulations governing the foreign military sales process should be reviewed to ensure a level playing field for U.S. companies.

Finally, the U.S. military services should expand their use of contractor logistics support to reduce overhead and forge a long-term partnership with industry.

ESSAYS ON MAJOR ISSUES

CONTRACTOR LOGISTICS SUPPORT

Patrick O'Neill, William Pratt, Ronald Stump,

and Philip Waring

Possible major benefits of contractor logistics support for the land combat systems industry include reductions in the $60 billion secondary-item inventory maintained by the DOD, reductions in DOD infrastructure, and assistance in maintaining the health of the industrial base. At the weapons system level, benefits include performance and cost efficiencies, reduced operations and support costs, increased readiness, reduced order and shipping time, reduced pipeline spares, and increased component reliability (through incentives).

Prominent among risks associated with the use of contractor logistics support is the possibility of contractor non-performance, which would be especially devastating in wartime. There are also risks relative to the protection of contractors on the battlefield, warfighter confidence in contractor capabilities, the integration of contractor and organic assets, and the possible loss of economies of scale (i.e., less than optimum performance at the enterprise level). Most of these risks can be mitigated through appropriate measures.

There are a series of impediments to a broad and fair consideration of contractor logistics support. The most significant, statutory in nature, involves two titles of the U.S. Code (i.e., 10 U.S.C. 2466 and 10 U.S.C. 2464). The former, known as the "50/50 Rule," defines the level of funding that may be made available to a military department for depot-level maintenance and repair by contractors. The latter, entitled "Core Logistics Capabilities," has prohibited most major weapons systems from entering into contractor logistics support contracts. This statute requires that the DOD maintain an organic capability to perform depot-level maintenance and repair on weapons systems essential to the national defense. Unless modified, these two statutes will preclude extension to the services of the full economic benefits of contractor logistics support.

A significant financial hurdle, especially for legacy systems, is the impact on the Army Working Capital Fund. Two specific hurdles associated with the Fund are (1) recapturing monies already disbursed to users, and (2) reimbursing the Fund for materiel taken from it.

Another significant hurdle is the presumed impact on the Defense Logistics Agency's (DLA's) cost recovery rates (CRRs). The Agency's intent is to keep CRRs at a level sufficient to cover the costs of the support structure required to maintain management oversight of depot stocks and the delivery of repair parts to worldwide DOD customers. It is DLA's belief that contracts with third-party logisticians would result in the depletion of certain stocks and could drive up the CRRs. The presumption of this CRR effect is based on DLA's view that there are fixed costs involved in maintaining the Agency's infrastructure and that there are too few assets over which to spread the costs of contractor logistics support.

It is generally believed that current accounting practices do not adequately state the true costs of logistics support. The use of activity-based costing and the direct funding (appropriation) of war reserve accounts would ensure CRRs proportional to the activity necessary to support the weapons system.

There is a proven method of comparing contractor and organic logistics support options. That method entails the use of automated tools to assist in a Level-of-Repair Analysis. The method enables optimal decision-making on both maintenance support and supply support alternatives.

Assessment of the outlook for contractor logistics support is informed by case studies of specific weapons systems (Abrams tank, Bradley Fighting Vehicle, Humvee); original equipment manufacturers (General Dynamics Land Systems, Oshkosh Truck Corporation); and third-party logistics providers (W&W Logistics). These studies suggest possible benefits of contractor logistics support across the entire land combat systems spectrum, and thus the value of more aggressive pursuit of options for such support.

Clearly, contractor logistics support for land combat systems is an option worthy of being pursued. It has the potential for cost savings and improved effectiveness, and it is consistent with acquisition reform initiatives. It can also prompt reductions in the logistics force structure, possibly enabling a reallocation of forces so as to provide more combat "teeth." Assuming it is cost-efficient, contractor logistics support might eliminate the need for government personnel and facilities to acquire, manage, store, and distribute spare parts, and could allow for a direct interface with the soldier at the retail level. Contractor logistics support is being pursued on some flagship land combat systems (e.g., the Marine Corps' MTVR), is being considered for others (e.g., the revolutionary Army IAV), and is working well on pilot programs such as that for the M1A2 System Enhancement Package.

"Contractors on the battlefield" is a concept in transition. The policy will continue to change if contractor logistics support becomes more prevalent. But the services will have to design the support structure necessary to optimally integrate the support strategies.

Seven specific recommendations as to contractor logistics support are worthy of consideration:

1. The DOD should pursue legislative action conducive to a level playing field for consideration of weapons system support options. One possibility is relief from the 50/50 Rule.

2. The DOD should reform the financial and accounting systems, in particular the working capital funds, to remove disincentives and potential suboptimization inadequacies. The financial and accounting systems must allow for true total cost comparisons.

3. The DLA should expand the use of vendor-managed or co-managed inventory practices throughout its supply chain.

4. The DLA should adopt activity-based costing, which will allow the allocation of indirect costs, and should compute the CRR on the basis of direct costs and an appropriate share of overhead. The DOD should direct-fund the DLA for those activities (e.g., R&D, engineering, war reserve materials) that are not associated with a weapons system.

5. For weapons system support decisions, a fact-based business case analysis using proven tools should be performed. This will allow for the comparison of organic and contractor support proposals in terms of cost, risk, and operational effectiveness.

6. If contractor logistics support is chosen as the preferred alternative, the contractor's supply management and distribution management structure must be integrated with direct organic support. The program manager should insert wartime clauses into contracts and develop contingency plans and performance measurement approaches to minimize the risk of contractor logistics support.

7. The DLA and the Army should expand the pilot program for contractor logistics support with the Abrams program manager, and consider instituting a pilot program on the Bradley and Humvee if the program managers desire.

IMPACT OF THE NEW ARMY VISION

Beverly Burton

In October 1999, Army Chief of Staff General Eric K. Shinseki announced a new vision for the Army in response to a changing world. Central to that vision is a major transformation of the force to make it lighter and more agile without compromising combat capability and survivability. While details of the transformation are still evolving, the Army is moving forward to make the vision a reality. The transformation will be in three steps: initial force, interim force, and objective force. Implementation of the Army's aggressive new vision will necessarily have important implications for the land combat systems industry.

Near Term: The Initial and Interim Forces. The initial force will consist of two medium-weight brigades that will "stand up" this year at Fort Lewis, Washington, to validate and refine organizational and operational concepts for the interim force. Concurrently, the Army is pursuing acquisition of the IAV.

The interim force will consist of the two initial brigade combat teams at Fort Lewis, plus other brigades to be named. Off-the-shelf equipment and some technological advances, along with doctrine, tactics, and training, will provide the desired capabilities to bridge the gap between heavy forces and light forces. This gap filler force will continue until the objective force can be achieved.

The Objective Force. The central enabler of the new Army Vision is the fielding of a new weapons system "ensemble,"[xiv] the Future Combat System. While Army leadership will not decide on a

specific vehicle or platform for the objective force until 2003, it has outlined the basic characteristics desired:

> The newly organized force will be built around a common unit design and family of combat systems that are C-130 deployable [i.e., 20-ton weight class]. . . . Ultimately, heavy and light forces will converge with similar capabilities in a family of systems on a common platform. . . . Throughout the process, transformation actions will ensure that today's light-force deployability is retained while providing it the lethality and mobility for decisive outcomes our heavy forces currently maintain.[xv]

The Army believes that its science and technology efforts hold the key to achieving the long-term transformation of the Army, and the Future Combat System is the Army's highest priority initiative in science and technology.[xvi] In collaboration with the Defense Advanced Research Projects Agency, the Army is working to develop technologies needed to create a family of systems with the characteristics necessary to support the new vision. It is relying on the science and technology community, including in-house laboratories and industry, to identify the "realm of possibilities" for the Future Combat System,[xvii] the goal being the creation of a combat system that can enter production in 2010 and be fielded as early as 2012.[xviii]

Technical Challenges. The Army is counting on advances in information, material, and weapons system technologies to enable a successful transformation to the objective force.[xix] Increasing mobility by reducing system size and weight for the Future Combat System is not difficult; simultaneously maintaining lethality and survivability is a major technical challenge. The Army is prepared to alter its traditional approach to overmatching adversaries. As the Army Assistant Secretary for Acquisition, Logistics, and Technology recently explained:

> Where we are deploying over long distances and our adversaries are not, we are likely to find that we will not have overmatch *on an individual platform basis*. Instead we will achieve an overall capability overmatch by training our soldiers to exploit the synergy of agile, survivable, and lethal platforms that are digitized and networked to provided interoperable situational awareness.[xx]

Enabling Technologies. The Army is relying on technological advances to achieve its vision. Industry will play a crucial role in advancing required technological improvements. Key areas to exploit include the following:

> **Guns, missiles, and precision munitions in all combinations to meet essential lethality requirements,[xxi] improve mobility, and reduce the logistics footprint**
>
> **Advanced components, to include "armor, threat sensors, and active protection [systems integrated] into manned systems with inherently small silhouettes and high agility"[xxii]**

Propulsion devices, to include batteries, fuel cells, more efficient engines, electric motors, hybrid drive, and multiwheel drive, for improved mobility

Stealth technology to improve survivability

Lighter armor

Composites and ceramics to reduce weight

New defensive aids such as active systems or improved sensors to increase survivability at lighter weights

Robotics

Wheel technology

Wheels vs. Tracks. The new Army Vision has re-invigorated the "wheels-versus-tracks" debate. While the Army maintains that it is not predisposed to a solution, General Shinseki stated in October 1999 that he thought the Army could "'in time,' as technology allowed, transition to a lighter, all–wheeled vehicle fleet."[xxiii] Tracks have a traditional advantage for mobility over rough terrain, while wheels have improved mobility on improved surfaces. The Army recognizes that wheel technology has advanced greatly in the past 10 years, driven by the recreational vehicle industry.[xxiv] Wheeled vehicles have advantages in reducing the logistics footprint, including fuel tonnage, and improving readiness.

Implications for Industry. Since the land combat systems industry has received a rather small share of the defense budget in recent years, the Army's transformation plan, if it is supported in the political process, will provide a stimulus to industry. If embraced by the Congress, the new vision will result in an infusion of funding for R&D of advanced technologies for the Future Combat System, the procurement of that system, and the modernization of legacy forces. However, there will likely be some offsets from ongoing programs such as the self-propelled howitzer Crusader.

The Army transformation potentially offers new incentives and opportunities for the partnering of U.S. and foreign firms. It also potentially provides new opportunities for foreign sales, which would further stimulate U.S. industry. If wheeled vehicles were tabbed for a prominent role in execution of the transformation, there could be increased pressure for mergers between track and wheel firms. The vision's emphasis on a reduced logistics tail could increase opportunities for R&D and contractor logistics support.

Conclusion. The new Army Vision could reverse the recent trend of declining budgets and dwindling production orders that has characterized the land combat systems industry. However, that vision is a challenging one, and congressional support and associated funding increases are as yet by no means assured. The Army is depending on technology to point the way to the best means of achieving its desired end state, while skeptics question the reliance on "futuristic technologies" not yet fully developed. Realization of the vision ultimately depends on the industry's ability to deliver technological solutions. And that, in turn, depends on the ability of the Army, together with industry, to convince the Congress that those technological solutions are within reach and that investment therein is essential to national security.

THE NEW ARMY VISION

Anthony F. Romano

"We will begin immediately to transition the entire Army into a force that is strategically responsive and dominant at every point on the spectrum of operations."[xxv] Thus, on October 12, 1999, General Eric K. Shinseki, Chief of Staff, United States Army, announced the new "Army Vision" and directed its immediate implementation. This vision calls for a lighter, more lethal, more reliable, more fuel-efficient, and more survivable fighting force capable of responding quickly and with a smaller logistics footprint and need for replenishment than any force fielded to date. Under this construct, a medium-weight, combat-ready brigade will be deployable within 96 hours; a division within 120 hours; and five divisions within 30 days—all on C-130 *Hercules* aircraft— anywhere in the world.[xxvi]

In the near term, employment of new tactics, techniques, and procedures, combined with extensive use of existing off-the-shelf systems, should prove sufficient to address medium-weight brigade requirements. However, the ability to quickly and effectively deploy a fully capable force in the time frame specified by the Chief of Staff, U.S. Army, underscores the need to leverage the DOD, industrial, and academic science and technology efforts.

The Army Research Laboratory, as well as various Army Research, Development, and Engineering Centers, are all well positioned, assuming adequate funding, to develop the necessary technologies to support the Army Vision. In partnership with industry and academia, they provide a tremendous talent base and infrastructure from which to plant technology "seed corn" and harvest superior capability. To realize the transformation, the Army/Industry/Academia team must focus on technology projects in areas that directly benefit the new Army Vision: mobility, lethality, and survivability.

Mobility. For tracked and wheeled vehicles, the ability to move quickly, quietly, and efficiently will be of paramount importance. Science and technology initiatives focused on improving mobility include the following:

- Active, electronically controlled suspensions to dampen structural vibration and shock, thereby providing an on-road feel regardless of terrain. This will allow for significantly higher speeds and for reduced vehicle structural damage, system equipment damage, and crew discomfort.

- Rubber-band tracks to lower track weight and improve durability. Recent advances by the Army Research Laboratory in rubber formulation and processing have led to the development and deployment of track pads with three times more durability than those currently used.[xxvii]

- High-efficiency, low-weight, hybrid electric power technologies for propulsion systems, armor, and armaments. Research will focus on improving generators, drive systems, energy storage and recharge capability, and electromechanical conversion—all to provide more power, higher acceleration, fewer emissions, lower energy consumption, and a lower thermal signature (for "stealth" operations) than conventional vehicles have.[xxviii]

- Composites, titanium, and other lightweight materials for both chassis structure and armor. Their use will provide significant weight reductions, improve survivability through better ballistic protection, and reduce the signature through smoothing and shaping.[xxix]

Survivability. Mission success will require increased survivability across a broad threat spectrum to protect ground combat vehicles and crews. Science and technology efforts to improve detection, hit, and kill avoidance technologies include the following:[xxx]

- Reduction of visual, thermal, radar, acoustic, and seismic signatures under various atmospheric conditions. Signature management will involve the development and use of advanced composites and special chemical agent–resistant coatings.[xxxi]

- Sensing devices that detect precision munitions, and electronic countermeasures to significantly confuse or physically disrupt incoming threats.

- Improved armor (i.e., ceramic, composites, and titanium) to counter anti-armor capability, reactive armor to defeat kinetic energy penetrators, and electromagnetic armor to defeat shaped charges. Improved laser protection is also being developed, as are non–ozone-depleting substances for more robust fire suppression inside the crew compartment.[xxxii]

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Lethality. Defeating an enemy in the future will require kill technologies that nullify an opponent's kill-avoidance capability. These technologies include precision munitions, compact kinetic energy weapons, and electromagnetic guns. Programs to develop smarter, more accurate, and smaller lethal weapons will allow for kill efficiency with a fraction of the requisite number of conventional munitions, significantly decreasing weight, improving mobility, and reducing the logistics footprint.[xxxiii] Examples of work in this area include the following:

- Line-of-sight and beyond-line-of-sight munitions capable of defeating high-value armored vehicles equipped with explosive-reactive armor or active protection systems.

- Lightweight, miniature, hypervelocity kinetic energy missiles to provide a significant increase in the mobility, lethality, and survivability of a dual-role close-combat weapons system. Development of continuous control actuation for close-range firing or short-range air defense scenarios will allow the missile to more easily adapt to changes in target heading, azimuth, or elevation.

While current technology may be good enough to begin transforming the force, it will have to change sufficiently to stay ahead of advances in enemy threats. Therefore, successful transformation to a medium-weight force will require increased Army commitment to applicable science and technology programs through robust investment, as well as an industry commitment to affordably translate proven technologies into warfighting capabilities.

Given these commitments, necessary technologies can be matured and integrated into such systems as the Future Scout Cavalry System and the Future Combat System. This will ensure that the

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Return to the Top
Return to the ICAF Home Page