

**Spring 2015
Industry Study**

**Final Report
*Land Combat Systems***



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LAND COMBAT SYSTEMS 2015

ABSTRACT: The Land Combat Systems (LCS) industry, which consists of the Combat Vehicle (CV) market and the Tactical Wheeled Vehicle (TWV) market, faces challenges following the drawdown of U.S forces in Iraq and Afghanistan. Looming budget cuts, defense force structure realignments, and a new U.S. National Security Strategy have caused instability across the LCS industrial base. The TWV market has remained competitive for both Original Equipment Manufacturers (OEMs) and suppliers because of the predominately commercial nature of this segment of the industry. Due to the military unique nature of combat vehicles (no commercial application), the CV market has fewer OEMs and suppliers, although these market participants compete aggressively. As the Department of Defense (DoD) continues to struggle with budget cuts and Congressional directives, both industry and DoD must work together to ensure that the LCS industry remains viable domestically, while also seeking "best of breed" products from the global marketplace.

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INTRODUCTION

The 2011 Budget Control Act (BCA), force drawdowns in Iraq and Afghanistan and changes to the National Security Strategy have created uncertainty within the Land Combat Systems (LCS) industry. Constrained by shrinking defense budgets, the LCS industry faces reduced demand. Original Equipment Manufacturers (OEMs) and suppliers must make difficult choices. Companies engaged in non-defense markets are weighing the choice of continuing to dedicate resources and infrastructure in support of military requirements, potentially at the risk of the profitability of their commercial divisions. Companies solely dedicated to military production are assessing future demand to make informed decisions about remaining in the LCS industry, withdrawing or diversifying in order to ensure viability. With reduced defense budgets for the foreseeable future, this industry faces a competitive and uncertain environment.

OEMs and suppliers are challenged by what they view as insufficient DoD planning for future LCS requirements. During the wars in Afghanistan and Iraq, the Land Combat Systems industry experienced growth not seen since World War II; now, that industry will see an equally unprecedented reduction.¹ Unpredictable defense spending has stymied DoD's acquisition process. For instance, as workloads decline, LCS industry-specific manufacturing processes and critical workforce skills are in danger of atrophying. Additionally, the potential for another round of Base Realignment and Closure (BRAC) recommendations is increasing as DoD considers its peacetime requirements. Where a few new build opportunities exist, OEMs and suppliers are increasing overhead rates to compensate for workload shortfalls and DoD's shift to refurbishment and maintenance of aging fleets. Lastly, many OEMs and suppliers are strengthening their lobbying efforts in order to manage these realities. These issues must be addressed holistically in order to develop solutions to mitigate threats and ensure long-term LCS industry viability.

The report that follows outlines the work of the 2015 LCS seminar and provides a comparative analysis of the Combat Vehicle (CV) and Tactical Wheeled Vehicle (TWV) markets, domestically and globally. This year's seminar visited commercial firms, DoD program managers and Organic Industrial Base (OIB) organizations in order to gain an appreciation for the condition of the LCS market. The seminar read widely to understand past procurement strategies, current market conditions, and future market requirements. Visits to several international LCS firms in Germany and Switzerland further enabled the seminar to consider the state of both the domestic and global markets. Through interactions with industry leaders and acquisition professionals, the LCS seminar engaged in candid discussions on the future of the LCS industry. The seminar's findings are the basis for this report.

Defining the LCS Industry

The LCS industrial base consists of "commercial firms" (firms such as Navistar and Oshkosh who primarily focus on commercial, non-defense products), "defense "firms" (firms focused primarily on the military market, such as BAE Systems and General Dynamics Land Systems), and government agencies that manufacture and support two classes of vehicles; CVs and TWVs. CVs require a military unique manufacturing and repair/reset infrastructure. TWVs, on the other hand, can take advantage of commercial production facilities and supply chains. The Anniston Army Depot (ANAD) and The Joint Systems Manufacturing Center (JSMC) are examples of Government Owned Contractor Operated (GOCO), and Government Owned Government Operated (GOGO) facilities where DoD maintains critical capabilities while also absorbing some of the overhead cost associated with maintaining a portion of the department's CV fleet. Defense companies that compete within the CV market often partner with government agencies through Public-Private Partnerships (P3) and other arrangements to offset the costs associated with maintaining capital infrastructure and manufacturing equipment needed to produce and repair military unique designs. Conversely the TWV market is heavily dependent upon commercial

development solutions. Still, commercial firms often vertically integrate to gain competitive advantage and market share, increasing market power (leverage over DoD as a monopsony buyer).

CVs are primarily tracked vehicles that have military specific design and applications. They are constructed with heavy armor and use complex weapon systems to support combat activities. The two primary OEMs in this market are BAE Systems, Inc. (BAE,) the U.S. subsidiary of the British defense firm, and General Dynamics Land Systems (GDLS). There are a variety of platforms that fall within three classifications of CVs; Tanks, Tracked Infantry Fighting Vehicles and Wheeled Combat Vehicles. These platforms include but are not limited to the Abrams Tank (M1); the Bradley Family of Fighting Vehicles (M2A3/M3A3); the Stryker Family of Vehicles; The Armored Multi-Purpose Vehicle (AMPV); The Armored Recovery Vehicle (M88); the Paladin Self-Propelled Howitzer (M109A7) and the Amphibious Assault Vehicle (AAV).

TWVs support a variety of missions, including logistics and command and control. TWVs operate in a variety of on and off-road environments and are increasingly modified with armor and weapons systems. The three primary TWV OEMs are AM General (AMG), Navistar (NAV) and Oshkosh Defense (OSK). TWVs are categorized into three classes; Light, Medium, and Heavy. Examples of platforms within these categories include the Joint Light Tactic Vehicle (JLTV), the Mine Resistant Ambush Protected (MRAP) and the Heavy Expanded Mobility Tactical Truck (HEMTT).

In 2010 the budget to support the LCS Industrial base was approximately \$14.4 billion², which is in stark contrast to the 2015 Budget request of \$2.8 billion³. The nearly 80 percent reduction represents a dramatic shift in DoD requirements from procurement to fleet sustainment. Among the only foreseeable full scale procurement initiatives within the LCS industry are the JLTV, the Amphibious Combat Vehicle (ACV) and the AMPV. However, most funds are likely to be used to maintain the existing fleet, a fleet that expanded rapidly to support the wars in Afghanistan and Iraq.

INDUSTRY NATURE & ASPECTS

Current Conditions

The CV and TWV industry environment is uncertain due to budget cuts, shifting force structure, DoD acquisition decisions, lack of a clear Defense Industrial Base (DIB) preservation strategy, significant special interest influence and difficult to define land force objectives within our national security strategy. This uncertainty has led to market unpredictability, limiting the industry's ability to effectively plan and manage resources. The DIB's chief complaints are sporadic procurements and low-volume acquisitions. Most CV producers are facilitated for a much higher level of production, and have extensive idle and/or excess capacity. The subsequent problem for DoD is how much capacity to maintain in the face of numerous program cancellations including, for example, the Future Combat System (FCS), Crusader and Ground Combat Vehicle. At issue is DoD's ability to pay for this excess capacity – both in terms of overhead rates and maintenance of facilities and tooling.

U.S. ground forces enjoy the advantage of technologically advanced LCS vehicles. This advantage has become a requirement as history proves that tactical troop presence remains necessary to achieve operational and strategic objectives in deployed environments. As a result of the dynamics already described, the CV industry is out of balance, with considerable excess (unnecessary) and idle (needed but underused) capacity. For CVs in particular, there is no civilian demand for these military-unique items. Political dynamics and declining military budgets exacerbate the imbalance. While DoD is the sole buyer, the CV market is an oligopoly and the relatively few sellers wield significant influence over CV cost and production schedules. The TWV industry, on the other hand, is healthier due to the flexibility inherent with commercially derived products. In both markets, new-build programs continue to attract competitors.

Shrinking budgets and troop reductions have defined the past few years, making investment decisions difficult for the U.S. Army and U.S. Marine Corps. Manufacturers within the CV and TWV industries cite low demand and fewer deliveries as factors making it difficult to sustain engineering skills, key facilities, and suppliers. Partly in response, the Army's Program Executive Office (PEO) for Ground Combat Systems (GCS) commissioned a study to examine the health of the industry. Although not publically released, this effort, known as the A.T. Kearney Study, found that only 4% of workers are truly "critical" and even at reduced production rates, manufacturers have enough work to maintain these skills⁴.

Within the CV market, DoD's demand for "new-build" CVs is very low. However, demand for recapitalization, rebuild, and upgrade programs have increased. The Army's focus is on Service Life Extension Programs (SLEPs) for its current combat vehicle fleet, including M1 Abrams Main Battle Tanks (MBTs); M2 Bradleys; M109 Paladins; M992 Field Artillery Ammunition Support Vehicles; and M88 Hercules recovery vehicles. For the Marine Corps, the focus is on survivability upgrades to Amphibious Assault Vehicles (AAVs) and conducting a SLEP for its M1A1 Abrams.

Entering the CV market is particularly challenging. Any new entrant must be prepared to make large investments in capital, design capacity, engineering and systems integration teams, as well as recruiting and training a skilled manufacturing workforce. GDLS and BAE are "entrenched" as known providers. New entrants expect resistance because these industry giants have made large, long-term capital investments in people, facilities, manufacturing equipment, and supply chains. Both existing firms are protective of limited contract opportunities in the current environment. While it is possible for a would-be CV competitor to enter this market, any entrant must be financially resilient and capable of differentiation through design, engineering and support capabilities. Further, DoD's vendor qualification standards and product expectations often present challenges for new entrants, who may not be used to complying with Federal Acquisition Regulations (FARs). So, while there is room to compete, the complexity of procurement law and DoD acquisition procedures mean that it is highly unlikely for a non-defense firm to attempt to enter this market at the OEM level. Competition for new programs is most likely to come from another defense firm entering from an adjacent market or partnering with an existing CV manufacturer.

New-build TWV programs include Joint Light Tactical Vehicle (JLTV) and SOCOM's Ground Mobility Vehicle (GMV) and DAGOR. Unlike CVs, the TWV industry builds its vehicles on commercial production lines. Because TWVs can easily be built with commercial technology on existing commercial lines, this market enjoys greater diversity of participating firms and greater competition for new contracts. Because TWVs are only a portion of their business portfolio, these manufacturers can sustain themselves with commercial production during times of little or no military production. The TWV industry also remains more active than the CV industry in Foreign Military Sales (FMS) prospects. Despite these positive aspects, some firms may still choose to exit the TWV market due to a lack of business. However, for DoD, this does not really pose a significant problem as history has shown that many commercial manufacturers will compete for any new programs based on commercial technology, even re-entering the TWV market to do so. One additional incentive for new firms to enter the market is the reality that once a DoD contract is awarded and production begins, it is uncommon for the government to switch from one manufacturer to another – which typically results in a change of vehicle make/model and therefore imposes significant switching costs. This is particularly true when the government does not own the Technical Data Package.

Second-tier or sub-contractor supply chain management is another area of concern. Some suppliers such as Allison Transmissions enjoy tremendous supplier power because they are one of only a few manufacturers of critical components like highly reliable heavy duty automatic transmissions, and they have an extensive commercial market that provides the vast majority of their sales and profit. What is true for Allison is not necessarily true for all DoD suppliers. Many smaller, less diversified suppliers may be highly dependent on the LCS market and severely affected by declining DoD demand. In some cases, these companies may go out of business or shift to new product lines if DoD demand decreases too

far. The A.T. Kearney study mentioned earlier evaluated 76 smaller suppliers and found only two were categorized as being at “catastrophic risk of failure” or in need of Army intervention. Another 24 were classified as at “moderate or significant risk”.

Politics and special interest intervention is common in U.S. defense markets. The U.S. Congress has exerted influence in the market through such provisions as the Defense Authorization and Appropriation Acts, Acquisition Law, the Buy American Act, and specialty metal restrictions. Further, Congress has intervened by appropriating un-requested funds to continue CV production, even when the Army has attempted to end production for both M1 tanks and Bradleys. Directed appropriations challenge DoD’s ability to effectively execute an acquisition or sustainment strategy. Ultimately, “all politics are local”, leading Congress to intervene to preserve defense-related jobs in many congressional districts. This fact is not lost on defense firms who lobby to ensure members of Congress are kept well informed of the jobs at stake should production slowdowns occur. In fact, we observed that some firms seem to concentrate as much on congressional influence as on product innovation and production efficiency. Firms with little capacity to lobby or with weak congressional support often find themselves at a disadvantage.

Outlook

While the operational environment within the CV and TWV markets is turbulent, it is not unprecedented. Historically, DoD acquisitions ebb and flow in periods of peace and conflict – rising during wartime and tapering as conflict subsides. Given these tendencies, there are three broad trends we can anticipate for the next 10-15 years. First, it is likely that the LCS industry will continue to shrink along with reductions in DoD’s force structure. Second, inter-service resource competition will extend beyond system-specific programs and will likely envelope a broader portfolio of resourcing struggles. Third, with the ever-increasing pace of technology transfer, it will be more difficult to ensure DoD’s capability dominance in the future. DoD’s ability to innovate and maintain a technological and industrial advantage has defined the American way of war, but the U.S. should not expect to maintain this advantage.

Given anticipated resource constraints, DoD will likely make smaller investments, focusing only on critical capabilities across the breadth of land combat systems. As a result, for the foreseeable future, DoD leaders must also balance the risk of each decision to invest in modernization and sustainment while simultaneously considering the health of the DIB. For instance, strategic planners must determine if SLEP investments for the M1, Bradley, Stryker and M109 fleets, along with the award of the AMPV program, are enough to sustain sufficient industry capacity while DoD contemplates its future force structure and LCS requirements for the “weapon system(s) after next.” On the TWV side, some recapitalization of existing fleets, along with anticipated investments in the JLTV and the Ultra Light Combat Vehicle (ULCV) are expected to sufficiently sustain the TWV market.

The Army’s Training and Doctrine Command (TRADOC) is the lead agency for force development concepts. In the near term, the land combat system market must posture to accept limited funding and modernization as described above. As resources dwindle, materiel investments will decline and the Army will likely focus on leader and Soldier development to fill the capability void. In the mid-term, currently described as Force 2025, the Army will invest in Research and Development (R&D) efforts focused on programs producing systems with improved lethality, survivability and deployability. This focus will allow ground forces to achieve strategic influence by rapid employment of tactical formations. Simultaneously, these systems will provide overmatch against any adversary.

What does this mean in terms of the future LCS market environment? For DoD, both the Marine Corps and U.S. Army will face the decision of what risks to assume between modernizing existing vehicles and funding investment in future system developments and force structure in support of land warfare 2025 and beyond. Lack of a clear and comprehensive strategy vis-à-vis LCS makes these decisions even more difficult.

Challenges

At present, U.S. public debt exceeds 18 trillion dollars and is expected to grow. In this environment, defense spending will be challenged. According to the US Army Strategic Planning Guidance 2014, “Reduced Funding ... leads to significant reductions in planned end strength, materiel readiness, and capital investments through at least 2023.”⁶ The anticipated reduction of another 30,000 Soldiers will bring active army force structure to approximately 420,000 and will likely drive senior leaders to right-size a variety of materiel programs in line with a smaller force. With these challenges, DoD should not assume the LCS industrial base will endure in its current form.

As already implied, the TWV and CV markets are sufficiently differentiated so as to make broad generalities very difficult. Reduced budgets will impact the TWV segment differently than the CV segment. This is largely due to the foundation upon which the TWV segment resides – the commercial truck industry – where these OEMs often build both military and heavy-duty commercial vehicles. This diversification helps sustain the TWV segment. For example, Oshkosh builds military products including the Medium Tactical Vehicle (MTV), the Heavy Expanded Mobility Tactical Trucks (HEMTT), Heavy Equipment Transporters (HET) and the Palletized Load System (PLS). They also produce a number of heavy-duty commercial vehicles including Pierce fire trucks, front loaders, garbage trucks and access equipment. This diversity of product lines enables Oshkosh to withstand defense budget cuts. The CV industry does not share the same flexibility. CV OEMs typically concentrate on only military-unique products, which have no commercial application and are restricted in terms of international and foreign military sales. Therefore, CV manufacturers have no way to generate added economies of scale or to increase profits and productivity without planned DoD acquisitions.

While the defense budget has been in decline since 2010, the language in the 2016 Presidential Budget (PB) indicates that the out-years may be even bleaker for DoD. Guidance in the PB also directs that DoD divest itself of “unnecessary...weapons.”⁷ Yet, as implied previously, the fiscal environment incentivizes the Services to refit, maintain, and sustain existing equipment instead of pursuing new acquisitions. This approach is not unique to the ground forces, or those who manage land combat systems. For example, the Marine Corps’ CH-46 helicopter entered service in the mid-60s and remains in service today. The U.S. Air Force (USAF) intends to keep B-52s flying past the ripe old age of 100 years. Divesting of “unnecessary systems”, limiting investments in future systems and extending service life for existing systems are all goals in tension with one another as it relates to the department’s mission and industry’s ability to support.

Diminishing acquisition budgets have led the Army and Marine Corps to make some tough decisions regarding short-term funding priorities. Army priorities in the short term (FY 2016 to 2019) focus largely on tiered readiness and refurbishment vice acquisition of new CVs or TWVs (JLTV notwithstanding).⁸ The Marine Corps is in a similar situation: combat operations have driven a focus on readiness versus new procurement. Despite the current challenges, both the Army and Marine Corps will need to consider replacement programs for their aging CV fleets. With current procurement trends, the earliest possible delivery of a new CV would likely be 2025. While lacking a clear long-term strategy, bridging from today’s readiness to modernization for the future is an enormous challenge.

Further, as the administration continues to pursue its rebalance to the Asia Pacific region, a theater more reliant on naval and air forces, the department’s budget request will likely cast an even larger shadow on ground forces. Power projection and operational reach requirements in the Pacific will force acquisition trade-offs, and are anticipated to bolster support for both USN and USAF requirements – especially when combined with a National Security Strategy which shies away from ground-force commitments and leans towards strategic deterrence capabilities. The department can be expected to scrutinize its service doctrine and assess the capabilities needed for a vastly different operating environment with vastly different geography, resulting in an updated acquisition portfolio to develop programs that provide these capabilities. With the exception of amphibious systems such as the ACV,

already funded programs like AMPV and JLTV, and non-combat forces designed to support humanitarian and disaster relief operations, ground forces can expect to receive fewer dollars.

If the Army and Marine Corps are presented with the mandate to expand global engagements and adopt an increasingly expeditionary posture, this shift could alter force structure planning and potentially reduce the number of Armored Brigade Combat Teams and associated equipment. That said, the department is charged to manage not only the most likely threats, but also the most dangerous. DoD may be directed to re-introduce combat forces into the Middle East, which will certainly revitalize the dynamics of LCS industry. It is exactly this sort of uncertainty and the number of possible future scenarios that DoD must balance as it manages its force structure, capabilities investments and a somewhat beleaguered CV industry.

Recommendations

The preceding sections described the current state of the LCS industry and market conditions within the U.S., identified some of the most serious challenges facing the industry, and contemplated what that future may look like if there are no changes. Through in-depth study of this industry and numerous visits with both government and defense manufacturers, these observations lead to several recommendations.

Providing as much stability and predictability as possible in DoD spending will have the most significant and positive impact in the coming years. Even in the face of shrinking budgets, DoD should pursue predictability as much as possible by developing a clearly articulated strategy for procurement and sustainment of all desired capabilities. The U.S. must carefully evaluate its long-term national security interests and goals and prioritize spending accordingly. These goals must be conceptually linked— starting with the National Security Strategy, tied to the National Defense and National Military Strategies and correlated with global contingency plans – in order to best inform the desired size, composition, and forward basing of U.S. Armed Forces through 2025-2030. Based on Geographic Combatant Command (COCOM) input and analysis of expected threats, the land components can then identify desired capabilities and determine the appropriate types and numbers of land combat systems needed to best support strategic, operational, and tactical success.

Having established clear requirements, DoD can then examine the best way to meet them. One option is to continue with the status quo and procure our systems from the domestic defense industry. Another is to look beyond our shores and consider international procurement solutions. In the near-term, sustainment of existing systems is a priority and will continue to support domestic providers who recap and upgrade our existing fleets. However, these legacy systems may not provide the capabilities necessary in future strategic environments. Although the U.S. maintains strong capability and capacity within the domestic LCS industry, DoD can increase competition and adopt a "best of breed" mentality by pursuing opportunities to acquire LCS solutions available from our international partners and allies. There may be significant economic benefits supporting the argument for procuring foreign-made systems, particularly when the purchase quantities are small or when an "off-the-shelf" (non-developmental item) is available. The Army's procurement of the Stryker Infantry Fighting Vehicle (IFV) is emblematic of this sort of approach, having been procured from an existing variant of a Swiss-designed vehicle. International products are not uncommon in the U.S. CV market. For instance, all four vehicle designs entered in the USMC ACV 1.1 competition are of foreign origin with U.S. manufactures acting as prime contractors.⁹ This sort of approach allows a U.S. manufacturer to quickly enter a competition for which it does not have a suitable proprietary design, or to enter a market in which it has no history. As a result, opportunities for international partnering, or direct purchases of foreign designs, should be considered. Rather than solely focusing on country of origin, system suitability, innovation and economics should assume increased priority as DoD considers new system acquisition.

While discussing foreign product solutions, we must also include broader recommendations gleaned while visiting foreign LCS firms. There were several obvious and common contrasts between European and domestic firms. Most striking was the culture surrounding the valuation and management of employees. European employees were well trained to become highly skilled in a variety of abilities, giving the firms exceptional flexibility in adjusting to changes in product demand, including the ability to cease production of a specific product line and restart it at a later date. The ability and willingness to consider breaks in production is entirely absent among U.S. firms. Instead, U.S. firms cling to the idea that it is an untenable course of action due to cost and time required to restart a production line. Another difference between U.S. and European firms is the European mindset for setting production levels. U.S. firms seem to prefer maximizing production capacity, in order to drive costs down. When spending decreases, this drives costs up, which are passed along to DoD in terms of diseconomies of scale. U.S. production capacity does support rapid delivery and often supports customer schedule demands. In contrast, European firms tend to operate closer to their minimum sustainment rate (MSR) at all times. While this is slightly less efficient and leads to a higher cost for their products, it also increases their ability to respond easily to reductions in demand. With a smaller and highly trained workforce, they are able to reassign personnel to other products and avoid losing highly trained and skilled workers. Moving forward, the U.S. industry and DoD would be well served to consider some of the approaches used by European firms that make them more flexible and resilient.

Next, the Department must take action to improve efficiencies within the OIB. While current projections for recapitalization and upgrade work will occupy DoD's OIB (depots and arsenals) in the near-term, the future is less certain. Existing U.S. law requires service depots to complete 50% of the available depot level work for major weapon systems. This percentage is calculated at the service level, is measured in overall dollars spent, and is not correlated with specific weapon systems. Therefore, some view this as an arbitrary contract ceiling, which impinges on similar work that could be performed by the OEMs and contractors across the DIB. Conversely, U.S. law (10 USC §2464) requires DoD to maintain a minimum of "core" logistics capabilities and an ability to sustain its weapon systems within the OIB – known as "ready and controlled source of technical competence".¹⁰ The core requirement is an aggregate determination tied to the number and types of systems within the DoD inventory, across all the services. For example, a USAF system can be maintained at an Army depot and DoD will get credit for meeting its core requirements. The Core and 50/50 mandates often compete against each other and create instability and problems projecting workload within the OIB. Further, OIB Direct Labor Hour (DLH) rates fluctuate based on workload. As DoD makes readiness tradeoffs in order to reduce Operations and Maintenance (O&M) spending, depot workloads typically decline. As workloads decline, the overhead necessary to support the "core" legislative mandate causes a diseconomy of scale. As a function of current accounting practices, DoD then applies overhead costs to fewer systems being sent into overhaul, and raises the costs charged to the services to refurbish each system sent to the depots. These practices frustrate customers of the Army's Working Capital Fund (AWCF) who are forced to pay higher rates for refurbishment of fewer vehicles. This compounds the problem as customers then stop sending vehicles in for depot level repairs. Therefore, a comprehensive review of the OIB structure, accounting and processes is necessary. This is not to be confused with a suggestion to eliminate DoD's OIB capability. In fact, the capacity for organic overhaul and limited production must be preserved to ensure our nation's surge capacity and ability to provide combat systems to our nation's forces whenever crisis erupts. Yet, as stewards of our nation's resources, excess OIB capacity must be identified and eliminated. Another round of Base Realignment and Closure (BRAC) determinations should be initiated and Congress should support DoD in its efforts to consolidate its capabilities and facilities, without yielding entirely to commercial providers.

Another practice that should be re-examined is fleet-management; specifically DoD's drive for maximum commonality within and between systems. Intended to produce savings in production and life-cycle management while simplifying tactical sustainment operations, such savings are not always realized. As systems are upgraded through new production or depot overhaul, commonality quickly declines across

both the Active and Reserve fleets. An analysis of alternatives for fleet management, such as shifting away from vehicle commonality and procuring vehicles in smaller, more frequent batches, could improve competition and enable a more effective and economical acquisition process.

Next, supply chain management and the viability of the second-tier and subcomponent suppliers must be considered. The ability of the OEMs to provide a finished product is dependent on both manufacturing and assembly/integration skills, but also on the myriad of suppliers producing the parts and subcomponents for each system. Already, market demand fluctuations have forced OEMs to acquire many smaller firms (vertical integration). In some cases smaller suppliers have also made the decision to exit the industry. This is particularly true in the TWV market and can be viewed as the creative destruction inherent to the normal business cycle. DoD must not lose sight of the entire supply chain when considering MSRs and making decisions about what systems will be acquired or sustained. Further, DLA must be included in DoD’s decision making process in order to ensure a thorough assessment while simultaneously enabling this critical combat support agency’s ability to provide the right parts and components, at the right time and at the right cost.

Finally, while certain legislative protections are afforded to the DIB as described above, DoD has abdicated some of its capability and is now reliant on industry for design, engineering and the majority of U.S. LCS production. Preserving these capabilities is equally important and may in fact be more critical for the long-term health and sustainment the entire industry (OIB and DIB combined). The skills necessary to design and engineer CVs, in particular, are unique and quite perishable. U.S. industry has repeatedly proven that it can replicate production and overhaul capability effectively, but without design and engineering there will be no product development and no subsequent innovation in support of U.S. made CVs and TWVs. One way to preserve critical design and engineering skills is through robust Research and Development / Science and Technology (R&D/S&T) initiatives. R&D/S&T efforts will help keep the LCS industry “warm”, preserve the ability to deliver future land combat systems, and comes at a much reduced cost compared to production and acquisition. Relatively small, yet consistent investments in this area could sustain critical skills. Further, these sorts of expenditures will enable continued technology development and maturation and will generate the innovation necessary to deliver highly capable combat systems that will ensure our forces retain a dominant operational and tactical advantage.

COMBAT VEHICLE SWOT EVALUATION

Overview

The LCS Industry Study used a simple analytical tool to assess the health of the industry. The SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis provides an assessment of the industry as a whole and helps frame opportunities for improvement. Today’s CV market in the U.S. is dominated by two major firms: BAE and GDLS. These two companies currently supply all of the heavy and medium combat vehicles in use by the U.S. military, as reflected in Table 1.

Table 1: Manufacturers of Combat Vehicles in U.S. Military Inventory

Vehicle	BAE	GDLS
M1 Main Battle Tank		X
Bradley variants	X	
Stryker Family of Vehicles		X
Light Armored Vehicle (LAV)		X

AAV	X	
M88 Recovery Vehicle	X	
M109 Paladin/FASSV	X	
M9 ACE	X	
M113 Infantry Carrier	X	

Strengths

BAE L&A and GDLS have extensive experience in the development of heavy and medium CV systems and it is this in-depth experience with the design, development, and production of these systems that has been key to sustaining U.S. heavy combat power. Since purchasing United Defense in 2005, BAE L&A has continued developing modifications to Bradley, AAV, M113, M88, M9 ACE, and M109 Paladin. Likewise, GDLS has designed and implemented multiple upgrades to the M1 Abrams (SEPv2), Stryker (Double V-Hull [DVH] survivability), and LAV. The quality of the design, manufacture, and upgrade of these CV systems is evidenced by their extended service life. For example, M1 hulls and turrets are anticipated to remain in service for another 35 years. In addition, the recent combat experience of the U.S. Army and U.S. Marine Corps has provided a wealth of knowledge that CV manufacturers are using to refine modifications, develop new technologies, and address platform deficiencies.

The strength of these manufacturers lies, in part, with their highly skilled workforce trained to support unique aspects of CV production. Ballistic armor welders in particular are commonly identified as being critical to a firm maintaining its competitive edge in the U.S. CV market. BAE and GDLS have both established their own welding training programs. In the case of BAE, the predominantly aluminum hulls of the Bradley and M109 Paladin require welders who are highly skilled in working with aluminum. GDLS welders, during the development and production of the Israeli Defense Force's Namer, a Merkava MBT derived armored personnel carrier, have developed advanced welding techniques. In both cases, the welding techniques developed during these manufacturing processes remain the intellectual property of the U.S.-based elements of BAE and GDLS, and can be readily applied to other U.S. CV programs.

The production facilities in which these skilled workers and advanced manufacturing processes occur are ample and the capacity of the CV market as a whole can address most emergent requirements and production challenges for the foreseeable future. BAE is leveraging their existing contractor owned and operated (COCO) facilities at York, Pennsylvania for new hull production of the M109 Paladin Integrated Management (PIM) system. JSMC, in Lima, Ohio, is facilitated to handle new production of M1 Abrams tanks. The U.S. Army manages two primary depots, Anniston Army Depot and the Red River Army Depot, for the repair and maintenance of the M1 and Bradley, respectively. Further, these facilities can be adapted to modify existing platforms or produce new ones, such as the Israeli Defense Force Namer hulls in production at JSMC.

In the CV market, second tier manufacturers provide key components critical to the operational capability of the vehicle platform, the most critical of these being engines and transmissions. All U.S. CVs, with the exception of the M1 tank, use diesel engines produced in the U.S., such as the Cummins VTA-903 diesel engine for the Bradley. Diesel engines are produced commercially by companies such as Caterpillar, and repaired using commercial parts at the depots. The Cummins VTA-903 engine was initially produced commercially, but has become military-unique since only military vehicles (Bradleys, M109s, and AMPVs) have continued using the engine since the 1980s. With the M1 engine, which is a Honeywell-designed turbine, the production and maintenance facility has been established at Anniston Army Depot, providing an organic support capability. There are very few transmission providers for CV systems (L3 and Allison), but these companies have decades of experience in transmission design and

engine/ transmission pairing. Both of these U.S. companies provide significant industrial capability in terms of both design/technology and extant facilities that can support all phases of a CV lifecycle.

Both GDLS and BAE have leveraged capabilities that exist in other portions of their respective corporate global structure to pull necessary technologies into the U.S. for combat vehicle production. In the case of the Stryker, GDLS leveraged a design developed in Switzerland and modified it to satisfy Stryker program requirements. Additionally, BAE, GDLS, and other firms have developed international partnerships to leverage technical production capabilities. For the USMC's ACV program, there are four teams vying for the development contracts (BAE/Iveco, Science Applications International Corporation [SAIC]/Singapore Technologies Kinetics/Armotec, Lockheed/Patria/Plasan, and GDLS). The marriage of U.S. and international CV experience will potentially lead to innovative advanced technologies and capabilities for future CV design and production.

Weaknesses

The most significant weakness of the CV market is the fact that there is no commercial market for such vehicles. This portion of the LCS industry base is dependent upon DoD. In essence, DoD owns the entire industry – controlling the demand, funding and requirements. Absent DoD demand, industry producers could elect to exit the CV market, eliminating excess capacity in pursuit of more profitable markets. Additionally, unlike a commercial market where companies pursue independent R&D to gain competitive advantage, DoD historically pays for R&D in order to make vendors viable. This is required due to the fact that spending money for independent research does not come with a guaranteed return on investment, and most firms will not take such a huge gamble.

The relatively short-term planning and procurement approach on the part of DoD is another significant weakness of the CV market. Some critics have charged that DoD policy and programming efforts lack a clear vision and a well-conceived, durable strategy in terms of force structure (which drives CV requirements) and a deliberate approach to preserving a viable DIB. During the Cold War, concerns over Soviet tank capabilities started the U.S. Army quest for a completely new main battle tank, the M1.¹¹ By the end of the Cold War, the Army outlined Future Combat System (FCS) requirements for a set of new, lighter, more maneuverable CVs.¹² However, as a result of a lack of a durable strategy in a world without a well-defined unitary threat, the Army and Marine Corps have not been able to bring a new CV program to operation since the end of the Cold war.

In spite of the decline in near-term budgets, the Army has significant existing requirements to recapitalize, rebuild, or upgrade its vehicle fleet, but was forced to announce a 25 percent reduction in modernization investments.¹³ This has led to significant delays in recapitalization of several systems, most of which are aging platforms.¹⁴ Consequently, modernizations efforts will occur at slower pace, with the work schedule extended along a timeline that barely maintains CV market firms' minimum sustainability rates. Congress is sensitive to this impact and has allocated additional funding to support industry's stated minimum workload, but directing use of these funds cause an involuntary reprioritization of the Army's baseline budget. The impact, while mitigating concerns in the industrial base, negatively affects other Army priorities and programs.

Currently, there are limited new combat vehicle production projects available to sustain the industrial base. The opportunities that do exist are split between GDLS and BAE, and only the Namer and M109 PIM programs are producing new hulls. This low volume increases the per-unit cost of each new vehicle, a condition that will not change for the foreseeable future. Congressional mandates that provide funding to achieve the aforementioned MSRs have also led to excess in a number of CV platforms, such as the M1, which now exceed the force structure requirements. Because of these dynamics, the industrial base – both organic and commercial – is inefficiently applying capacity.

The scale and complexity of combat vehicle production dictates the need for large facilities, for initial production, recapitalization, rebuild, and testing. These requirements have led to a split in capabilities between various facilities within the combat vehicle market: GOGO, GOCO, and COCO.

Regardless of the facility type, CV facilities have large fixed costs. In the case of JSMC, annual fixed costs for the facility are tens of millions of dollars. A low-volume work load combined with high fixed costs results in a more expensive per-unit cost for recapitalization or rebuild, distributing overhead costs across fewer vehicles. Part of these fixed costs for the government includes providing tooling and machinery that may be required under terms of the contract. While the government may benefit from providing such equipment, the government must also maintain this tooling. This leads to inefficient management and provides no incentive for the OEMs to innovate or upgrade tooling they do not own.

Innovation and technological development of combat vehicles is also in decline. The budget reductions to R&D accounts, combined with the persistent perception that the U.S. will be able to indefinitely maintain its technological advantage over potential adversaries, has undermined the urgency of modernizing the U.S. Army and U.S. Marine Corps combat vehicle fleets. Examples of avoiding the large costs of cutting-edge weapons procurement programs are exemplified in the cancellation of the Crusader, FCS, and GCV programs.¹⁵ These cancellations have negatively impacted the CV market's ability to innovate and mature new technologies.¹⁶ The government's failure to provide a long-term strategy discourages industry to both invest in R&D and adopt innovative approaches to future systems. A senior procurement official recently stated that if a program is not currently in development, then it will not likely be delivered in the next 20 to 25 years. Lack of innovation now will translate into a capability disadvantage in the future.

Threats

One threat to industrial base preservation is the ability of second-tier suppliers to continue supporting the OEMs. Many of these suppliers across the CV market lack the financial resiliency that the large OEMs enjoy and may face the risk of insolvency as DoD acquisition recedes. Potential insolvency is even more probable given the military-unique nature of most components used in CV production. There is limited or no commercial application for many CV components, and small, poorly diversified suppliers are more susceptible to the market's anticipated decline. So far, Congress has helped minimize this threat, demonstrating strong political support for preserving employment across the industrial base, but it is uncertain how long this can last in the face of declining discretionary spending in the federal budget.

While DoD's demand is decreasing, the CV market workforce is also dwindling. The typical approach to this largely unionized workforce focuses on retaining the most senior and skilled workers. Yet, this approach does not support the long-term growth of technical competence within the industry. During market contraction, younger workers are not retained and therefore the industry fails to build its bench of workers with sufficient technical skills. Therefore, when senior workers retire, the industry will have a very shallow pool of skilled replacements from which to support future production. In this respect, the CV market is at risk and will remain so for the foreseeable future.

Preserving the workforce ties directly into the strong Congressional support for depot, OEM, and GOGO CV production facilities, with the tendency for work to be shared between those sites. This practice translates into jobs for Congressional constituents. Unfortunately, keeping facilities open when there is significant excess and idle capacity places a financial burden on the industry. As budgets and procurement opportunities decline, it is possible that Congressional interest in preserving constituent jobs will prevent necessary consolidation designed to provide long-term survivability of the broader industry. Over time, an increasing percentage of the CV budget will be spent maintaining idle capacity and facilities despite a lack of work, as opposed to using these dollars in other areas such as R&D and/or new CV programs.

Recommendations

Recommendation: DoD should consider examining a new procurement strategy for CV systems based on a "buy less, more often" concept. Under this approach, DoD could gain incremental improvements over existing capabilities in a shorter period of time. This is in contrast to the existing

procurement approach, which is based upon substantial improvements and complex requirements, resulting in programs timelines that take close to 15 years to get to full rate production. Adoption of an incremental acquisition approach would impact DoD's preference for pure fleet by introducing multiple variants of a given vehicle. This would increase the logistics and the sustainment requirements. However, given light of the potential impacts of sequestration, DoD should conduct a cost-benefit analysis of the various procurement options to identify the best way forward.

Recommendation: DoD and Industry partners should collaborate to create a CV vision and strategy flowing from the development of a durable, multipolar world national security strategy. Now may be the time to consider a long-term vision for CV capabilities developed by all the stakeholders across the DoD, OIB, and DIB. A new vision and strategy will help drive innovation within the acquisition process and solidify DoD CV requirements. DoD must continually manage the nexus of the acquisition process, the strategy, and production stability for manufacturers and critical second-tier suppliers. In short, a durable CV strategy, connected to an appropriately tailored acquisition process (e.g., minimizing the option of early down-selects of potential domestic and foreign OEMs), and a dependable production schedule will help normalize and reduce the typical fluctuations of CV acquisitions.

Recommendation: DoD should seize the constrained budget environment as an opportunity to look for innovative CV solutions through maintaining S&T funding. While seemingly counterintuitive, constrained budgets have the potential to force prioritization and innovation. Genuine innovation may result from the blurring of lines between TWVs and CVs. For instance, TWV and CV vendors may collaborate to pursue the production of a hybrid fleet (e.g., half-tracked vehicles) with dramatically increased lethality, sustained survivability, and improved mobility. If so, this would increase the number of competitors in a "blended" CV market. Simultaneously, technology investment offers the potential for leap-ahead capabilities supporting a theoretical hybrid fleet or new advanced conventional CV capabilities and platforms. By advancing new technologies independent of a new procurement program, all programs benefit and take advantage of advancing, developmental technologies.

Recommendation: DoD should re-evaluate how overhead costs are apportioned across programs with a goal of separating the overhead costs of maintaining a facility from the incremental costs of each unit procured/manufactured. Currently, overhead costs are spread across the number of items manufactured; thus a reduction in the total number of units produced increases per unit cost. By clearly identifying the actual costs of preserving excess capacity and separating them from the manufacturing costs, DoD could make better decisions based on the perceived benefits of sustaining industrial capacity while not exacerbating the problem of increased production costs for each unit. As an example, identifying the cost of maintaining the facility and design team for one of the transmission vendors (L3 or Allison), and separating these costs from the production cost, would allow DoD to understand exactly what the true overhead costs are and potentially devise ways to reduce them.

Recommendation: DoD must re-examine OIB capacity and seek opportunities for maximizing use of existing facilities. In order to do this, as DoD considers new programs in the out years, the department may want to consider incentivizing any new OEM entrants to use existing facilities under a P3 or other arrangement instead of creating additional capacity. Also, the department could expand the product lines at JSMC, as well as at the depots and arsenals. Under this initiative, the federal government could consider leasing plant floor space to new users in order to reduce the relative overhead costs associated with maintaining these facilities. In order to accomplish this, DoD should consider shifting the JSMC facility management contractor from GDLS to a third party. Additionally, BRAC consolidations, while unpopular for many reasons, may be necessary – including examination of JSMC, Red River, Anniston and others. For example, increasing P3 concentration in Alabama where wage rates are lower may reap long-term reductions in spending. Consolidating some facilities would increase efficiency and reduce the threat of a potentially haphazard approach to consolidation or realignment driven by congressional cycles vice deliberate DoD planning. The Department could consider consolidating Abrams, Stryker, and Bradley work to a single location for each system, creating system centers of

excellence. In the short-term, there would be increased expenses associated with making these adjustments but would result in long-term savings, improve facility usage rates, and position each facility to better defend and strengthen their argument for sustaining operations throughout the anticipated downturn in DoD spending.

TACTICAL WHEELED VEHICLE SWOT EVALUATION

Overview

As with the analysis used for the CV market, the SWOT evaluation was also used to assess the health of the TWV portion of the LCS industry and help frame an understanding for potential areas for improvement. The military Tactical Wheeled Vehicle industry is comprised of five OEMs, listed in Table 2, who are responsible for the majority of DoD TWV systems.

Table 2: Manufacturers of Tactical Wheeled Vehicles in U.S. Military Inventory

Vehicle	AM General	GDLS	Oshkosh	Navistar	BAE
High Mobility Multipurpose Wheeled Vehicle (HMMWV)	X				
Family of Medium Tactical Vehicles (FMTV) - 5 Ton			X		
Family of Heavy Tactical Vehicles (FHTV) - 10 Ton			X		
LVSR			X		
Med Tactical Vehicle Replacement			X		
Mine Resistant Ambush Protected vehicle (MRAP)		X	X	X	X

Strengths

The TWV market is strong, due to the commercial nature of its vehicles. As stated earlier, Oshkosh builds military products like the Medium Tactical Vehicle (MTV), the Heavy Expanded Mobility Tactical Trucks (HEMTT), Heavy Equipment Transporters (HET) and the Palletized Load System (PLS) which are derivatives of commercial truck technology used for civil sector development and support such as building and repairing roads and firefighting.¹⁷ TWV companies have developed the capacity to easily expand and contract production to accommodate DoD TWV demand changes, employing adaptive manufacturing lines which permit the production of military and commercial vehicles in the same facility. This flexibility allows the OEMs to keep vehicle unit costs down by providing economies of scale and lowering OEM overhead costs as the product base expands. As a result of its commercial sales, the TWV industry is more capable of withstanding the current DoD budgetary turbulence than perhaps the rest of the LCS market.

The commercial nature of TWVs promotes a great deal of competition in the industry, ensuring a stable and robust supply chain, and minimizing barriers to market entry. Companies with commercial vehicle production capability and manufacturing infrastructure are able to enter and compete in the market, without considerable added capital investment, due to the commonality between existing commercial platforms and processes and those required for DoD TWV systems. This commonality was evidence in 1979 when the U.S. Army issued a proposal for the High Mobility Multipurpose Wheeled Vehicle (HMMWV), to which more than 60 firms responded, including automotive companies such as

Chrysler and American Motors Corporation (now AM General). More recently, the market has experienced entry from nontraditional TWV manufacturers such as Lockheed Martin and SAIC who have submitted proposals to develop and build the Joint Light Tactical Vehicle (JLTV) -- DoD's newest TWV requirement. The result of this competitive market is that there is High OEM/supplier competition in the TWV market, which elevates DoD buyer power by promoting competitive pricing and encouraging OEM investment in R&D and prototype development. Such significant supplier competition maximizes the return on limited DoD financial resources, but more importantly, provides the warfighter with innovative solutions to provide additional protections and capabilities that may not have otherwise been realized in a more supplier constrained environment.

The relative ease with which TWVs are sold internationally is also a result of the commercial nature of the industry and is another TWV strength. The preponderance of TWV technology is in keeping with conditions and obligations of the Arms Export Control Act (AECA) and International Traffic in Arms Regulations (ITAR), which facilitate the transfer of TWVs to U.S. allies through foreign military or direct commercial sales. TWVs are largely built using commercial technology and are not weapons that are subject to less stringent export controls. Unarmed and unarmored TWVs are usually on the commerce control list, vice the state department munitions list, which makes it easier for U.S. firms to compete in the international market.¹⁸

Weaknesses

While the ability of firms to remain competitive in the TWV market is strong, there are market weaknesses. One significant weakness is that DoD often finds itself in a vendor lock and sole-source pricing environment after completion of the initial competition, OEM selection and initial production. This weakness is characterized by DoD's desire for pure fleeting make/models and the desire to avoid high switching costs associated with changing OEMs during production and sustainment. Pursuing a pure fleet often results in DoD anointing the chosen OEM as the sole provider of the selected fleet. Therefore, DoD is later forced to negotiate with a monopolistic OEM who is in a position to set prices for future production runs and associated repair parts. A related issue is the lack of DoD control of technical data packages (TDPs), which become critical in an environment of continually extended vehicle life cycles. OEMs have historically been reluctant to transfer or sell TDPs to DoD. Selling TDPs, which represent the OEM's intellectual property, is not normally done in the commercial market and retaining TDPs reinforces the company's lock on all future sales and servicing of these vehicles. Maintaining control of TDPs provides supplier power for the manufacturer as a likely sole source monopoly for both the trucks and parts when rebuys and follow-on support are required. DoD is therefore dependent on the OEM to obtain the necessary parts and components to support the vehicle lifecycle. The lack of government-owned TDPs also weakens DoD's ability to leverage OIB depot capabilities, leaving DoD somewhat dependent on OEM support to help manage the fleet.

Another key TWV market weakness results from the military's relatively low usage rates and the associated obsolescence problems. With few new programs on the horizon, DoD's fleet management strategy is to extend the service life cycle of TWVs, resulting in a life cycle of 30 to 40 years, as compared to the commercial truck cycle of 10 to 15 years.¹⁹ DoD's strategy of life cycle extension efforts is common, given the would-be expense of replacing an entire fleet of DoD system every 10 years. For example, to replace the entire TWV fleet, DoD would need to invest tens of billions of dollars. At the same time, the commercial market from which DoD TWV capabilities derive are continually changing form, fit, and function as technology progresses, causing DoD to miss out on the adoption of new technologies. Lifecycle extension also results in DoD inventory obsolescence problems as commercial parts for older vehicles and systems become harder to obtain. Over time, what were once commonly available commercial spares become military unique repair parts.²⁰

An additional weakness of the TWV market is the Environmental Protection Agency (EPA) requirement for commercial diesel vehicles to burn low sulfur fuels. DoD has received a waiver to this low emissions requirement for its vehicle fleet. This is problematic for DoD as over time the commercial market continues moving to improved low emission technology. Unless DoD adapts to comply with low emissions requirements, the department is increasingly isolated as a sole buyer of non-compliant engines as the commercial manufacturers adjust their plant, tooling and facilities to produce EPA compliant products. Either DoD will need to fund and transition to the newer engines, or be left to prop up a cost-center in support of the manufacturers who are asked to provide the older, non-compliant engines.

A final weakness is the fact that DoD has very few TWV new start programs on the horizon. This affects the business base for companies in the market. TWV OEMs normally organize themselves with a separate defense sector within their overarching corporate structure. Defense business, therefore, typically comprises only a small percentage of the parent company's overall sales. When defense business wanes, the parent company leadership may decide to leave the defense sector and pursue more promising business opportunities. Having very few new procurements drives a boom/bust cycle that increases OEM turnover and industrial base instability. Still, DoD is willing to live with this churn given the relative ease of market entry by commercial companies when TWV demand increases.

Threats

In addition to the strengths and weaknesses of the TWV market, there are some major market threats DoD must understand. One significant threat to the industry is special interest politics. The impact of the military / industrial / congressional complex influences budgets, acquisition strategies, and depot work share, resulting in less efficient use of scarce TWV investment and modernization resources. Congress is susceptible to industry influence and often directs DoD investment decisions that benefit existing manufacturers and associated constituents. Lobbying often results in DoD being forced to pursue sole-source in procuring an existing TWV make or model, rather than competing a contract. Special interest politics can also result in companies seeking funds in excess of those sought by DoD for TWV investment in order for their company to remain profitable.

Navigating the complexity of the defense acquisition system is also threatening the TWV industry, particularly given the commercial nature of the entrants and their frustration with the government's acquisition bureaucracy. The Defense market is highly regulated with TWV firms being subject to a myriad of DoD acquisition regulations and requirements prescribed in the Federal Acquisition Regulation (FAR), Defense Federal Acquisition Regulation (DFAR), and service supplements. Further, TWV firms are subject to routine audits and oversight by the Defense Contract Audit Agency (DCAA) and the Defense Contract Management Agency (DCMA) to ensure fair and reasonable contract prices as well as the integrity of the contracting process. This body of regulations and controls forces firms to have a specialized legal and administrative staff devoted to guiding the company business through the defense acquisition process and regulations. This increases overhead costs for the OEM and represents a barrier to market entry for smaller commercial entities and companies unfamiliar with defense acquisition processes.

A final threat to the TWV market is the preservation of Army and Marine Corps Depots and GOGO production facilities. These facilities, while preserving an organic industrial capacity for DoD, act as an insurance policy against OEMs departing the market place. However, they are costly in terms of added overhead and drive up DoD's direct costs by adding excess or idle capacity. This is something DoD should reexamine given that most modern TWVs do not require significant depot level maintenance. Additionally, these facilities compete with the OEM to provide maintenance and overhaul support functions. Further, government facilities are not typically incentivized or resourced to improve efficiency. While these facilities are appropriated to keep them operating, they lack the necessary capital investments needed to help them keep pace with industry in terms of lean practices that drive long-term improvements and efficiency.

Recommendations

The TWV market is a large and diverse commercial vehicle supply chain, influenced by global market forces and including new vehicle acquisitions and legacy system recapitalizations and rebuild. The market has experienced a steep decline in DoD demand over the past few years and is looking to foreign military sales as one avenue to help offset this decline. The recommendations provided below address strengthening the TWV component of the LCS industrial base and are limited to those that can be practically pursued and implemented by DoD.

Recommendation: Avoid vendor lock by shifting away from a pure-fleet mentality and pursuing a “buy less more often” strategy. The PEOs and PMs should consider making more frequent, smaller procurements that will enable DoD to stoke competition. As more frequent procurements are conducted, and multiple OEMs have an opportunity to aggressively compete, DoD will benefit from the latest in commercial technologies and obtain competitive pricing. Additionally, greater competition will help DoD avoid sole source production and sustainment contracts. This strategy would also reduce parts obsolescence and allow DoD to benefit from commercial market economies of scale, while also reducing the number of DoD TWVs that slowly become military-unique. Additionally DoD should consider buying, or at least having an option to buy, the system TDPs— like DoD is attempting to do with the JLTV Engineering and Manufacturing Development (EMD) source selection. Acquiring the TDPs provides DoD an ability to compete future production and sustainment contracts, as occurred when Oshkosh won the second competition for the FMTV contract over BAE Systems, the original manufacturer, resulting in significant cost savings to DoD.

Recommendation: Leverage S&T funding in a more focused manner. As sequestration continues to threaten DoD force structure, readiness, and modernization, firms must continue to invest in the up-front design and development of new technologies to meet future TWV capabilities by focused use of S&T funding. DoD should look at how S&T funding is provided to the OEMs and ensure that the funds are targeted to those industry efforts that have the greatest potential. Specifically, DoD must identify areas or special interests such as survivability and off-road mobility. Future S&T funding should help drive the development of critical capabilities and technology advances. Providing targeted S&T funding ensures that OEMs are able to advance technology and preserve engineering and design capability at the same time.

INTERNATIONAL LCS MARKET

There Is No Single European CV Market

The European CV market is not a single market in the sense of the U.S. market. Rather, it is a diffuse market consisting of 27 European Union (EU) member states and 25 NATO member states (not including the U.S., Canada, and Turkey), 23 of which are also EU members (excluding Norway and Iceland). The market is influenced by each countries’ acquisition objectives, the EU regulatory framework, NATO planning and equipment pooling concepts, and encompasses multiple individual national programs.²¹ The market is funded by individual countries’ defense budgets, and because of budget cuts and austerity measures implemented by most European countries since the 2008 financial crises, has been shrinking. Therefore, for the last 20 years European combat vehicle manufacturers have relied on exports, developing a diverse product mix and flexible manufacturing techniques, enabling firms to stop and start production based on demand. Recent Russian aggression in the Ukraine, however, may reverse this trend in the short term as Europe’s front line states (e.g. Poland, the Baltics) focus on their capabilities and states further to the West increase defense spending as a signal of resolve.²²

The Regulatory Framework

As with the U.S. market, national governments - as the primary consumer – play an important role in the European combat vehicle market. European states have exhibited the same tendencies to protect their defense industries, out of concern for national security and local economics, as the U.S. However, many are also members of the EU, founded in large part to create a single market by removing intra-Europe trade barriers.²³ Therefore, the EU regulatory framework – and the European Defense Agency, founded in 2004 as the EU body to improve defense cooperation between member states – plays a role in the market; through recommendations for equipment pooling and sharing arrangements, attempts to limit “offsets;” and efforts to legislatively limit defense industry protectionism.

The starting point for the EU defense acquisition regulatory framework is Article 346 of the Lisbon Treaty of 2007 which states:

Any Member State may take such measure as it considers necessary for the protection of the essential interests of its security, which are connected with the production of or trade in arms, munitions or war material.²⁴

This provision and a similar one in the EU’s original foundation treaty have largely prevented the integration of the European defense market, allowing national industrial base concerns, including the insistence on offsets in intra-EU transactions, to predominate. However, through the 2009 European Commission (“EC” (the EU executive)) Defense Procurement Directive (Directive 2009/81/EC,) the EU sought to compel member states to include in their national defense procurement regulations measures that would weaken Article 346 through limiting its application to “exceptional and clearly defined cases,” an anti-offsets provision, and allowing defense firms to challenge EU member states defense procurement decisions in the European Court of Justice. Nonetheless, EU member states largely continue to pursue their own procurement and industrial base policies and the EDA, with a meager 30 million Euro annual budget, is seen as ineffective.

Budgets and Austerity

The 2009 financial crises and resultant national austerity measures have become the key drivers of the European defense market, greatly restricting European demand for new combat vehicles. Between 2001 and 2011, a time when a number of European nations were engaged in combat/peacekeeping missions in the Balkans and Afghanistan, European defense spending declined by roughly 16% from 263 to 240 billion Euros, with especially large cuts (14%) in equipment acquisition.²⁵ This decrease had a profound effect on the European combat vehicle industrial base, leading to some consolidation, but also a focus on export markets and far less reliance on domestic government contracts and support than U.S. firms. European CV firms export focus will likely increase as the Euro depreciates against the dollar, making European products even more competitive in the international marketplace.

Another way in which European firms deal with austerity is their ability to efficiently stop and restart production in response to demand. This ability and willingness of European firms to accept a break in production is a significant difference between the European and U.S. industries. Every interview involving the U.S. CV industry indicated that completely ceasing work on a particular vehicle line would result in high costs and long delays to restart production. Estimates for cost and delay reached as high as \$800-\$900 million and two years.²⁶ European firms are able to restart production with minimal cost or delay, with the exception of long lead items (such as vehicle hulls), which can take up to 24 months to produce. This ability derives from the European culture towards workforce and production capacity. European firms invest in extensive training for their workers to make them highly skilled in a variety of areas and able to shift to a different work area when production ceases on a specific vehicle. These firms also tend to set capacity lower than U.S. firms, so when production levels decline there are fewer employees to reassign.

European Combat Vehicle Market Participants

The European market for land combat systems is diverse with a wide range of participants. However, in recent years the industry has consolidated – much like in the U.S. – into four dominant manufacturers: Krause-Maffei-Wegmaan (KMW) and Rheinmetall of Germany, Nexter of France, and General Dynamics European Land Systems (GDELS), headquartered in Madrid and a subsidiary of the U.S. defense conglomerate. Further consolidation is in the offing as Nexter and KMW intend to merge in 2015. Remarkably, the U.K. acknowledged in its 2009 on its domestic CV industrial base that there was no longer a need for it to retain an armored vehicle industrial base, a blow to U.K.-based BAE Systems.

KMW's products include armored fighting vehicles (Boxer, Dingo,) tanks (Leopard,) and self-propelled artillery. KMW is focused on exports – the German Army has not placed an order for new or refurbished tanks since the early 2000s. KMW has had notable export successes, selling the Leopard to 17 nations, including an ongoing contract to produce 62 tanks for Qatar. However, German government restrictions have challenged the company in some cases, for instance resulting in the cancellation in 2014 of a proposed sale of Leopard 2 tanks to Saudi Arabia. Nexter, KMW's proposed merger partner, is a French firm wholly owned by the French government. Its products include the Leclerc main battle tank and a line of armored personnel carriers. Nexter is also export focused, with exports accounting for 75% of its gross revenues in 2013.²⁷ The view from Europe is that KMW is pursuing the merger with Nexter as a response to the German Government's refusal to approve the sale of Leopard 2 tanks to Saudi Arabia; following a merger, future sales of products developed outside of Germany could be made through Nexter, circumventing German export controls and following France's more forgiving licensing regime (and avoiding internal German political considerations).

Rheinmetall produces both tracked (Puma infantry fighting vehicle) and wheeled combat vehicles (AMPV (with KMW), Fuchs, Boxer.) Like KMW, Rheinmetall is currently export focused but it too has had difficulties with German export restrictions. However, in 2014 it successfully negotiated an agreement to sell Algeria nearly 1000 Fuchs wheeled combat vehicles, with German Government approval. Rheinmetall will manufacture the vehicles in Algeria.

GDELS, an amalgamation of a number of European defense firms including GM Defense, Steyer (Austria), MOWAG (Switzerland), and Santa Barbara Systems (Spain,) is the clearest example of European defense industry consolidation. Key products include the Eagle IV protected patrol vehicle and the Piranha multi-purpose armored vehicle.

Recommendations and Observations With Respect To European Combat Vehicle Manufacturers

1. Evaluate use of "U.S. eyes only" restrictions imposed on trusted foreign firms partnered with U.S. firms competing for new programs – this serves as a barrier to entry and reduces market competition and U.S. access to new technologies. There are two key concerns:
 - "U.S. eyes only" restrictions limit partner understanding of requirements;
 - While "U.S. eyes only" restrictions are necessary to protect security of some information, the degree to which they are imposed must be weighed against benefits derived from access to offshore solutions and increased competition.
2. Encourage U.S. combat vehicle firms to partner with European firms to take advantage of European CV technological advances. European CV manufacturers complain that, given the size of the U.S. market, they want to compete. However, they also claim barriers – especially the culture of lobbying and lack of familiarity with U.S. ITAR – make entry impossible.
3. When evaluating the U.S. CV industrial base, consider the experience of European firms, which have thrived with minimal domestic demand by tailoring products for the export market and taking steps to

allow more flexibility in stopping and starting production. There may be important lessons for U.S. CV firms.

4. As a step to protect the U.S. CV industrial base, the U.S. Government should work closely with U.S. CV firms to encourage and support their export efforts. European CV firms acquired by GDELS noted that one important benefit of their acquisition was the strong U.S. government backing they are now receiving in export markets.

CONCLUSION

Required Vision for Industry Leaders

Funding shortages resulting from budget cuts associated with the BCA have reduced demand and created idle capacity within segments of the LCS industry. The trickle-down effect has caused a tremendous amount of uncertainty as the DoD struggles to identify the future role of land combat forces and develop a tightly nested acquisition strategy to deal with this level of uncertainty – including shifting force structures and a perceived lack of demand. The DoD’s inability to articulate its land force mission requirements has led to some concern about the status of the firms within the LCS industry. If enigmatic national security strategies do not abate, this could lead to continued acquisition turbulence and further LCS market unpredictability -- ultimately hindering effective planning and resource management. A shared vision among DoD, OIB, and DIB decision makers is needed to ensure the viability of the two distinct and highly concentrated markets within the LCS Industry.

The TWV Commercial Advantage

The commercially based TWV market remains much more resilient than the defense-unique CV market – a function of the significant commercial integration within existing manufacturing and supply chains. Commercial derivation allows the TWV market to absorb greater fluctuations in demand than the CV market. Additionally, the competition among TWV firms increases DoD buying power through technical innovation and reduced prototype costs savings. Despite these advantages, the TWV market shares similar capacity and demand dilemmas to those that continue to plague the CV market. As budgets continue to decrease, DoD is unable to replace existing fleets with those inclusive of the latest technological advancements. This is forcing DoD to maximize available recapitalization, rebuild, upgrade and SLEP opportunities through 2025, at a minimum. The DoD must provide a long-term acquisition strategy that will account for reduced budgets and low demand in order to encourage OEMs, second-tier firms, and sub-contractors to continue competing within the LCS industry.

Acquisition Reform

Streamlining acquisition practices, purchasing TDPs for TWVs, and focusing on S&T funding will provide a more stable and competitive environment. PEOs and PMs can reduce program cancellation vulnerability by acquiring fewer quantities on a more frequent basis. While acknowledging the risk of moving away from a pure-fleet concept, this strategy could enable firms to aggressively compete and produce low-priced, technically advanced end items, while also reducing the frequency of sole source contracts, which lock programs into a single vendor. Further, acquiring the TDPs will provide DoD with the ability to compete, or have the threat to compete, future production and sustainment contracts. Continued investment in S&T funding will also allow the DoD to direct funding towards firms that have the greatest potential to design and develop next generation technology.

Call for an Effective BRAC

A BRAC initiative is recommended to assess the viability of the OIB and to account for perceived excess capacity, while seeking reduced overhead rates, and incorporation of streamlined supply chains that focus on efficient distribution and inventory management. Based on current accounting practices, if

depot facilities cannot support production rates that are commensurate with the BCA budget environment, it may be prudent to shift some recapitalization, rebuild, upgrade and SLEP efforts to the OEMs. BRAC decision makers must also determine which depots can effectively support P3s that allow the OEM's to incorporate lean business practice solutions within these OIB facilities. The DoD should consider a new approach to the GOCO relationship at the JSMC, and should also identify methods to streamline the DLA, OEM, and depot supply chain management relationship to account for improved quality control for repair parts and components for high-tech weapon systems.

Incorporation of the European Business Model and Improving FMS Sales

European LCS competitors remain viable in a highly concentrated market that has fewer sales opportunities than their U.S. counterparts. Highly skilled employees provide production flexibility that enables these firms to withstand gaps in product line sustainment. European firms typically require a smaller manufacturing facility footprint, and operate with a minimal sustainment rate mindset. U.S. firms may be required to adopt some of these European business practices in order to remain viable within the LCS industry. Promotion of FMS and the general relaxation of import/export legislation such as ITAR will also make U.S. CV firms more competitive within the global market. If these restrictions were changed and U.S. firms had more opportunity to sell internationally, this could incentivize our DIB partners to incorporate European technology and adopt similar business practices into their production and manufacturing approach.

Appendix A: Acronyms

AAV	Amphibious Assault Vehicle
ABCT	Armored Brigade Combat Team
ACE	Armored Combat Earthmover
ACV	Amphibious Combat Vehicle
AECA	Arms Export Control ACT
AMG	American Motors General
AMPV	Armored Multi-Purpose Vehicle
ANAD	Anniston Army Depot
AWCF	Army Working Capital Fund
BAE	British Aerospace Engineering Systems
BCA	Budget Control Act
BBP	Better Buying Power
BFV	Bradley Fighting Vehicle (M2A3, M3A3)
BRAC	Base Realignment and Closure
COCO	Contractor Owned Contractor Operated
COCOM	Combatant Commander
CONUS	Continental United States
CV	Combat Vehicle
DCAA	Defense Contract Audit Agency
DCMA	Defense Contracting Management Agency
DCS	Direct Commercial Sales
DIB	Defense Industrial Base
DLA	Defense Logistics Agency
DLH	Direct Labor Hour
DoD	Department of Defense
DoJ	Department of Justice
DVH	Double V-Hull
EU	European Union
EDA	European Defense Agency
EMD	Engineering Manufacturing Development
FAR	Federal Acquisition Regulations
FCS	Future Combat System
FMS	Foreign Military Sales
FMTV	Family of Medium Tactical Vehicles
FY	Fiscal Year
FYDP	Future Years Defense Program
GCS	Ground Combat Systems
GCV	Ground Combat Vehicle
GDLS	General Dynamics Land Systems
GOCO	Government Owned Contractor Operated
GOGO	Government Owned Government Operated
GMV	Ground Mobility Vehicle
HEMTT	Heavy Expanded Mobility Tactical Truck
HET	Heavy Equipment Transporter
HMMWV	High Mobility Multipurpose Wheeled Vehicle
IB	Industrial Base
IR&D	Independent Research and Development

IFV	Infantry Fighting Vehicle
ITAR	International Trade in Arms Regulation
JLTV	Joint Light Tactical Vehicle
JSMC	Joint Systems Manufacturing Center
KMW	Krause-Maffei-Wegmaan
LAV	Light Armored Vehicles
LCS	Land Combat Systems
LVSR	Logistical Vehicle System Replacement
MBT	Main Battle Tank
MLRS	Multiple Launch Rocket System
MPC	Marine Personnel Carrier
MRAP	Mine Resistant Ambush Protected
M-ATV	MRAP All-Terrain Vehicle
MSR	Minimum Sustainment Rate
MTV	Medium Tactical Vehicle
NAV	Navistar
NATO	North Atlantic Treaty Organization
NSS	National Security Strategy
OEM	Original Equipment Manufacturer
OIB	Organic Industrial Base
O&M	Operations & Maintenance
OSK	Oshkosh Defense
P3	Public-Private Partnership
PB	Presidential Budget
PEO	Program Executive Office
PIM	Paladin Integrated Management
PLS	Palletized Load System
PM	Program Manager
PMO	Program Manager Office
R&D	Research & Development
SLEP	Service Life Extension
S&T	Science and Technology
TACOM	Tank-Automotive & Armaments Command
TDP	Technical Data Package
TRADOC	Army Training and Doctrine Command
TWI	Training With Industry
TWV	Tactical Wheeled Vehicle
ULCV	Ultra-Light Combat Vehicle
ULSD	Ultra-Low Sulfur Diesel
USAF	United States Air Force
USD (AT&L)	Under Secretary for Defense for Acquisition, Technology, and Logistics
USMC	United States Marine Corps
WSARA	Weapon Systems Acquisition Reform

Endnotes

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