

**Spring 2008  
Industry Study**

**Final Report**  
*Land Combat Systems Industry*



The Industrial College of the Armed Forces  
National Defense University  
Fort McNair, Washington, D.C. 20319-5062

## Land Combat Systems 2008

**ABSTRACT:** The seminar surveyed the state of the U.S. Land Combat System industry. The study found that the current LCS industry has responded well to the demands of wartime production. Funding fluctuations, domestic specialty metal usage requirements, and long lead times contributed to delays in some procurements, leading the study to make recommendations for improvements to acquisition processes. In the near future, the demand for tactical wheeled vehicles will increase because the Iraq conflict has led to a new emphasis on the survivability of equipment and personnel. The challenges presented by globalization and impending budget cuts will drive the future of this industry. Concerns that the increased demand placed on the industry would be problematic were proven to be unfounded. A concern, though, is that globalization has created competing priorities for some suppliers as potential profit expansion requires overseas markets for combat vehicles. Another major development is the entrance into LCS markets by both commercial vehicle manufacturers and large defense firms traditionally focused on aerospace products. Finally, maintaining an industrial base for these systems is very challenging in a commercial setting, but the U.S. continues to seek ways to remove excess capacity from the government's organic industrial base and seems less inclined to maintain the technological expertise of its acquisition workforce. This trend puts the Government at increasing risk as it becomes difficult to manage a shrinking base while preparing for the next conflict.

COL Faisal Al Sabrah, Yemen Army  
Mr. Thomas Barnard, Department of State  
LtCol Andy Bianca, US Marine Corps  
LtCol Greg Breazile, US Marine Corps  
COL Scott Calisti, US Air Force  
Mr. Russell Hanks, Department of State  
Ms. Christine Hazlett, Department of the Air Force  
COL Scott Hickenbottom, US Army  
Mr. Ashley Johnson, Department of the Navy  
Mr. Jim Kelly, Joint Staff  
COL Keith Landry, US Army  
Mr. Lloyd Luedtke, Department of the Army  
Mr. David Martin, Department of the Army  
Lt Col Tom Skrocki, US Air Force

COL Richard Shipe, US Army, Faculty  
Dr. Sorin Lungu, Faculty

## PLACES VISITED

### Domestic

Aberdeen Test Center, Aberdeen, MD  
Anniston Army Depot, Anniston, AL  
General Dynamics Land Systems Anniston Operations, Anniston, AL  
BAE Systems Ground Systems Division, York, PA  
Program Manager, Expeditionary Fighting Vehicle, Woodbridge, VA  
Program Manager, Joint Light Tactical Vehicle, Woodbridge, VA  
Program Manager, MRAP, Woodbridge, VA  
Textron Marine and Land Systems, New Orleans, LA  
MTU Detroit Diesel, West Detroit, MI  
General Dynamics Land Systems, Sterling Heights, MI  
Spartan Chassis, Charlotte, MI  
Joint Systems Manufacturing Center, Lima, OH  
Allison Transmissions, Indianapolis, IN  
AM General, South Bend, IN

### International

Egyptian Armed Forces Armament Authority, Cairo, Egypt  
Egyptian Armed Forces Technical Institute, Cairo, Egypt  
Egyptian M1 Tank Co-Production Plant, Cairo, Egypt  
Arab American Vehicles Co., Arab Organization for Industrialization, Cairo, Egypt  
Egyptian Electronics Factory, Arab Organization for Industrialization, Cairo, Egypt  
GDELS Steyr-Daimler-Puch Spezialfahrzeuge, Vienna, Austria  
Krauss-Maffei Wegman (KMW), Munich, Germany  
MAN Sonderfahrzeuge, Vienna, Austria  
MAN Nutzfahrzeuge, Munich, Germany  
RENK Aktiengesellschaft, Augsburg, Germany

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## **Introduction**

What is a “Land Combat System” and how is it produced by industry? This deceptively simple question is actually a difficult question to answer. Taken at its broadest, the “Land Combat System,” from the American perspective, is our Military as a whole or the U.S. Army and (to a degree) the U.S. Marine Corps. By extension, the ability of the U. S. Government (USG) to wield influence and project power throughout the world depend on the Land Combat System. The industry that supports Land Combat Systems (LCS) is an ill defined industrial segment that includes a sub-sector of defense industries, civilian vehicle manufacturers and a host of second-, third-, and lower-level suppliers of pieces and assemblies to feed the production chain.<sup>1</sup> Today, this industry includes both private, for-profit businesses, and government, not-for-profit facilities.

The USG has defined for itself a national defense that requires superior military capability. This requirement drives the demand for defense systems, including land combat systems. National defense planning is limited by fiscal reality and available technology, informed by planned employment of the force, and influenced by Congress and the ability of the industrial base to provide the desired capabilities. National defense, a public good, is shared equally by all citizens and cannot have competitors in its provision.<sup>2</sup> The USG decided long ago that security requirements include the need for an advanced combat capability and land combat capabilities remain an integral part of the national strategy. The unique association between the Department of Defense (DoD) and the Defense Industrial Base (DIB) is one of monopsony – only the DoD procures fighter aircraft, aircraft carriers, and land combat systems. This market is distorted not only by the monopsonistic nature of its interactions but also by the political landscape. Relationships among the DoD planners, Congressional funders and Corporate salesmen, known as the “Iron Triangle,” influence acquisitions and have the potential to negatively impact on the performance of the end-user, the U.S. war fighters.

Although Americans typically spend more on toothpaste during peacetime than combat vehicles, the relative importance of maintaining a healthy LCS sector does not diminish in the absence of conflict. Faced with two conflicts and instability in many other regions, spending on these vehicles has quadrupled from \$10B before the current wars to over \$40B in FY2008.<sup>3</sup> Examining the LCS industry at this time can provide insights into the health and ability of the sector to respond to increased demands.

### ***Defining the Study***

This study provides a snapshot of the industry in 2008. It is not intended as a comprehensive statistical, economic analysis of the industry. Rather, it is an anecdotal examination of key aspects of the design, fabrication and deployment of wheeled and tracked vehicles with a focus on the increase production requirements consequent to the conflicts in Iraq and Afghanistan. Our team agreed on the major points and attempted to focus on strategic, rather than tactical, issues across the industry. The study focused on repeated observations from the industry and depended on the accuracy of that information. Many of our conclusions have been drawn from incomplete data, a necessary part of strategic decision-making in a dynamic environment.

## ***Major Findings***

In our examination we found several major trends. Concerns that the increased demand placed on the industry would be problematic were proven to be unfounded. The LCS industry has handled the surge in demand admirably and, in fact, this demand has been little more than a blip for suppliers of commercial parts and components used by the industry. A concern, though, is that globalization has created competing priorities for some suppliers as potential profit expansion requires overseas markets for combat vehicles. Another major development is the entrance into the LCS field by both commercial vehicle manufacturers and large defense firms traditionally focused on aerospace products. Finally, maintaining an industrial base for these systems is very challenging in a commercial setting, but the U.S. continues to seek ways to remove excess capacity from the government's organic industrial base and seems less inclined to maintain the technological expertise of its acquisition workforce. This trend puts the Government at increasing risk as it becomes more dependent on those seeking to sell equipment to the military at a profit. The majority of our findings and recommendations fit into three broad categories:

- challenges presented by future budget decreases;
- shifting industry requirements based on current conflicts; and
- consequences of globalization.

## ***Organization of the Paper***

The challenges presented by globalization and impending budget cuts will drive the future of this industry. The paper first looks at issues of globalization and of the increased demand for military vehicles during wartime. After a brief assessment of both the industry's and the government's structures in this industry, the report will expand on its assessment of current performance and provide findings and recommendations to maintain and improve the health of both the government and the industry pieces of the Land Combat Systems industry.

## **Exogenous Conditions/ Government Structure**

### ***History***

The organizational structure of the LCS industry continues to be shaped by historical (and current) events, federal legislation and government policies, technological advances, customer needs, and market forces. The post WWII period saw a combination of competition, government control and consolidation producing a distinctive defense industry by the 1970's. The era of automotive companies serving as prime contractors for combat vehicles ended in 1982, Chrysler reached an agreement with General Dynamics for the sale of Chrysler's Defense Division, renamed General Dynamics Land Systems (GDLS). Divesting this division, Chrysler severed its connections with tank development and a major commercial manufacturer withdrew from the combat vehicle industrial base. Other major industry players in the thriving 1980s LCS market were FMC Corporation's Defense Systems Group, Harsco Corporation's BMY Combat Systems Division, AM General Corporation, and Oshkosh Truck Corporation.

In the 1990s, defense spending withered. From 1990 to 1994, defense budgets dropped 15% from \$293 billion to \$251 billion and military procurement fell by 40%. In 1993, Secretary of Defense Les Aspin and Deputy Secretary of Defense William Perry informed industry leaders that DoD would not stand in the way of any corporate mergers or acquisitions they felt necessary

to make in order to adapt to decreased spending. Known as “The Last Supper,” this event signaled the beginning of defense industry consolidations and mergers in the 1990s. FMC and BMY merged in February 1994 to form United Defense Limited Partnership (UDLP). This merger created the largest U.S. supplier of light and medium weight tracked armored vehicles. The other major supplier, GDLS, focused on vertical integration by acquiring several smaller companies in 1996 and 1997.

The dawn of the 21st Century brought an increase in procurements again. Large defense companies like General Dynamics, Boeing, and Lockheed Martin expanded through acquisitions and mergers, offering defense services in air, land, sea, and space systems as well as IT services. Other companies like Oshkosh and AM General were diversifying into commercial vehicle markets to remain viable. In 2000, GDLS was awarded the first new major production contract for armored combat vehicles in over a decade, for the Stryker family of lightweight-wheeled combat vehicles, signaling a DoD move away from tracked vehicles.<sup>4</sup> Anticipating the problems inherent in an industry with a single supplier, the Army awarded a development contract to GDLS and UDLP in 2002, with Boeing as the Lead Systems Integrator (LSI), for the Future Combat Systems (FCS) program. This team approach, combining the expertise of GDLS in heavy tracked combat vehicles with UDLP’s expertise in light and medium-weight vehicles, was created to ensure the survival of these two remaining military vehicle manufacturers.<sup>5</sup> Seeking access to markets in Europe, GDLS purchased Santa Bárbara Sistemas (Spain, 2001) and Steyr Daimler Puch (Austria, 2003) and acquired the Swiss firm Mowag via the purchase of its parent company, GM Defense Canada in 2003. BAE Systems, headquartered in London, England, responded with a \$4.2 billion deal for UDLP, making BAE prime competitors with GDLS in both the U.S. and the European markets.

The organizational structure of any industry influences the conduct of industry participants, and the LCS is no different. The net result of the past three decades is the globalization of an industry, dominated by GDLS and BAE, supported by a complex, world-wide, industrial network of suppliers, and functioning under a peculiar set of operating rules specific to the United States and a different set of rules in the global market. (A further examination of the history of the industry and its consolidation can be found in Annex A.)

## ***Globalization***

Globalization, a geo-political and economic development that many believe had its origins in the late nineteenth century British Empire, is a trend that is creating major changes in defense industries worldwide. In the period after World War II, the U.S. and European nations created the structures that would promote the free flow of capital and goods as well as foster technological exchanges. The Bretton Woods Institutions -- the World Bank, the International Monetary Fund and the General Agreement on Trade and Tariffs -- helped to rebuild western Europe and the Pacific Rim but also served to ensure the access to their financial markets. The success of this system through the 1990s is measured by the rebuilding of war-damaged countries and a subsequent economic growth. Until 2000, fifty percent of the world’s economic growth came from “western” countries, the U.S. and Western Europe, even though these countries made up only thirty percent of world population.

Even though these countries currently maintain an economic advantage, world demographics are reducing their influence. While these nations comprise only fifteen percent of the global population today, U.S. and European economic growth is expected to make up about thirty percent of the world’s total over the next few years. Looking ahead, though, growth in

developing countries, particularly India and China, will lead to the erosion of U.S.-European economic dominance. China has amassed more than \$1.5 trillion in investments in the U.S. with even more invested globally. Middle Eastern countries have amassed an investment portfolio in excess of \$4.5 trillion worldwide, based primarily on the worldwide demand for oil.<sup>6</sup> The U.S., on the other hand, is now the world's biggest debtor.

But growth is not the only challenge. The expansion of international businesses, led thus far by U.S. and European companies but facing challenges from India, China and the Middle East, is transforming defense industries around the world. The ease of moving finance and labor from country to country challenges the foundation of a "national" defense industry. Already, defense industries in the U.S. utilize global suppliers for items that are either better or cheaper from abroad. This tendency pushes industry to seek ownership of assets. It will become increasingly difficult to separate asset ownership from national policies as companies seek to maximize their use of technological and financial assets throughout a truly global supply chain. Some countries have chosen to take advantage of the economies of scale offered by the transnational businesses, even in defense procurement. Meanwhile, other countries attempt to control "domestic" industries in the name of national security. It is doubtful that any government can exert sufficient control over these industries to ensure a truly national enterprise given the changed nature of state control and the transnational mobility of capital, technology, and labor.<sup>7</sup>

### ***Demands of War***

The nature of the conflicts in Iraq and Afghanistan have had a dramatic impact upon current capabilities as well as those of the future. As combat operations in these areas took on dimensions beyond the expectations of the Pentagon's strategic planners, a set of requirements for new equipment and the replacement or repair of deployed equipment impacted the industry. Perhaps the most compelling change has been the collapse of the battlefield, an environment where there are no "front lines" or "rear areas" in these theaters. The ever-present threat of Improvised Explosive Devices (IEDs) and Explosively Formed Penetrators (EFPs) blurs the distinction between combat troops and support troops, much as it blurs the distinction between tactical and combat vehicles. All troops are vulnerable, all must be able to fight, and all require protection and situational awareness. These realities have given rise to a whole new class of armored vehicles, to the employment of add-on armor to existing platforms and are shaping the capabilities and affordability of future systems. The costs associated with greater survivability will put pressure on dwindling budget dollars and force trade-offs between upgrading existing systems for today's fight and fielding the next generation of LCS.

Combat experience created the demand for a new class of vehicle in the U.S. inventory, designated the Mine Resistant Ambush Protected (MRAP) vehicle.<sup>8</sup> The DoD will field some 15,000-19,000 MRAPs ranging in cost from approximately \$500,000-600,000 each depending on the variant.<sup>9</sup> The flat-bottomed, less armored (and less expensive) HMMWV also has been enhanced with a series of armor upgrades to increase its ability to protect its passengers from IED attacks. The Stryker has received similar modifications. One industry leader observed that due to the Iraq war, "we are no longer in the combat vehicle market, we are in the armoring business and our greatest concern is that some other firm will invent a stronger and lighter armor plate." This expectation has led to the design of bolt-on armor additions for vehicles within the Army's Future Combat Systems (FCS) and the Marine's Expeditionary Fighting Vehicle (EFV). By utilizing the bolt-on design, not only will legacy vehicles operate in more severe conditions, but the military can also adapt and upgrade vehicles more easily in the event of advances in



armor technology. In any event, this need for more survivable vehicles will make armor technology a required core competency in competitions for existing and future work on all classes of vehicles.

Unfortunately, this dependence on heavily-armored vehicles dramatically increases the costs of these platforms. Currently, the DoD is able to fund these unanticipated expenses through supplemental budgets and deficit spending, but this funding is not sustainable in the resource-limited environment the USG faces. With increasing political pressure to manage costs and the rising cost of mandatory spending programs, the DoD will have choices to make.

These fiscal trends will force DoD to manage the costs of future systems by decreasing either quantities or capabilities or both. The Marine Corp has invested heavily in reset and upgrading its current LCS fleet to support its forces in Iraq and Afghanistan, but it recently announced a slash in the order for the Expeditionary Fighting Vehicle (EFV) and has delayed procurement of the Marine Personnel Carrier (MPC) by two years. Still, reducing its requirements from 1,013 to 573 vehicles, very little money was saved, primarily due to development problems and the increasing cost of armor. The Army's FY09 budget estimate reveals that overall procurement expenditures for the service are expected to slip from an estimated \$26.7 billion in FY-10 to \$23.7 billion in FY-13.<sup>10</sup> In 2009 alone, the estimated bill to support the Army's costs for reset, repair and ammunition (to replenish stocks expended in the Iraq/Afghanistan conflicts) topped \$23B, while it also planned to delay the deployment of the Joint Light Tactical Vehicle (JLTV), the replacement for the HMMWV, to the 2012 -2017 POM cycle. Given the cost of current combat operations, some Congressional leaders are increasingly questioning the affordability and utility of the FCS. The questioning of future programs and the diversion of funds to current expenditures will continue as the priority to resource the current fight erodes support for future systems and shift industry's focus from new, advanced systems to extending the life of the legacy systems.

While the current level of spending brings increased profitability and flexibility to the LCS industry, some are concerned that this comes at the expense of research and preparation for "the next war."<sup>11</sup> Shrinking budgets and extending legacy products could require the industry to shed excess capacity, cut costs, and continue to partner or merge in order to survive. The trend also reinforces a tendency to source globally and continues the ongoing erosion of the national character of the industry.<sup>12</sup> These market forces might also encourage the industry to limit its own risk and leverage the capabilities and capacities of government facilities through public-private partnerships, providing benefits both to industry and to the government facilities.

### ***Structure of Industry***

The blurring of the distinction between tactical and combat vehicles has created both bottlenecks and opportunities for the industry. The matrix of public and private enterprises that participate in LCS sometimes compete against each other and other times work together. As one industry contact pointed out, "We have to be friendly. We are either contracting, subcontracting, or competing with every business on every contract."

The structure of the LCS industrial base is both traditional and atypical compared to other defense-centric industries. The LCS industry constitutes a subset within the larger industrial base focused on tactical and combat vehicles, both wheeled and tracked. These vehicle systems are further classified by lethality, survivability and weight—light (<20 tons, usually wheeled but some tracked), medium (20-40 tons, mix of wheeled and tracked) and heavy (>40, usually tracked).

Within each of the discrete segments of the industry, there has been significant consolidation over the last several decades. The industry includes a small number of Prime defense contractors that assemble battle tanks, armored personnel and security vehicles, heavy, medium and light trucks and artillery. A larger number of Secondary partners manufacture the engines, transmissions, armor, sensors, and weapons systems as sub-contractors. This study focused on the defense requirement within the industry. Some products, such as engines and transmissions, have a wide overlap in the commercial world. Others, such as weapons systems, have none.

In the combat segment, there are three primary providers also serving as systems integrators: General Dynamics Land Systems (GDLS), BAE Ground Systems Division (BAE-GSD) and Boeing Integrated Defense Systems (Boeing IDS); the tactical truck segment also has three primary providers: AM-General, BAE Tactical Vehicle Division (BAE-TVD) and Oshkosh.

As the combat experiences in Iraq and Afghanistan have heightened the requirement for force protection, a surge of providers has emerged to meet the needs for MRAP vehicles. The MRAP requirements encouraged traditional LCS participants such as Oshkosh, Textron, GDLS and BAE to offer a variety of MRAP solutions, primarily based on existing technology developed overseas. It also enticed new players (Force Protection and Navistar) to successfully enter the market. The next generation of vehicles, the JLTV, is attracting even more interest. As the design and development phase of this project moves forward, more new entrants such as Northrop-Grumman and Lockheed-Martin, traditionally aerospace and air defense industry participants, are now teaming with traditional LCS players to provide sophisticated integrated solutions for ambitious JLTV capability requirements.

In general, the degree of vertical integration in the industry is relatively low. As a result, the industry's supply chains have expanded, become diverse, and more importantly, have grown very large. This trend will continue in the future as the systems themselves become more technologically sophisticated, requiring integration of more capabilities. Additionally, Government facilities interact with industry throughout the production cycle. Arsenal provide Government-furnished items (e.g., gun barrels) and depots support fielded systems in partnership of Original Equipment Manufacturers (OEMs). A multi-tiered structure is present with upper level, tier one product level contractors serving as system integrators, managing systems design, coordinating the procurement of sub-assemblies and parts, and serving as final producers/assemblers to deliver the final product: a combat system. Government depots also reside in the product level tier serving as producers of rebuilt systems, but they lack the design and systems integration capabilities of the other OEMs.

The OEMs today manage hundreds of suppliers, the second tier of the chain. This number is down significantly from the thousands of suppliers a decade ago. These tier two suppliers furnish products directly to the OEMs. This system cascades down to multiple layers of suppliers supporting the industry. Further, a tier one contractor might also be a tier two or three supplier to a different firm in the same or a completely different product line. From the buyer's perspective, sub-tier two suppliers generally do not have good visibility in the supply chain. The same is true for sub-tier suppliers to OEMs; it becomes more difficult to maintain surveillance of the supply chain the deeper one delves into the lower tiers.

## ***Government Facilities***

The U.S. defense industrial base includes an assortment of U.S. Government owned arsenals, maintenance depots and ammunition factories. As noted above, these facilities form an integral part of the industry in cooperation with private companies. Suffering from cutbacks and consolidation during the post Cold War 90s, the utilization of government facilities has increased as a result of the demands of combat operations in Iraq and Afghanistan.<sup>13</sup>

These operations have been consolidated in recent years, with few facilities remaining. The DoD closed excess facilities and designated specific locations as the lead for different types of products in an effort to limit duplication of services. Currently, the Joint System Manufacturing Center (JSMC) in Lima, Ohio, is the only facility capable of fabricating the M1 main battle tank. Two major depots -- Anniston Army Depot (ANAD) and Red River Army Depot (RRAD) -- and several smaller facilities also are in operation.

In an effort to survive the resource constraints of the 1990s, the depots began seeking partnership opportunities with private industry to keep facility utilization at an acceptable level. As the demand for depot services steadily increased following the initiation of operations in Iraq and Afghanistan, these partnerships have proven valuable in expanding industrial capacity on short notice. This has created a renewed interest in the depots among private industry, and encouraged more public-private partnerships (P3) in the current resource-rich environment, providing value to both government and industry.

The USG's network of depots, arsenals, munitions factories and proving grounds provide unique capabilities and capacity that would be difficult to maintain on a commercially viable basis during periods of low demand. The need to maintain the capability and capacity to develop, produce, and maintain war fighting material is constant even though the use of the capacity fluctuates greatly depending on a complex and changing operational environment. Still, given the ever increasing costs associated with maintaining and operating heavy production facilities and increased global participation in the industry, these facilities, in partnership with private industry, serve as an insurance policy ensuring the nation access to defense production facilities on U.S. soil at short notice.

## ***Government As Buyer/Regulator***

Even while the USG partners with industry at some facilities to ensure industrial base viability, it also serves as the regulator of the domestic industry and as the sole buyer (with the exception of a small amount of export business) for the industry's products. The USG role as a regulator is complex and driven by competing sets of interests. Congress passes laws to protect domestic industry (Buy American Act), implement socioeconomic goals for small and disadvantaged businesses (Small Business Act), and protect fair play in acquisition (Procurement Integrity Act). To safeguard multiple interests--sovereign, taxpayer, small business, domestic supplier base--other laws have been passed regarding accounting procedures, quality, safety, competition, freedom of information, pricing, ethics compliance, conflict of interest, subcontracting, and labor practices that contribute to the unique aspects of federal acquisition. The Federal Acquisition Streamlining Act (FASA), passed in 1994, emphasized the Government's preference for commercial items and commercial purchasing procedures, but created some conflicts for compliance with other regulations. The Federal Acquisition Regulation (FAR) Part 12 was revised incorporate simplified purchasing procedures for commercial items. (FAR Part 12 is included in Annex B as an example of this simplification.) These two initiatives have had a limited impact on commercial acquisitions, with the continuing

requirement of the Buy America Act. Furthermore, many in the DoD procurement and program offices appear reluctant to open the process to non-traditional suppliers or solutions.

As a buyer, the Department of Defense is the single largest consumer of LCS products in the world, outspending the budgets of virtually every country combined. To manage these purchases, the USG applies an acquisition system consistent with laws designed to protect the USG's sovereign rights and interests. By law, this acquisition system exists to "manage the nation's investments in technologies, programs, and product support necessary to achieve the National Security Strategy and support the Armed Forces. The Department postures its investment strategy to support today and tomorrow's force, all the while seeking to advance capability at a "fair and reasonable price."<sup>14</sup> As expected, this management includes elements to spend U.S. tax dollars to the benefit of citizens, spreading the benefit throughout the nation to provide employment and economic benefit as broadly as possible. The anticipated reduction in acquisition funds will impact the ability of the USG to wield its influence in shaping industry through acquisitions. It will also challenge industry's (especially second and third tier suppliers) ability to remain engaged in supplying the USG's requirements through the imposition of higher production costs that decreased spending brings.

## **Conduct and Performance**

### ***Requirements and Needs***

#### **Industry**

Five major structural elements have impacted the LCS Industry: U.S. policy and law, legacy events and structure, demand fluctuations, buyer preferences and the developing global market. These five structural forces have shaped the conduct and performance of both industry and government organizations as each attempts to meet the other's needs.

For Industry, the shifting demands of Iraq/Afghanistan operations combined with the USG's current priority of meeting short term needs create an outsized impact on industry conduct. Additionally, the uncertainty over long term production quantities has hindered the ability of manufacturers to make long-term investment plans. As a result, many LCS companies have necessarily adopted a short term focus on facility utilization to the detriment of long-term capital investments. In many cases, the LCS industry has turned to leased facilities and has taken advantage of arrangements with depots to reduce investment risk and maximize flexibility, agility and the ability to quickly reconfigure operations in response to urgent and shifting wartime requirements. The USG's requirements have also pushed the industry to sacrifice economic efficiency and manufacturing optimization to maintain this piece-work manufacturing atmosphere. In spite of these disruptions, industry has adjusted well to these requirements; the industrial base has demonstrated remarkable flexibility and responsiveness to the shifting operational demands. However, the concern is that the emphasis is on short range planning and rapid response; this may have consequences for the long term health and management of the land combat system's industrial base. Because the assembly process cannot be upgraded to take advantage of the latest advances in fabrication technology due to low volume, the unit cost for combat vehicles continues to increase significantly. More importantly, when the military's operational pace slows and a more frugal defense establishment resets the force, the industrial productivity throughout the industry will fall and investment in the industry will be scarce.

While the capital investment challenges are great, the wartime surge in demand has impacted the structure of competition in the LCS industry. In the current “boom” market, DoD spending is at a level that provides a comfortable profit margin to those firms with legacy investments and to those that can compete and win contracts on the relatively few new programs anticipated in the coming decade. Many of the major firms have a long and vested interest in legacy programs and those firms should be able to maintain a margin of safety in their operations based on ongoing requirements to support those programs. One strategy adopted by many of these legacy system suppliers is to use their R&D resources to develop new capabilities for the old platforms or to anticipate new requirements. These firms invest in future products as a hedge against market penetration by new suppliers. This forward looking business strategy continues to extend the life of existing equipment such as the HMMWV and facilitates decisions to postpone new product development and deployment. The outcome of this intense competition to capture and maintain market share while providing immediately deployable solutions has produced many excellent alternatives to totally new system procurement and many of these innovations have already demonstrated success in current operations.

Moreover, the upgraded legacy systems typically offer an adequately functional alternative, usually at a lower cost than new system design, development and production, to meeting a large proportion of the desired capability requirements. Utilization of these enhanced systems also provide the USG with the opportunity to develop a future “high-low” procurement option for new capabilities. Program costs can be reduced by allowing the purchase of a smaller number of the most advanced system upgrades at a high cost, while purchasing a larger number of lower-cost, less-capable legacy systems. The utilization of variants with differing configurations, the concept behind the FCS Manned Ground Vehicles, produces capability, compatibility, and the benefit of legacy system familiarity, logistics and support, all at a lower cost. Among the historical industry players, the capacity to provide responsive products while defending market share and maintaining political influence is vibrant. The strategy employed by the industry could pay dividends to the government in the future as inevitable reductions in combat operations and declining budgets present challenges to DoD in the reset and repair of the force.

### **Government**

U.S. trade laws and government policy on technology security have had a significant impact on the recent conduct of the land combat systems industry R&D. The well intended restrictions outlined in the International Traffic in Arms Regulations (ITARs) were implemented as a response to the Cold War and also serve as an attempt to defend a domestic defense industry from the potentially adverse effects of globalization. LCS firms, like most others, seek markets that can enhance their profitability. Increasingly those markets are outside the U.S. The bureaucratic burden on industry that ITARs impose push many firms to work around the application, if not the intent, of the regulations. Exporting technology developed in the U.S., even if the transfer is within the same company and even if the application is successful, is a time consuming and expensive burden imposed even as the market depends on global expansion and integration for its health. Expectedly, as the restrictions become too onerous, the incentive for companies to move R&D operations off-shore in an effort to avoid them increases. Many LCS firms have embraced global expansion by rapidly developing foreign subsidiaries, suppliers, and markets. The U.S. and the domestic LCS have avoided the worst effects of these restrictions until this point, however, the impact could create conflicts between government and industry

interests in the near future. As more and more LCS companies find ways to evade the restrictions of ITARs, the U.S. actually achieves less control over the diffusion of critical technology. Additionally, the potential migration of LCS R&D operations from American shores to overseas locations can compound the problem by decreasing employment opportunities for U.S. scientists and engineers. If, in the coming years, these trends escalate, U.S. technological leadership could come under attack as domestic research facilities become “empty vaults” of technology security while the most relevant and exportable research and technology is developed elsewhere.

Public policy, public opinion and the evolving wartime experience continue to exert a tremendous influence on service doctrine and the level of risk (read number of casualties) leadership is willing to accept in foreign operations. The net effect of these forces has changed the technological focus of the LCS industry by way of the government’s unprecedented changes in the requirements for vehicle protection. The blurring of tactical/combat distinctions produced the blanket requirement for armor and vehicle survivability. This change impacts the design, development, manufacture and logistic support, shifting the focus from mobility to survivability. The creation of systems like the rapidly developed MRAP and future systems like the JLTV are evidence of this change in philosophy and technology. Old industry structures and outdated processes are rapidly changing in order to keep pace with aggressive vehicle performance, cost and schedule requirements, even though the same requirements are a disincentive to invest in facilities. Formerly rival companies are now partners as each seek partners to leverage their strong capabilities, whether armor design, and fabrication expertise, or systems integration.

The decision to maintain in-house capability or outsource elements of design and production have become the critical differentiators among competitors and their chances of participating in the relatively few new projects. Until now, this new operating environment in the industry has produced some outstanding results and partnerships. Innovative mixtures of design, integration and automotive manufacturing experience continue to produce excellent products for U.S. warfighters and present the DOD with a competitive industrial environment that continues to elicit the best from the LCS industry. These excellent results, however, come with an increasing price tag for each item produced. In wartime, these costs are subsumed in large budgets and a willingness to maximize performance and schedule with no regard for price. As budgets, and profits, contract, industry players will be forced to compete for smaller profits or leave the market. As this eventuality comes to pass, the enthusiasm for partnerships and cooperation could wane. In this scenario, two questions stand out. The first is whether the partnerships critical to the new systems designs survive or the programs suffer. The second is the question of whether the USG investments in its depots and arsenals will have been sufficient to fill in the gaps in the LCS industry’s supply chain in the event of critical exits from the defense, and government, market.

### ***Fabrication and Production***

Based on recent combat experience, the Army and Marines have gone through rapid changes in force structure, size, and doctrine. They are increasing estimates of expected vehicle requirement as they increase force size.<sup>15</sup> Simultaneously, both services are undertaking ambitious modernization programs to include the Army’s FCS and the Marine’s EFV and MPC vehicles. Finally, every service needs to repair, reset, or replace worn out, damaged or destroyed vehicles.<sup>16</sup>

Each of these combat demands continues to exert its influence on the LCS industry in its own way. The threat IEDs and EFPs to U.S. troops combined with the demands from political

leadership and the American people to provide the most safest combat systems U.S. technology and industry continue to be the primary drivers of industry trends. Trucks that were once soft-skinned and considered almost “administrative” require armor protection, weapons, and increasingly sophisticated communications, counter-IED, and situational awareness technology. This blurring and the trend toward increasingly complex vehicles with significant armor protection is evident in future programs like the JLTV and the Marine Personnel Carrier. We also got a glimpse into this phenomenon with the recent procurement of the MRAP. The MRAP program highlighted many of the changing demands placed on the LCS industry while at the same time demonstrating the challenges to the structure and performance of that industry.

In many ways, MRAP -- part truck, part personnel carrier and part armored vehicle -- represents a success story. The rapid deployment of the MRAP was partly successful due to excess capacity available in the commercial automotive industry. Driven by a desire to provide more IED protection to troops, the USG made it the highest priority, designating it DX project (the highest designator), waiving certain procurement requirements, authorizing vast sums of money, and opening the field to any and all who could produce a vehicle in large quantities that met performance requirements in the time allotted. The industry responded with unique teaming arrangements and some new entrants into the market, particularly those with expertise in armor and truck production. Navistar, a major commercial truck manufacturer, was able to compete as a prime while automotive firms such as Demmer Corporation and Spartan Chassis participated as key sub-contractors, but only after some significant barriers were removed.

Other barriers remained. Full compliance with defense acquisition requirements, often referred to as FAR Part 15 procedures, drive contractors to set up separate production lines and purchasing procedures. Separate processes drive additional costs throughout the supply chain. Second, third and fourth tier vendors are unable or unwilling to set up compliance procedures and therefore cannot certify compliance with the strict content requirements needed by the prime contractors to comply fully with procurement regulations.

No single company had all the expertise. Nor did any of the primes have all the capability or facilities required to surge for MRAP and still continue with existing production and reset requirements. The teaming process and the entry of new suppliers brought together the capabilities, expertise, and facilities necessary to meet the demand. In addition to the primes and their partners, there were 62 major Tier 2 vendors for 15 critical sub-assemblies.<sup>17</sup>

BAE's Tactical Vehicles Division (formerly Armored Holdings and Stuart and Stevenson) and Ground Systems Division (York, PA) each produced their own MRAP variants (Caimen and RG-32 respectively). GDLS teamed with Force Protection (FPI), a relatively new entrant that had been producing a low volume of Cougar vehicles for the Army and Marine Corps combat engineer units since 2003. GDLS Anniston Operations and GDLS Lima Operations (JSMC) were the major GDLS units involved in producing MRAPs. GDLS's Canada division teamed with Demmer and BAE's OMC unit located in Benoni, South Africa to produce RG-31s. GDLS Canada obtained rights to market and produce OMC's RG-31 in North America prior to BAE's purchase of OMC. Some of the RG-31s GDLS Canada sold to the US Army prior to the advent of the MRAP program were built by BAE GSD in York, PA. Navistar's IMG produced over 4,000 MaxxPro MRAPs utilizing their expertise in assembly line production. The Primes needed expertise in ballistic welding available at the Red River Army Depot and JSMC and the available space. The depots were looking for additional workload, a significant metric in their business, and no single location had sufficient qualified welders for the required quantity of work while still meeting other requirements such as reset work. When firms needed additional

space, some spent capital on buildings, others chose to lease space (providing them maximum flexibility to expand and contract at minimal cost), and both depots and primes spent money on tooling and facilities.

Although MRAP highlighted both the positive and the negative in the LCS industry during this war, the same trends and issues are encountered in the ongoing reset work. The same trends and issues will influence future programs as well, particularly the partnering among the depots and the primes.

While one must be cautious about generalizing the MRAP experience, the industry was able to produce thousands of unique vehicles in an amazingly (given current acquisition trends) short period of time, made expedient use of industrial capacity, teamed to leverage expertise and capability, worked additional shifts when necessary, and moved equipment around the country where the work could be done.

Another commonality experienced by both contractors and depots was supply chain management difficulties. Many argue that the Buy American Act and the new specialty metal provision entitled, "Protection of Strategic Materials Critical to National Security," have had the most far-reaching impact, domestically and internationally, on our ability to buy and sell in today's global marketplace. International purchasing power contributes to competitive pricing and innovative solutions. International selling power contributes to the increased economic health and viability of our domestic supplier base. And it often means our allies are operating equipment that is interoperable with our weapon systems.

The U.S. economy has long benefitted from global markets and free trade. Domestic industry, Congress, and the defense department constantly struggle to strike a balance between the advantages of globalization and necessity of ensuring the preservation of key industrial capabilities needed to support national security.

The defense industry contends that restrictions like ITARs, the Buy American Act and the procurement of specialty metals from solely domestic or qualifying country sources run counter to globalization and impede their ability to seek the best, and most cost-effective, solutions to meet DoD requirements. Other industries, such as the steel and specialty metals industries, argue for legislative protection because of their historical importance to national defense and because they claim overseas companies unfairly benefit from subsidies, currency manipulation and fewer environmental regulations. While this debate over steel and metals continues, the assembly line at Rock Island Arsenal ceased producing ballistic shields for Stryker vehicles at one point because there was insufficient domestic steel armor for both the ballistic shields and for the MRAP vehicles.<sup>18</sup>

In discussions with defense business leaders within the land combat systems industry, they point to these domestic restrictions as complicating factors in their supply chain, adding administrative costs, limiting their sources of supply and sub-optimizing cost, schedule and performance, all of which, in turn, decreases their competitiveness. In an industry where DoD purchases represent 0.4 percent of the U.S. market (specialty metals) or 6.3 percent (steel), the cost of compliance becomes an important factor.<sup>19</sup> For industry, even though it is interested in serving the USG market, cost considerations become an important factor in a very small segment of its overall market. This will impact the small consumer (DoD) through increased costs or lack of supply.

Another element of this challenge, common throughout industry and at the depots, was managing the rest of the supply chain and managing subcontractors. Vendor parts and materials, especially ballistic steel, were often the critical factors delaying production lines. For items with



few domestic suppliers, the challenge of seeking parts and materials on the global market sometimes caused disruptions due increased lead times. According to many in industry, working with single year contracts combined with the USG tendency to allocate funds only at the last minute made the situation worse. Citing difficulties in both quality and delivery schedules in working through the Defense Logistics Agency (DLA), even the depots began to turn to the contractors to manage their supply chain to improve delivery times and dependability, according to some industry spokesmen.

Most in industry believe that multi-year contracts would ameliorate supply chain issues and could reduce costs to the USG by providing predictability and stability in their businesses while minimizing risk. Two elements contribute to this observation. First, many orders arrive with a required delivery date within the supply chain lead time requirement. Contracts routinely state that the firm is to make no investment prior to the obligation of funding. However, some businesses assume the risk of expenditures in anticipation of a contract in order to shorten delivery times to the expected contract's provisions. The second issue arises when a firm is dealing with military unique parts and low volume items. Firms face much greater expenses for these items when purchasing for a shorter term contract. The ability to predict more accurately the demand for these items over a three or five year term would allow the firm to realize cost savings by ordering in volume.

The experience of the MRAP program suggests that the Defense Priority Allocation System is not very potent when dealing with global supply chains. For some vendors, defense business is only a small fraction of their overall business, particularly companies focused on commercial or dual use products; others are outside the U.S. According to many industry spokesmen, it was more often relationships and patriotism that resolved supply chain issues.

Responsibility for the industry's performance rests largely with USG rules and practices and with America's ongoing conflicts. The Army embraced modularity, Congress authorized growth in the Army and Marine Corps, and Congress and the executive branch continue to negotiate budgets and authorizations to support the war effort. Supplemental spending has vastly increased, making more money available for operations, but also to reset equipment worn out, damaged, or destroyed in theater. The Army was already underfunded before the war started, and the operational tempo and surge requirements have depleted pre-positioned stocks. By some estimates it will require \$9 billion to replenish pre-positioned stocks alone.<sup>20</sup> Still, the level of support provided by the USG may not be enough to overcome the difficulties that the USG's policies create for the LCS industry.

## **Outlook and Recommendations for US LCS Industry**

The U.S. Land Combat Industry is struggling with its identity. Globalization has eroded the national identity of some producers and current product requirements have blurred the traditional lines between combat systems and tactical vehicles. Still, the industry remains stable for now, even though more consolidation and partnerships could create a semblance of flux. At current funding levels, the industry, from a financial perspective, could not be healthier. Profits are up, companies are investing in the business, and orders appear stable for the next several quarters, if not longer. On the negative side, the investments tend to be in current requirements rather than future needs, an expanding supply chain is becoming more difficult to manage, and expected budgetary constraints could interrupt development and procurement in the industry. These changes facing the industry could be eased and managed with attention to certain key

challenges posed by industrial realignment and national security.

### ***Challenge #1: Planning for an uncertain future***

Bernard Baruch is reported to have said, “You can talk about capitalism and communism and all that sort of thing, but the important thing is the struggle everybody is engaged in to get better living conditions, and they are not interested too much in government.”<sup>21</sup>

With this seemingly obvious statement, Baruch summed up virtually every conflict around the world today. In this environment, it is difficult to imagine what form future threats to U.S. security might take and even more difficult to plan for them. The possibilities are endless: maritime attacks, energy crises, food shortages, failed governments, global pandemics, and even great power rivalries. It will be critical for DoD to consider carefully the plethora of potential futures and muster its ever more scarce resources to address the greatest risks and manage the lesser risks. In LCS, planning for flexible and varied operations will serve the national interest better than remaining focused on current operations and threats. They will evolve and new threats will appear. The LCS industry will respond to DoD’s requests. It is incumbent on DoD to ensure the requests it makes are useful for the uncertain future environment.

**Recommendation:** DoD should capture lessons learned, prepare procurement contingency plans for the next conflict, and include wartime resourcing dilemmas in acquisition training. Many lessons have been learned about the response of the LCS industry to a rapidly changing and increasing demand in recent years. In retrospect, many of the measures taken to improve war resourcing could have been taken earlier. The knowledge gained should be preserved and reviewed with the goal of exercising and updating various measures that can be taken to improve wartime resourcing.

### ***Challenge #2: Decreasing DoD budgets will constrain LCS performance***

As today’s war effort wanes, DoD will have fewer dollars to fund new systems. Combined with the added costs for armor and technology, the DoD and industry will face a series of trade-offs between systems capabilities and quantities. Attempts by DoD to influence industry through market influence will be difficult since DoD purchases comprise less than 10% of the demand for diesel engines, transmissions, and other markets. DoD must consider its own ability to influence the health of the industrial base as the country moves into a new, leaner period and adjust its purchasing strategies to minimize disruptions to the industry. As the USG reduces defense spending, Congress and the DoD must be careful to avoid only focusing on short term goals and should assist industry in surviving the budgetary downturn.

By devoting some portion of its R&D money to long-term research and to forward looking development, the U.S. military can retain its qualitative edge in a technologically competitive environment. Careful of tendency to focus on short term (tying RD) and speeding process before development is ready

**Recommendation:** After many years of attempting to address the health of the manufacturing industrial base, DoD should create a Federal Government Corporation (FGC) to assume management of all arsenals and depots. FGCs operate at the boundary between the

public and private sectors and possess some characteristics of both. For the depots, an FGC would combine the safety and stability of a government agency with many of the incentives and freedoms of private firms. Portions of many government-owned facilities already serve the function of property manager for their tenants. By commercializing this practice, the proposed FGC should be able to accomplish two key goals in a resource-constrained environment. First, proper management of the real estate could serve to offset costs to the USG of maintaining the depots and allowing them to serve as the insurance policy necessary to guarantee the ability to respond to new conflicts. Second, by maintaining a workforce, albeit at a level somewhat reduce from today's totals, the FGC could serve as a reservoir for skills that could otherwise disappear with a market downturn. Further, the depots operating as an FGC would not need to compete for DoD business and would be able to make their own decisions (within some limits) on capital investments and facilities improvements. Since it would be politically difficult to eliminate or privatize these facilities, monetizing their assets and allowing them to compete for commercial work seems a reasonable solution.

**Recommendation:** Use LCS source selection plans to give favorable consideration to production proposals that utilize existing production sites. LCS production sites are far easier to open than close even after it is no longer needed, due to constituency pressures. Certainly at the tier one level, there is no indication that the LCS industry needs additional fabrication and assembly facilities. In conjunction with the FGS recommendation, facilities could be opened, closed, and modified at much less expense to both industry and government by maximizing the utilization of existing facilities.

**Recommendation:** DoD should change military doctrine to accommodate greater use of commercial products and supply chains. As technological advances outstrip the ten year DoD planning cycle, access to the best and most affordable technology will increasingly require the use of commercial products. Military logistics doctrine is vested in maintenance of military unique supply chains and is incompatible with the use of commercial supply chains. Exercising existing authorizations and reinforcing the preference through practice is important to stretching shrinking budgets.

### ***Challenge #3: LCS Requirements Shifting Due to Combat Operations***

The current operations in Afghanistan and Iraq are driving a fundamental shift in LCS requirements across the spectrum of light, medium and heavy vehicles. This is seen in both the increase in spending and the rapid deployment of the MRAP. As these requirements have evolved, so have the supply chains and the technical skills necessary to produce vehicles. Thus far, industry has been able to handle the surge in production resulting from the increased demand. Some supply chain issues surfaced in the sub-tier suppliers, possibly suggesting some capacity issues at that level. Most businesses managed these issues well, but the demand for thin gauge/tempered steel outstripped global production capacity. Any increase in demand would necessarily be met through tradeoffs or substitutions.

In conjunction with the increased production, LCS firms are also seeking to expand market share where possible. Most are seeking out opportunities globally where demand for

wheeled vehicles remains strong. Some firms are investing Independent Research and Development (IR&D) funds in armor technology hoping to gain a competitive edge in the market. Others, such as Textron and AM General, are spending IR&D funds to enhance, and hopefully extend the life of, current product lines.

**Recommendation:** Public-Private-Partnerships (P3s) are popular today and they should be encouraged. They are a politically and economically efficient way to divide labor and seek funding. For the depots, they provide a method of gaining work-hours for a politically sensitive labor force and contribute to maintaining employee job skills. The contractors are able to share less profitable work with the depots and concentrate on higher margin activities such as engineering, supply chain management and assembly. Contractors and depots both gain a valuable political asset, using P3 as a lobbying point when seeking further funding. It provides benefits to both parties and enhances the ability of industry as a whole to respond to changing demand and requirements.

**Recommendation:** DoD should expand the use of multi-year contracts, especially during periods of wartime surges in production. When used properly, multi-year contracts allow for more economic procurement from suppliers and more efficient production by the primes who can negotiate long-term commitments from suppliers. Additionally, multi-year contracts make cost-saving investments in plant, tooling, and processes more attractive to the primes. With multi-year funding for a program over a significant portion of its lifecycle, management of development, production, and servicing becomes more efficient, increasing the benefit to the USG.

#### ***Challenge #4: Globalization Creating Conflicts for Industry and Government***

The globalization of supply chains and defense companies could create conflicts in motivation between the USG and LCS companies. Companies find increasingly compelling reasons to maximize their profits by selling overseas and are engaging in partnerships among themselves as well as with government-owned facilities. Globally, capital markets are just as important as national policy when the firms make business decisions. This encourages firms to shift operations and IR&D to the best global business environments and enhances technology flows worldwide.

**Recommendation:** The USG should reform ITAR-type export controls, Buy America restrictions, and specialty metal restrictions to allow more flexibility to industry in managing its supply chain. The intent of ITAR in restricting technology transfers to certain nations is a good one, but quite often the application of the regulations impedes exchanges within companies and among friendly nations. Buy America, while less burdensome, impacts on supply chain management issues as well. Specialty metal restrictions also impact the supply chain and create a protectionist environment that impacts on DoD's costs and management. Each of the restrictions has been waived for various reasons, most recently in supporting the fabrication and deployment of the MRAP. With this string of waivers, it is obvious that this set of regulations is not functioning as intended. ITAR should be reformed to make it easier to say yes while

managing the adverse effects of technology export as weighed against the gains from a wider access to global markets. For specialty metals, direct assistance to target suppliers would provide a more cost effective method of controlling this domestic industry than continuing to impose costly protective measures.

**Recommendation:** The military should continue to use commercial engines and adjust its fuel supply doctrine to accommodate the use of both high sulphur JP8 and ultra-low sulphur fuels. The military cannot afford not to use commercial engines in spite of the supply chain issues that the use of two fuels creates in the transition period. Remaining isolated from the trend away from JP8 in both land and air systems would require a much greater investment in managing and securing a supply chain unique to the military.

**Recommendation:** Policy-makers should restore government expertise in managing development programs. The government has lost considerable technical and cost-management expertise during the 1980-1990 timeframe and no longer behaves as a well informed buyer. The USG needs to reacquire lost skills so that it can perform its role in managing development programs. This is a longer term process that begins with recruiting the appropriate talents into government service. Once there, the USG must find ways to make public service attractive enough to retain these employees while they develop the specific skills necessary to allow the USG to participate in the decision-making on acquisition programs as a well-informed buyer.

## European LCS Industry

### *Introduction*

This section will provide an overview and top level analysis of the European land combat system market. We'll describe how the market is structured and why. What the impacts of that structure are on individual nations and the European Union as a whole. Finally provide some recommendations for the European land combat market.

### *Market Structure*

The European land combat systems market is made up of a large number of nation based companies. Some restructuring of European land combat systems has begun with a shift from a large number of independent companies to a more commoditized market dominated by two major defense contractors – BAE Systems and General Dynamics European Land Systems, as shown in figure 1 below. However, these newly consolidated companies still exist as national champions within their respective countries although better aligned with their new owner. For example Steyr, MOWAG, and St. Barbara Sistemas are sharing common R&D efforts and marketing costs. They have also shared some production work with each other during peak periods.

## EUROPE -- LAND COMBAT SYSTEMS CONSOLIDATION

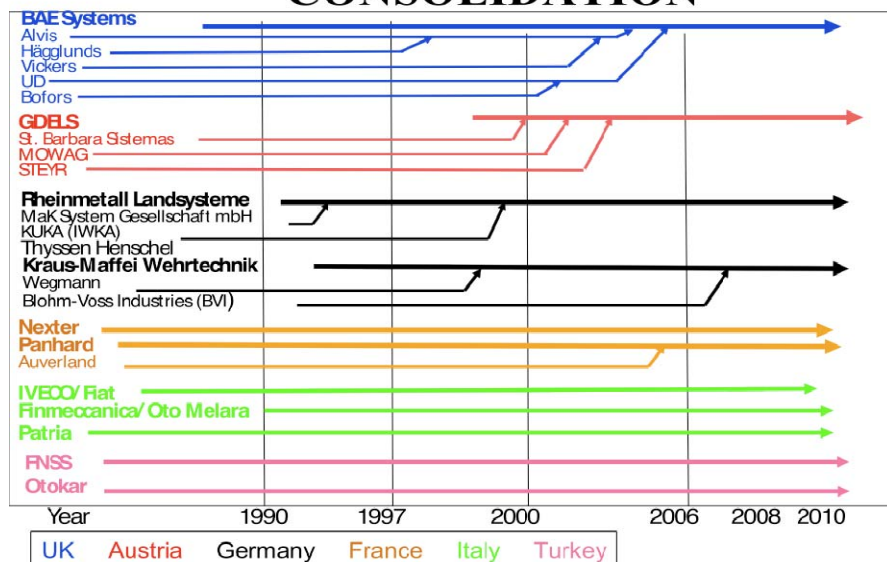


Figure 1.

Europe is made up of a large number of sovereign nations, each with its own industries and their own procurement programs and processes. In the United Kingdom, the defense industry is privately owned and horizontally integrated. In Germany, it is a mix of publically and privately owned but vertically integrated. In France, it is more fragmented, with substantial portions still in government hands. In Italy, the industry is vertically integrated and privately owned though the government retains significant ownership of shares of the parent corporations and has representation on the governing corporate boards. This very disparate structure makes consolidation difficult. For example, the German Ministry of Defense would prefer only one land combat system defense company, and KMW and Rheinmetall are open to a merger; however, given one is publically traded and the other is privately owned they cannot agree on a leadership mechanism. Defense policy and certainly procurement is based on a policy of competitive autonomy relying on domestic suppliers as first choice, then European capabilities. The stated reason for this policy is protection of national sovereignty. Weapon systems aimed at defending that sovereignty are maintained in-country to allow control and preserve its own ability to design, manufacture, and support such equipment nationally.

### *Performance*

The European Union consists of 27 participating member states, with 26 of them also participating members in the European Defence Agency. Only Denmark has opted out of participation. Although all are members of the European Defence Agency, each member state executes independent military procurement programs. A European Defence Agency conducted study found 23 different national armored fighting-vehicle programs throughout Europe. The national defense budgets of the participating member states support disparate national objectives and procurement policies that result in costly duplication. Some governments, keen to promote their indigenous defense industry base, have limited procurements to their national base. This

hinders industry's efforts to better collaborate across borders both within and beyond the European Union.

This problem is compounded by low defense spending throughout the European Union. In 2006 the total defense expenditure of the 26 participating members in the European Defence Agency was €201 Billion, or 1.78 percent of their combined gross national product. Compared to the United States expenditure of €491 Billion, or 4.7 percent of its' gross national product. Just two of the 21 EU-NATO members spend the NATO benchmark of 2 percent of the gross domestic product on defense.

Manufacturing and selling in a national market is no longer sustainable in a global market. Given the budgetary reductions and the restructuring of armed forces, even the wealthier nations, such as the United Kingdom, Germany and France no longer can afford the cost of research and development for new weapon systems. The European Defence Agency's chief executive, Nick Witney, has said "The demand side needs to increasingly come together on the continental scale for the supply side to respond to that demand in a continental-scale market".

All the Defence companies we visited in Europe have placed a significant priority in exporting their systems outside of their respective countries. For example, KMW had a 70 percent increase in sales during 2007, due mostly from sales outside of Germany.

### ***The European Union Plan for Change***

The European Defence Agency was established under a Joint Action of the European Union's Council of Ministers on 12 July 2004, to support the Member States and the Council in their effort to improve European defense capabilities in the field of crisis management and to sustain the European Security and Defense Policy. The European Defence Agency has four functions:

- Developing defense capabilities
- Promoting Defense Research and Technology
- Promoting armaments co-operation
- Creating a competitive European Defense Equipment Market and strengthening the European Defense, Technological and Industrial Base

The European Defence Agency has made reasonable progress on its first two functions. Developing a defense capability development plan and long term vision has been the European Defence Agency's top priority. The Comprehensive Capability Development Process provides a systematic means of translating participating member states' politico/military requirements into available or planned military capabilities, structures and concepts that meet the collective ambition and strategic defense objectives of the European Security and Defence Policy.

The second function of promoting defense research and technology is beginning to make significant progress. The European Defence Agency has acted as a catalyst to focus the research and technology efforts of the participating member states on meeting the requirements identified in their Comprehensive Capability Development Process. They developed a framework for a European Defense Research and Technology Strategy, that lays out why and how the participating member states should invest collectively in key technologies. To aid in this effort getting started the European Union funded a three year, Joint Investment Program on Force Protection in the amount of €55 Million.

The third function of promoting armaments co-operation is the area in need of most improvement and policy change. The European Defence Agency has tried to promote

cooperation between the participating member states with limited success. Only the really large programs like the Euro Fighter and the Airbus A400M programs have been working as European programs. The smaller programs, like land combat systems, are the real issue. For example, as stated earlier there are 23 active national armored fighting vehicle programs. In 1998 the Dutch, French, British, and Germans started a joint effort to build an eight-wheeled armored vehicle, intended to be an European Armored Vehicle (Boxer). However, France dropped out in 1999, deciding to build their own vehicle. Britain dropped out in 2003 deciding to develop a lighter-weight vehicle instead. That left the Boxer contractors—Krauss-Maffei Wegmann and Rheinmetall Landsysteme in Germany and Stork in the Netherlands—with a much smaller number of vehicles to produce.

The degree of cooperation among the participating member states on European defense projects remains a distant goal. European governments still equip their militaries along national production lines. When asked if they thought the EDA could succeed in pushing for a European program versus National programs, every individual at every company responded with a resounding “no.” The mutual thought is it will take several generations for Europeans to start seeing themselves as European instead of German, Austrian, etc.

The European Defence Agency serves as only an advisory agency, developing best practices and establishing an Electronic Bulletin Board – Industry Contracts. All of these efforts are noble attempts to do the right thing but the European Defence Agency has no authority to enforce any of its policies. One of the biggest problems to collaboration is Article 296 of the European Commission Treaty. Article 296 states:

“(a) no Member State shall be obliged to supply information the disclosure of which it considers contrary to the essential interests of its security; (b) any Member State may take such measures as it considers necessary for the protection of the essential interests of its security which are connected with the production of our trade in arms, munitions and war material; such measures shall not adversely affect the conditions of competition in the common market regarding products which are not intended for specifically military purposes.”

The participating member states have adopted a broad interpretation of the provisions of Article 296 and have applied the exemption to the majority of all procurement contracts issued by their respective defense ministries.

The last function of the European Defence Agency is creating a competitive European defense equipment market and strengthening the European defense, technological and industrial base. Natural economic principles and forces will bring this change about, if and when the European Union starts executing European defense programs instead of multiple national programs. The European aerospace and defense electronics industries have already made this consolidation, dominated now by BAE Systems, Thales, and EADS. When left alone by the government, defense industry businesses will become more flexible, efficient and adapt to survive in an increasingly competitive market. The same consolidation will come in the land combat systems market; it will just take longer due to lesser cost and technology. As an example the state-owned French land systems company Nexter has been actively searching for industrial partners. And the Italians and Germans have talked about reorganizing their military contractors, but nothing substantive yet exists.

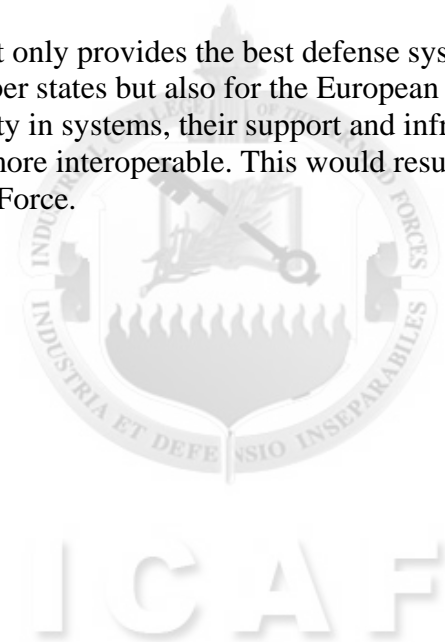


## ***Recommendations***

The European Union needs to find a way to make better use of its participating member states limited defense budgets. The only way the European Union can enhance its defense capabilities is through a greater degree of defense industry integration.

The Industry Study recommends the repeal of Article 296 of the European Commission Treaty. The repeal of Article 296 would result in a common procurement process for all items across the European Union. Defense system procurements would be executed the same as commercial items. All participating member states will be able to fairly compete in all procurements. The purchasing state will get the best product for the best price. This policy would allow the free market to work within the boundaries of the EU. The principles of open competition will drive the multiple defense-sector companies to be competitive. The remaining European defense industries would consolidate to remain viable much as the aerospace and defense electronics industries have already done. The removal of Article 296 would eliminate the interpretation or enforcement issues that presently exist with the Article 296 national security exemption.

This policy change not only provides the best defense systems at the best cost for individual participating member states but also for the European Union as a whole. This policy would drive more commonality in systems, their support and infrastructure making participating member states armed forces more interoperable. This would result in a major step towards an integrated European Defense Force.



## END NOTES

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<sup>1</sup> More traditionally, the LCS industry constitutes a specific element within the larger industrial base focused all equipment necessary - trucks, combat vehicles, small arms, weapon systems, communications equipment and other support items - for operations of military ground forces. In this study, the focus will be on tactical and combat vehicles; both wheeled and tracked, supporting both mobility and combat power requirements of the force. The individual companies comprising the LCS industry continue to evolve to meet changing demands of the Services and the Department as a whole. Collectively, they provide a mixture of capabilities, products, and components requiring integration as end items in the form of Bradley Fighting Vehicles, Stryker Combat Vehicles and M1 Abrams tanks, to cite a few. The LCS industry today is comprised of hundreds of second and third tier firms providing thousands of components in an increasingly complex and technologically advanced military capability. Production is distributed among numerous firms from engineering and continued independent research and development (IR&D), to vehicle hull fabrication and production, and finally integration and assembly.

<sup>2</sup> Kaul, Inge. 2007, "What is a Public Good?" (<http://mondediplo.com/2000/06/15/publicgood>)

<sup>3</sup> Office of Under Secretary of Defense for Acquisition, Technology & Logistics, *Annual Industrial Capabilities Report to Congress*, March 2008, p. 64.

<sup>4</sup> GDLS continued with its development contract for the U.S. Marine Corps' Expeditionary Fighting Vehicle, a tracked amphibious combat vehicle.

<sup>5</sup> AM General, the producer of the HMMWV, was not involved in this project, perhaps due to a lack of armor expertise.

<sup>6</sup> Martin Walker, *Globalization 3.0*, *The Wilson Quarterly*, Autumn 2007. pp. 16-17.

<sup>7</sup> Keith Hayward, *The Globalisation of Defense Industries*, *Survival*, Summer 2001, pp 115-32.

<sup>8</sup> Variants of these vehicles were available commercially in Europe and South Africa and had been deployed successfully by other nations.

<sup>9</sup> MRAP Visit Report

<sup>10</sup> Malanic, Marina, *Inside the Army*, 14 April 2008, Source: National Defense Budget Estimate for FY 2009

<sup>11</sup> The exact quote is "A war actually gets in the way of a defense contractor's normal cycle of research and development and production work." Morningstar. 2003, "Defense Stocks on the Brink of War" (<http://news.morningstar.com/articlenet/article.aspx?id=87342&qsbp=y>)

<sup>12</sup> The industry is already experiencing a consolidation both within its traditional boundaries and globally. BAE now operates on four continents, and GD is not far behind. For now, this global push is bringing U.S. and European companies into mergers and partnerships. The trend, however, is not likely to end there. As defense industries consolidate supply chains (and some suppliers), mergers, partnerships, and joint ventures such as the one between GD and Egypt could become more common.

<sup>13</sup> Government owned and operated depots and arsenals were established over two hundred years ago to ensure that the USG could maintain its capacity to produce and repair military equipment, particularly in a time of war and/or a national emergency. Some of these facilities are Government owned/Government operated, commonly referred to as GOGOs. Others are Government owned/Contractor operated, referred to as GOCOs. In both cases, the government provides facilities maintenance services. In each case, the primary goal of the government is to maintain a production capability that might not otherwise be preserved when economic conditions require a lean approach to defense contracting.

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<sup>14</sup> Introduction to Defense Acquisition, Seventh Edition, Sept 2005, (Defense Acquisition University, Defense Acquisition University Press, Fort Belvoir, Virginia), p. 1

<sup>15</sup> Alan L. Gropman, Combat Vehicle Sector Could be Headed for Turbulent Times, *National Defense*, April 2008. Available from <http://www.nationaldefensemagazine.org/issues/2008/April/Combat.htm> (accessed 1 April 2008).

<sup>16</sup> In some cases this requires refurbishing equipment to a zero-miles condition. In other cases it requires modernizing or upgrading existing systems. Finally, it can result in the purchase of new vehicles to replace older equipment or to meet the requirements of a larger force.

<sup>17</sup> Briefing on MRAP to LCS Industry Study Seminar, Feb 2008.

<sup>18</sup> Sherman, Jason, *Foreign Steel Needed to Make MRAP, Armor Production Goals*, 2.

<sup>19</sup> Deputy Under Secretary of Defense Industrial Policy, *Annual Industrial Capabilities Report to Congress*, February 2005, 9.

<sup>20</sup> Facing \$9 Billion Bill, Army Delays Target Date to Restock Prepo Equipment Sets, *InsideDefense*, 29 February 2008. Available from <http://www.insidedefense.com>.

<sup>21</sup> Brainy Quote, 2008, "Bernard Baruch Quotes," ([http://www.brainyquote.com/quotes/authors/b/bernard\\_baruch.html](http://www.brainyquote.com/quotes/authors/b/bernard_baruch.html)).



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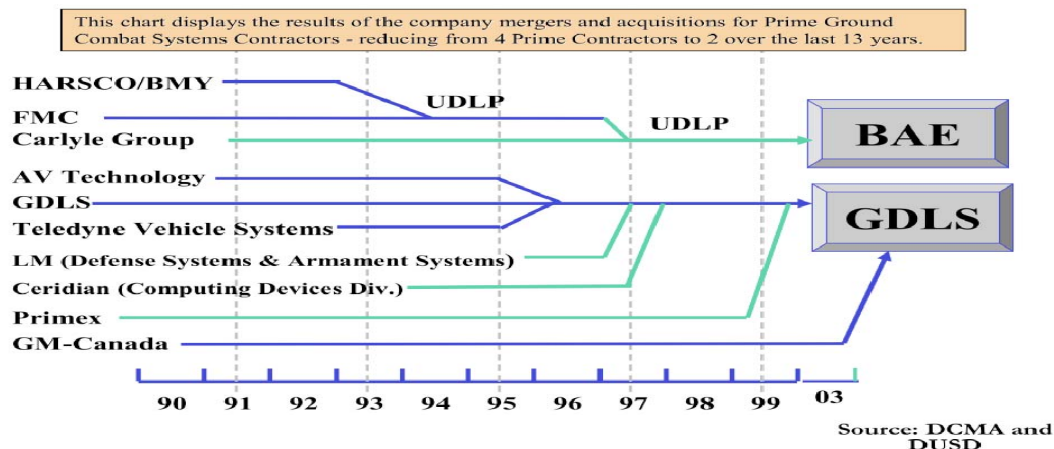
## Annexes

### Annex A *History of the LCS Industry*

The first major change in the LCS industry makeup during the 1980s occurred in 1982 when the Chrysler Corporation reached an agreement with General Dynamics Corporation for the purchase of Chrysler Defense Division, the prime contractor for the M1 Abrams tank. The divestiture of this division by Chrysler severed its connections with tank development and production that had existed since before World War II. General Dynamics' newly acquired division was renamed General Dynamics Land Systems (GDLS). Other major industry players in the thriving LCS market during the 1980s were FMC Corporation's Defense Systems Group (producers of the M2 Bradley Fighting Vehicle and M113 armored personnel carriers), Harsco Corporation's BMY Combat Systems Division (producers of the M88 recovery vehicle and M109 series howitzers), AM General Corporation (producers of the High Mobility Multi-Purpose Wheeled Vehicle (HMWWV)), and Oshkosh Truck Corporation (producers of heavy tactical trucks).

The 1990s were the opposite of the 1980s when it came to defense spending and growth within the LCS industry. The end of the Cold War and the expected "peace dividend" meant fewer dollars were available for military procurement programs. From 1990 to 1993, defense budgets dropped 15% from \$381 million to \$321 million and military procurement fell by 40%. This was the beginning of a "Procurement Holiday" for the U.S. military. In 1993, Secretary of Defense, Les Aspin and Deputy Secretary of Defense, William Perry gathered 15 defense industry executives for dinner at the Pentagon for what would become known as "The Last Supper." During this gathering, Aspin and Perry informed the industry leaders that the defense budget could no longer support the excess capacity existing in the defense industry and that DoD would not stand in the way of any corporate mergers or acquisitions they felt necessary to make in order to adapt. Aspin and Perry pointed out that DoD was supported by more contractors than it could sustain. The choice was between maintaining a large number of relatively weak competitors or a small number of healthy competitors.

### Ground Combat Systems Industry Prime Contractor Consolidation



“The Last Supper” signaled the beginning of defense industry consolidations and mergers in the 1990s.

In the LCS industry, the first major merger occurred in February 1994 when FMC and BMY merged to form United Defense Limited Partnership (UDLP), with FMC owning 60% of the new company and BMY the remaining 40%. This merger created the largest U.S. supplier of light and medium weight tracked armored vehicles and along with GDLS, reduced the number of major LCS producers down to just two. Other consolidations followed as GDLS focused on vertical integration by acquiring Teledyne Vehicle Systems, two Lockheed Martin divisions, Advanced Technology Systems, and Computing Devices International, all in 1996 and 1997.

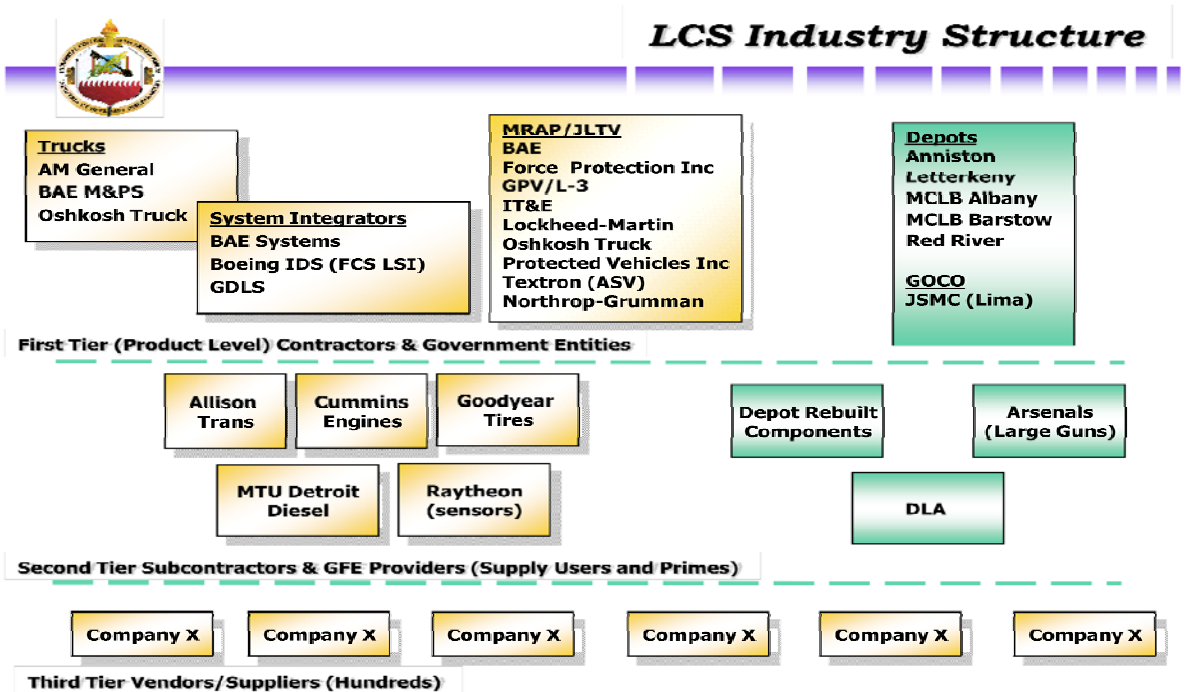
As the LCS industry entered the 21st Century, the “Procurement Holiday” of the 1990s was ending but the industry was nowhere near as active as it had been in the 1980s. Large defense companies like General Dynamics, Boeing, and Lockheed Martin were becoming full spectrum companies through acquisitions and mergers, and offering defense services in air, land, sea, and space systems. Other companies like Oshkosh and AM General were diversifying into the commercial vehicle markets in order to remain viable. In 2000, GDLS was awarded the first new major production contract for armored combat vehicles in over a decade, the Stryker family of lightweight-wheeled combat vehicles. The move away from tracked combat vehicles to a lighter and more easily transportable, wheeled vehicle signaled a change in the market for armored combat vehicles in the 21st Century. However, this did signal the end of the tracked vehicle, an outcome sought by some in the military. GDLS continued on its development contract for the U.S. Marine Corps’ amphibious replacement vehicle known as the Expeditionary Fighting Vehicle. This tracked combat vehicle will eventually replace the Amphibious Assault Vehicle (AAV) and is expected to enter service in the next decade.

In 2002, the Army awarded another development contract to GDLS and UDLP, with Boeing as the lead systems integrator for the Future Combat Systems (FCS) program. This joint venture would combine the expertise of GDLS in heavy tracked combat vehicles with UDLP’s expertise in light and medium-weight vehicles to design and develop a family of manned ground vehicles with a number of variants for many different purposes. In 2003 GDLS acquired Steyr Daimler Puch Spezialfahrzeug (SSF) from an Austrian investor group. SSF is now part of “General Dynamics European Land Combat Systems” which includes also the Spanish Santa Bárbara Sistemas and the Swiss MOWAG, and has its headquarters in Vienna, Austria. Another major international company saw the future potential of FCS along with the potential for increased reset and remanufacturing work as a result of the ongoing conflicts in Afghanistan and Iraq. BAE Systems, headquartered in London, England, was already a major international player in the LCS industry through its ownership of Bofors and Hagglunds in Sweden. In 2005, BAE Systems purchased UDLP in a \$4.2 billion deal that would make BAE the partner of GDLS on the FCS program as well as the prime competitor to GDLS in the U.S. LCS market. (For a detailed examination of European consolidation, see Annex D.)

## **Organizational Structure**

The chart below lays out the organizational structure of the LCS industry by tiers. Tier I identifies the major contract and government entities that are large enough to serve either as a

lead system integrators on major weapon systems (e.g. FCS) and/or large scale weapon system producers (e.g. Stryker). Tier II organizations are smaller in nature and are usually subcontracted by a Tier I producers to manufacture critical components (e.g. engines and transmissions). The Tier II subcontractor is usually a private industry but could also be DOD agency such as the DLA which provides supplies/repair parts or the Army Materiel Command which oversees the rebuild of components in DOD depots. The Tier II organization normally provides the manufactured components to the Tier I manufacturer, who is responsible for final assembly/integration of the weapon system.



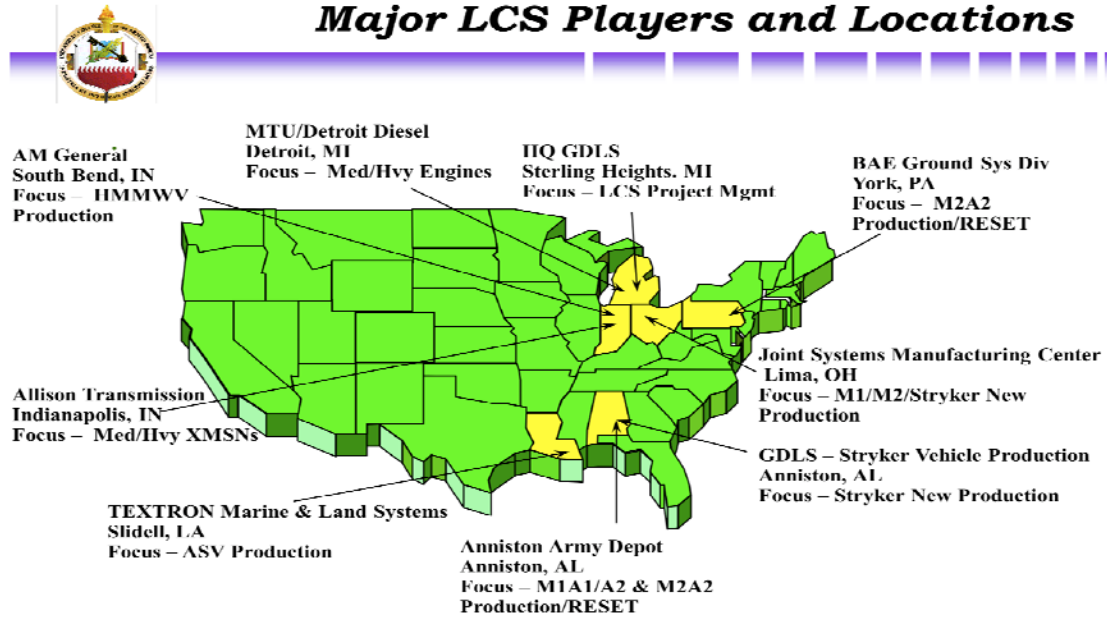
Tier III organization are yet smaller companies that are vendors/suppliers of components that support the efforts of Tier I and II organizations. There are thousands of Tier III vendors/suppliers located throughout the U.S. and abroad.

## Locations and Production

The heart of the LCS manufacturing occurs in the our traditional manufacturing belt of Pennsylvania, Ohio, Michigan and Indiana. Additionally, Anniston Army Depot has established itself as the prime DOD facility for the reset/recap of heavy tracks weapon systems and the production of Stryker family of vehicles. This development has attracted both BAE and GD to establish partnerships within the depot to take advantage of both facilities and proximity to the reset work where the three subcontract to each other on various aspects of the repair work. The production of Stryker vehicles is performed by GDLS personnel who utilize Anniston DOD facilities.

The chart below depicts the locations of Tier I and Tier II companies' facilities our LCS industry visited during our domestic travel phase. While our visits do not comprise an

exhaustive list of production facilities, the areas visit demonstrate the concentration of final assembly in these regions.



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## ***Annex B FAR Definitions***

### **2.101 -- Definitions**

“Commercial item” means --(1) Any item, other than real property, that is of a type customarily used by the general public or by non-governmental entities for purposes other than governmental purposes, and--(i) Has been sold, leased, or licensed to the general public; or,(ii) Has been offered for sale, lease, or license to the general public;(2) Any item that evolved from an item described in paragraph (1) of this definition through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a Government solicitation;

#### **15.403-1 -- Prohibition on Obtaining Cost or Pricing Data**

***Exceptions to cost or pricing data requirements.*** The contracting officer shall not require submission of cost or pricing data to support any action (contracts, subcontracts, or modifications) (but may require information other than cost or pricing data to support a determination of price reasonableness or cost realism) --

- (1) When the contracting officer determines that prices agreed upon are based on adequate price competition (see standards in paragraph (c)(1) of this subsection);
- (2) When the contracting officer determines that prices agreed upon are based on prices set by law or regulation (see standards in paragraph (c)(2) of this subsection);
- (3) When a commercial item is being acquired (see standards in paragraph (c)(3) of this subsection);**

#### **15.403-4 -- Requiring Cost or Pricing Data (10 U.S.C. 2306a and 41 U.S.C. 254b).**

(a)(1) The contracting officer must obtain cost or pricing data only if the contracting officer concludes that none of the exceptions in [15.403-1\(b\)](#) applies. However, if the contracting officer has sufficient information available to determine price reasonableness, then the contracting officer should consider requesting a waiver under the exception at [15.403-1\(b\)\(4\)](#). The threshold for obtaining cost or pricing data is \$650,000. Unless an exception applies, cost or pricing data are required before accomplishing any of the following actions expected to exceed the current threshold or, in the case of existing contracts, the threshold specified in the contract:

- (i) The award of any negotiated contract (except for undefinitized actions such as letter contracts).
- (ii) The award of a subcontract at any tier, if the contractor and each higher-tier subcontractor were required to furnish cost or pricing data (but see waivers at [15.403-1\(c\)\(4\)](#)).**



## ***Annex C Specialty Metals Restrictions***

### **OVERVIEW**

The specialty metals issue began in 1973, when the Berry Amendment added alloy steel, nickel, iron-nickel, cobalt alloys, titanium, titanium alloys and zirconium to a list of products that the DoD must purchase from domestic or qualifying countries.<sup>1</sup> The current specialty metal restrictions apply to end items within the six categories, with the exception of electronic components and those items meeting the definition of COTS. There is a waiver process for domestic non-availability, although it is burdensome and requires USD/AT&L and/or service secretary approval. The current trend is toward relaxation of the restrictions.

### **A VIEW FROM INDUSTRY**

The opinion of industry is divided between those mining and manufacturing the steel and specialty metals and those in the defense industry that must comply with the restrictions. The defense industry views the restrictions as preventing them from leveraging the global market to secure the highest quality parts at the lowest cost. The steel and specialty metals industry claims they are suffering from unfair trade practices, and a flood of underpriced Chinese steel, unequal environmental regulation, greater energy and labor costs and diminishing research and development dollars that will spell disaster for the industry.<sup>2</sup> Further, the industry contends, “the U.S. lacks a coherent strategy related to all manufacturing...but in this context, it lacks one related to specialty metals and the government needs to move quickly to create one.”<sup>3</sup> Given their importance to national security, legislative relief and intervention into foreign trade practices are the only solution to assure the industry’s long-term health.

Specifically, after reviewing industry association literature from the American Iron and Steel Institute and the Specialty Steel Industry of North America (SSINA) it is apparent there are 3 major trends they see as troublesome to the industry. First and foremost, all the industry information points to the Chinese steel industry as the major market threat. It is the largest steel industry in the world at 37 percent of global output and is now the largest foreign supplier of steel to the U.S.<sup>4</sup> In 2005, China made more steel than the next four largest producers combined. The second trend is the structure of domestic policy and regulations relevant to environmental rules, energy costs, rising healthcare, employee retirement benefits and corporate tax structure that put domestic suppliers at a disadvantage internationally. Finally, a shrinking industrial base equals fewer dollars for research and development, which in this industry is vital to maintaining a competitive edge. Additionally, the industry puts forth the argument that their, “factories are our laboratories.”<sup>5</sup> So without sufficient capacity, R&D will decline and the U.S. specialty metal industries will lose their advantage. Interestingly, the domestic source restrictions were not discussed as critical to the industry and it was conceded that the defense business was a small portion of their revenues.

The combined impact of these forces has resulted in transmissions, critical to producing land combat systems and trucks, sitting at the factory while department staff hustled to process a DNAD to secure their release. The specialty metal restrictions delayed the MRAP production

and reset for other land combat systems while the Department secured SECDEF permission to use foreign sources.

## ANALYSIS AND CONCLUSIONS

Integrators argue that the domestic restrictions add cost, limit competition, and sub-optimize the final product. The DoD concluded it was a very small purchasing share of the specialty metals market...small enough that the department would not be able to influence it.<sup>6</sup> Finally, any domestic restrictions can have repercussion with retaliatory trade tariffs from other source countries further complicating the issue and driving up costs. Therefore, the adverse impacts from the steel and metals restriction clearly outweigh the costs. The simple fact is, even if all specialty metals the DoD buys were domestically sourced, its market share is still too insignificant to drive market conditions and kick start the new investment needed to expand capacity. Therefore, the policy will not achieve its intended purpose, yet it adds costs to a cash strapped DoD.

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<sup>1</sup> Greenberg and Traurig, *FY 2007 Defense Authorization Act Introduces Procurement Reform*. Also, “qualifying country” is outlined at DFARS 225.872-1 and presently includes Australia, Belgium, Canada, Denmark, Egypt, Germany, France, Greece, Israel, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and Northern Ireland.

<sup>2</sup> AISI, *Steel and National Defense*, 3-8.

<sup>3</sup> Specialty Steel Industry of North America, *Specialty Metals and National Defense*, December 2005, 3.

<sup>4</sup> The Economist, *A Special Report on China’s Quest for Resources*, March 15-21 2008, 6.

<sup>5</sup> SSINA, *Specialty Metals and National Defense*, December 2005, 1.

<sup>6</sup> Liang, John, *Lawmakers Call for Widening of Specialty Steel Industrial Base*, InsideDefense.com, 1.

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**Annex D Europe – United States Comparison**

A 2006 European Union report estimated that although all participating member states spend about half the amount the United States does on defense, their defense capabilities are only about 10 percent as efficient as the U.S.<sup>14</sup> A comparison of European and United States defense expenditures is at Figure 1 below.

**European – US Defense Expenditures**

European - US Defence Expenditure - General		
	Europe*	US**
Total Defence Expenditure	€ 201 Bln	€ 491 Bln
Defence Expenditure as a % of GDP	1,78%	4,7%
Defence Expenditure Per Capita	€ 412	€ 1,640

\* Europe means 26 EEA participating Member States  
 \*\* Euro/Dollar exchange rate is based on average for 2006; rate of 1,2556

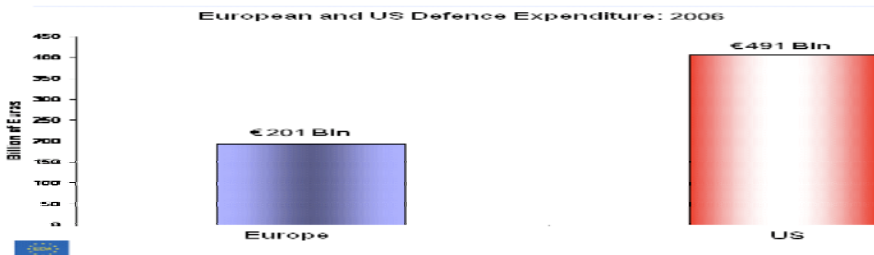


Figure 1

The United States defense industry went through a major consolidation after the end of the Cold war. The United States now has only two armored vehicle producers compared to two dozen European companies. A diagram of the land combat systems market consolidation is shown at figure 2 below. A diagram of the more limited consolidation of the European Land Combat market was shown at Figure 1 on page 18 of the main paper.

**EUROPE -- LAND COMBAT SYSTEMS CONSOLIDATION**

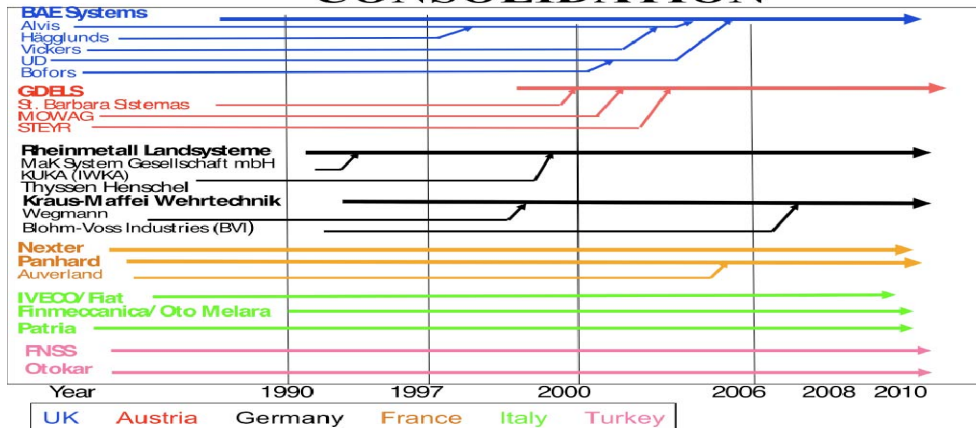


Figure 2

As mentioned earlier in this paper each country tends to execute independent national weapon system programs. Figure 3 below shows a comparison between the U.S. and Europe of armored fighting-vehicle programs. It is easy to see that Europe maintains a greater variety of systems even though the total size of its combat vehicle inventory is smaller than the US inventory.

<b>Comparison</b>		
	<b>US</b>	<b>European</b>
<b>Tanks</b>	M1 Series	Leopard II (KMW, Germany) Challenger II (BAE/Vickers, UK) LeClerc (Nexter, France) Ariete (Oto Melara-Iveco, Italy)
<b>Tracked Infantry Fighting Vehicles</b>	Bradley Series	AMX-10P (Nexter, France) Puma (KMW, German) Ulan (GDELS Steyr, Austria) Dardo (Oto Melara-Iveco, Italy) Warrior (BAE/Alvis, UK) CV-90 (BAE Haggglunds, Sweden)
<b>Wheeled Armored Vehicles</b>	Stryker (Piranha III) LAV (Piranha I)	Pandur (GDELS Steyr, Austria) Piranha (GDELS Mowag, Swiss) AMV (Patria, Finland) Centaro (Oto Melara-Iveco, Italy) Boxer (KMW, Germany) Unnamed (KMW, Germany) VBCI (Nexter, France) SEP (BAE Haggglunds, Sweden)

**Figure 3**

The acquisition practices of the United States and the European states also vary quite significantly. The U.S. tends to push the technology envelope in most system acquisitions while Europe tends to procure systems based on more mature technology. Given its preferences for more advanced technology, the U.S. mostly uses “cost reimbursable” type contracts for development. Europe tends to use predominantly fixed price contracts for LCS development efforts. The U.S. government tends to assume the bulk of the risk of cost, schedule, and performance in developing new systems. European governments tend to push a greater share of such risk to the contractor. European parliaments tend to approve spending on defense programs by phase, i.e. fully fund prototype development and then fully fund an increment of production that might occur over several years. The U.S. Congress meanwhile maintains fiscal oversight on major programs throughout the program’s life, annually adjusting procurement numbers, funding and imposing other oversight measure like mandatory reporting. A comparison of a number of issues is shown below in Figure 4.

Both the United States and Europe suffer protectionist tendencies with respect to domestic LCS markets. The U.S. with its Buy American Act, Berry Amendment, Specialty Metals legislation, and ITAR regulations and Europe with its Article 296 make it difficult for companies to compete internationally for LCS contracts. All countries have an innate desire to keep their defense programs within their boundaries. There are legitimate national security concerns such as the desire to control of defense technology and the risk of losing a national

supply base for parts. But in the end, for most countries it comes down to jobs and keeping them local. The defense industry provides a large number of high-paid positions.

## U.S. – Europe LCS Market Comparison

Issue	U.S.	Europe
Market Structure	Monopsony Full Spectrum Defense Companies Military Truck Firms	Export Driven Land Combat Systems Companies Commercial Truck Firms
Industry Ownership	Large publicly traded companies	Variety of Ownership Structures - Publically Traded - Family Owned - State Owned - Foreign Owned - Partially State Owned
Government-Industry Relationship	Arms-length relationships Competitive vs. Sole Source	Limited competition for National Champions, close long-term relationships Competition in absence of Champion
Funding Practices	Annual Congressional appropriations	Full system funding, or funded by phase; also significant corporate funded LCS product development
Contract types	R&D – Cost Reimbursable, incremental annual funding Production – Fixed Price, annual funding, some Multi-Year	R&D – Fixed Price or Limited Cost Reimbursable, funding by phase Production – Fixed Price, Multi-Year
Government Controls	ITAR Buy American, Specialty Metals Congressional Districts	National weapon export policies Article 296 Offsets
Risk Tolerance	High	Low
Field Support	Contractor Logistics	Organic
Emissions	Exempt	Euro-4

Figure 4

Defense programs are political mainly due to the number of jobs that can be brought to the local community. This is the main reason why the U.S. defense market has been able to consolidate while the European market hasn't. U.S. Companies consolidation did not take any labor outside the U.S. boundaries, some work may have transferred to different congressional districts but the consolidation did not impact the nation as a whole. The European market on the other hand consists of many smaller countries and consolidation there will move jobs from one sovereign nation to another. The consolidation will come in time as Europe becomes more European versus German, French, Italian, etc.