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Industry Study**

**Final Report
*Weapons***

Fragility in the United States Weapons Industry



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WEAPONS 2016

ABSTRACT: The Department of Defense is in an era of declining budgets and increased scrutiny of its spending, while experiencing increasing requirements to modernize forces and infrastructure, support ongoing conflicts, and maintain and develop technologically superior forces with the highest state of readiness. These conflicting demands have garnered significant attention from the Executive branch, Congress, uniformed and civilian military leaders, and, as a result of highly publicized debates between them, even the American public. Although there has been substantial focus by both Congress and the defense establishment to reduce waste associated with defense acquisition, little attention has been given to evaluating or ensuring the health of the defense weapons industrial base. To stabilize the existing fragile weapons industrial base, the United States needs a revised approach to the use of Research, Development, Test and Evaluation (RDT&E) funding, focused strategies to improve collaboration between defense and industry laboratories, meaningful revision of export controls and other regulations to support greater opportunities for industry, and continued efforts to improve the acquisition processes within the Department of Defense. Without focused improvement efforts, the United States can expect a reduction in capacity, innovation, and technological advantage within the domestic defense industrial base that will create significant and enduring negative consequences for the warfighter.

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PLACES VISITED

Domestic:

Aberdeen Proving Ground; Aberdeen, Maryland
Allegany Ballistic Laboratory; Rocket Center, West Virginia
Lehigh Defense; Quakertown, Pennsylvania
Naval Surface Warfare Center – Dahlgren Division; Dahlgren, Virginia
Trijicon; Fredericksburg, Virginia
Radford Army Ammunition Plant; Radford, Virginia
FN America; Columbia, South Carolina
Savannah River Site; Aiken, South Carolina
Raytheon Missile Systems; Tucson, Arizona
Taser International; Scottsdale, Arizona
ATK Armaments Systems; Mesa, Arizona
Sturm, Ruger & Company, Inc; Prescott, Arizona
Dillon Aero; Scottsdale, Arizona
Lake City Army Ammunition Plant; Independence, Missouri

International:

IABG; Munich, Germany
Dunarit; Ruse, Bulgaria
Arcus; Layskovets, Bulgaria
Arsenal; Kazanluk, Bulgaria
VMZ; Sopot, Bulgaria
OPTIX; Panagyurishte, Bulgaria
OpticoElectron; Panagyurishte, Bulgaria
Institute of Metal Sciences; Sofia, Bulgaria
Bulgarian Ministry of Defense; Sofia, Bulgaria
TEREM; Sofia, Bulgaria



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INTRODUCTION

A healthy defense industrial base has remained a critical element of U.S. military strategy since its importance was realized during World War II. Although President Eisenhower cautioned against the potential for an unchecked military-industrial complex, the increasing importance and intertwined nature of the Iron Triangle consisting of Congress, the Department of Defense, and the defense industrial base requires a revision of traditional thought regarding these relationships. A revised approach must consider the fiscally constrained nature of current and future budgets, rise of foreign competitors, impact of globalization, and shrinking domestic manufacturing capabilities in order to establish mutually beneficial relationships which continue to create innovative and technologically superior products. For this interdependent relationship to be successful, the U.S. government must be able to purchase reasonably priced weapons while providing sufficient profits to entice companies to participate in the defense weapons industry.

In addition to extensive domestic field studies to evaluate the domestic weapons industry, the Weapons Industry Seminar traveled to both Germany and Bulgaria to gain a greater appreciation for the international market, differences in business practices, and their views of U.S. defense procurement processes. The insights gained during international discussions provided a more comprehensive understanding of the challenges, opportunities, and overall health of the industry. These informed the Seminar's recommendations which are aimed at strengthening the domestic weapons industry.

The Weapons Industry Seminar noted similar challenges and opportunities across the defense weapons industrial base. As such, this paper provides a holistic view of the industry and the recommendations can be applied to nearly all aspects of the industry. In fact, the recommendations provided for research and development, acquisition, and supply chain management could be applied across the entire defense industrial base to strengthen domestic capabilities.



KEY ASSUMPTIONS

This report makes several key assumptions, which are listed below in order to more fully inform the reader and aid in understanding the context and recommendations therein.

- Defense budgets will remain constrained for the foreseeable future, regardless of the controlling political parties in either the Executive or Legislative branches. As mandatory spending continues to consume increasingly larger portions of the annual U.S. budgets, it will be incumbent upon the Defense Department to justify existing funding levels and will be even more difficult to find support for budgetary increases.
- The U.S. will continue to value technological superiority when considering the procurement of new weapon systems.
- The cyclical nature of crisis response, the absence of consistent, multi-year funding for weapons procurement, and increasingly constrained defense budgets necessitate the sale of U.S. weapons to foreign partners and allies as a way to sustain the domestic weapons industry.
- Regardless of financial constraints, the U.S. government, with the support of the majority of the U.S. population, will continue to maintain a military of sufficient strength and modernization to protect the nation and project power abroad.
- Reductions in military force end strength will necessitate increased reliance on allies and partners to address regional security challenges. Utilizing common systems with interoperable sensors, platforms, and weapons enables the U.S. to lead or participate in a wide spectrum of operations without the need to singlehandedly provide all forces or equipment.
- The U.S. will continue to rely heavily on nuclear weapons as a strategic deterrence and will maintain all three methods of nuclear weapon employment (land-, air-, and submarine-launched platforms).



DEFINING THE WEAPONS INDUSTRY

The weapons industry is difficult to define. This difficulty exists, in part, due to the vast number of raw materials, suppliers, manufacturers, and distributors which serve the various markets and sectors in which the industry resides. Additionally, there is a mix of privately held, publicly traded, and state-owned organizations, which develop and/or test products which may have both military and non-military applications. In order to be effectively evaluated by the Weapons Industry Seminar, it was necessary to place bounds on what would be considered as part of the weapons industry. The products that were considered as part of the industry include:

- **Less-than-lethal Weapons:** Includes systems designed to produce an incapacitating effect such as directed energy (including, but not limited to, focused microwaves, lasers, or high-voltage electricity) or non-lethal projectiles.
- **Small Arms:** Includes handguns, rifles, shotguns, grenades and grenade launchers, and crew-served weapons.
- **Munitions:** Includes ballistic projectiles for weapons ranging from small arms to kinetic-effect missiles.
- **Energetics and Propellants:** Includes all types of gunpowder; solid and liquid chemical propellants for systems such as rockets, missiles, and torpedoes; and explosives.
- **Nuclear Weapons:** Includes all weapons which generate an explosive effect as a result of a fission reaction between radioactive isotopes.
- **Sensors and Optics:** While not independently considered weapons, this equipment supports the employment or enhances the accuracy of weapons. For the purposes of this research paper, sensors and optics were included in this study because of information related to export controls on this sector.

The following items were not considered as part of the study of the weapons industry:

- **Aircraft, ships, submarines, tanks, or other mobile manned and unmanned platforms.** Each of these typically serve as a platform for various weapon systems.
- **Cyber:** The weapons industry was bounded with a focus on kinetic or physical effects. Although offensive cyber capabilities exist which may result in a kinetic effect, these capabilities were not evaluated in this study.



LAW AND POLICY

EXPORT CONTROLS

A major challenge that surfaced repeatedly during interactions with industry representatives across sectors was the need for export control reform. Multiple provisions within current law, as well as U.S. management of arms exports, preclude domestic weapons manufacturers from competing in the world market. As Department of Defense spending declines, American firms need to supplement domestic business with overseas sales in order to remain viable. The following changes could help improve domestic suppliers' ability to bid on and win weapons contracts in the expanding international markets, especially in Asia and the Middle East. In turn, this would help ensure continued domestic capacity to serve future Department of Defense requirements.

Congressional Notification Threshold

The first step in large-scale reform of small arms exports is to repeal the overly restrictive one million dollar notification threshold, as currently required by the Security and Fair Enforcement in Arms Trafficking Act of 2004. This lengthy notification process effectively bars American businesses from bidding on foreign contracts, since they are unable to guarantee delivery within the contractually required timeframe. Prior to 2004, the notification threshold was a much more reasonable \$14 million, which aligns with other "major defense equipment"¹ notification levels. Arguably, because most small arms manufacturers use essentially the same technology and have a large base of commercial buyers, they need fewer export controls than other defense-related items. This argument could be used to classify small arms as "defense articles or services,"² which would bump the notification level even higher, to \$50 million, thus further reducing stress on the industry.

International Traffic in Arms Regulations (ITAR) and the United States Munitions List (USML)

The purpose of export control policy is, "...protecting the United States from the security risks associated with technology transfer. Exports are to be encouraged, but some technologies could contribute to an adversary's capability to threaten U.S. national security now or in the future."³ Additionally, and admitted by arms control supporters, "exports of less-sophisticated military equipment, including semiautomatic and automatic weapons, are controlled for altogether different reasons. These small arms are plentiful and should not be considered sensitive technology. Illicit traffic in firearms and small weapons does not threaten a technological edge of the United States."⁴ For this reason, there needs to be a detailed review of the ITAR-controlled USML to ensure only items that represent a true risk to U.S. national security or global stability are included. Other items, like small arms, which could have military utility and are able to be transferred under Category XXI, "Miscellaneous Articles," should be considered for removal. The newly pared-down USML would then serve as the foundation for congressional notification.



The Department of Commerce (DOC) deals with product exports every day and is well-versed, efficient, and effective in their role as gatekeeper for the U.S. Government. Their stated mission is “to create the conditions for economic growth and opportunity.”⁵ Thus their interest is to grow, not stifle, the defense industrial base. The best way to accomplish this mission is to break down barriers of entry to international markets. Once removed from the USML, small arms should fall under the Department’s Commercial Control List. DOC would treat these items like any other sensitive export; and much of the cumbersome paperwork and notifications burden would be removed, therefore easing the export process for domestic small arms suppliers.

An alternate approach to removing small arms from the USML and establishing them as a separate category under DOC control is to put the entire export control staffing process under the umbrella of one agency. This would create economies of scale for the departments involved, while simultaneously producing more expedient timelines for those seeking to export arms and/or accessories. In addition, industry perceives the DOC to be more efficient and less influenced by Congress than the Department of State. This recommendation has already been supported by high-ranking government officials, such as former Secretary of Defense Robert Gates, who argued for such a reorganization in 2010.⁶

Currently, there are mandated timelines related to the export control process that, while appearing reasonable on paper, in practice are rarely met. Therefore, the following export control timeline is proposed:

- 1) 30 days for the Department of Commerce to review and comment on an export license application, and
- 2) 30 days to issue or deny the license after all requirements have been met.

This shortened timeline would result in only two variables, both of which would be under industry control: how long they take to fill out the initial application, and how long they take to answer any questions raised during the initial 30 review period. Additionally, to increase transparency, the Department of Commerce should adopt a single computer-based system that would allow industry to track their applications, access the full Commercial Control List, and view examples of approved export applications and licenses. Such a system would create a single, comprehensive medium for controlled items exports that focuses on approving applications and increasing America’s market share overseas.

Safeguards for Sensitive Technologies

While considering other export-related reforms, it is important for the U.S. to continue to strengthen end-user and technology diffusion monitoring programs. We must recruit and retain U.S. expertise in the field of technology diffusion in order to understand which state and non-state actors have the capability to obtain sensitive weapons technologies and how they might seek to exploit it. Technology diffusion diagnostic tools can provide early indications of who may be motivated to obtain advanced weapons technology, the ways and means to control the diffusion, and to record diffusion patterns or trends that may threaten U.S. national security.

Initiated by President Obama in the fall of 2009, the current export control reform (ECR) initiative seeks to improve the protection of U.S. sensitive defense technologies while providing



fewer restrictions for less sensitive items to encourage exports.⁷ This program should continue to receive the necessary resources to ensure the U.S.'s competitive advantage in defense manufacturing and technology. It will help the United States remain true to commitments of interoperability with allied nations, while reducing opportunities for arms to fall into the hands of adversaries. Weapons technology diffusion will have enduring consequences for U.S. military readiness, research and development, the defense industry, foreign affairs, and defense spending. It is therefore critical that the U.S. continues to push for export control reform, enhance end-use monitoring programs, and obtain the expertise to understand how diffusion occurs in order to develop policies that improve national security, strengthen industry, safeguard the transfer of other technologies, and inform trade and global research efforts.

Treaties

In an increasingly complex world, multilateral treaties are an essential mechanism by which states attempt to regulate each other's behavior. In the past century, there has been a proliferation of such treaties, including the recent Trans-Pacific Partnership (TPP) Treaty signed by the United States and 11 Pacific Rim countries. The TPP has vocal supporters and detractors from across the political spectrum. The left-leaning Atlantic Magazine has criticized the agreement, arguing that "trade agreements, at their heart, create winners and losers, and the TPP will likely create some U.S. manufacturing losers at a time when economists worry that the country is becoming too service-oriented."⁸ While not specifically discussing potential harm to manufacturers in the weapons industry, this argument would very likely hold true for this sector.

One treaty specifically affecting the domestic, as well as global, weapons industry is the United Nations (UN) Arms Trade Treaty (ATT) which aims to regulate "the international trade in conventional weapons - from small arms to battle tanks, combat aircraft and warships - and work to prevent the diversion of arms and ammunition."⁹ The treaty was adopted by the UN General Assembly in 2013, and was signed by the United States later that year. Secretary of State John Kerry said at the signing ceremony, "This treaty will not diminish anyone's freedom. In fact, the treaty recognizes the freedom of both individuals and states to obtain, possess, and use arms for legitimate purposes. Make no mistake, we would never think about supporting a treaty that is inconsistent with the rights of... American citizens, to be able to exercise their guaranteed rights under our constitution."¹⁰

Historically, treaties have largely governed the conduct of war rather than the trades or industries involved in the production of weapons. The ATT seeks to diminish the illicit global weapons trade, but in fulfilling its mission, it necessarily places new regulations on weapons manufacturers. Globalization and its concomitant realities – open borders, increased access to information and technology, ease of transfer, and a global marketplace – has enabled the growth of the illicit weapons trade. Many domestic groups and think tanks have opposed the ATT, not yet ratified by Congress, concerned about how proposed regulations will be enforced or interpreted. Little data exists on its domestic effects in the three years since being signed by Secretary Kerry, but there has been much skepticism. The right-leaning Heritage Foundation said this about the treaty, "All nations require official authorization for the commercial import or export of firearms, but authorization is not required in most cases for the import or export of



items such as gun slings or scopes. The draft paper, however, states that all components ‘specifically and exclusively designed’ for firearms must be authorized by ‘competent national authorities.’ This phrasing implies that nations must ban the trade in components, except when this trade is explicitly authorized. This requirement would impose additional burdens on a currently legal trade, and it raises both Second Amendment and free trade concerns.”¹¹ These provisions of the ATT illustrate why it is important to consider the second- and third-order effects that treaties may have on the health of an industry where American producers already often find themselves at a disadvantage.

INDUSTRY INCENTIVES

Another type of non-materiel solution to the current fragility within the weapons industry is to establish new policies that would incentivize industry to improve their processes or help them increase capability and capacity. This approach would have government and industry share the financial burden of certain mutually-beneficial changes. Taken alone or together, these recommendations would improve the overall health of the domestic weapons industry.

ISO Certification for Supply Chain Security

Supporting existing International Organization for Standardization (ISO) accreditation options could benefit a wide range of suppliers and buyers across the entire U.S. economy. ISO, an internationally recognized authority on industry standards, has already developed a standards series on global supply chain security. ISO 28001 accreditation requires that each organization uses a similar security strategy, updates them regularly, and conducts partner assessments. Unfortunately, there is little perceived benefit for a firm to seek ISO 28001 accreditation. The United States does not currently allow such firms to use expedited entry procedures at U.S. ports of entry.¹² Nor is it easy to objectively measure the return on investment for resources spent on securing the supply chain. However, one study of fourteen companies considered leaders in supply chain security did show significant benefits in a range of areas. Improvements were realized in: product safety, inventory management, supply chain visibility, product handling, processes, customs clearance, resilience, and customer satisfaction. The transportation service providers in the study also reported a 90% reduction in theft and tampering.¹³

Repatriation

Over the past quarter century, the “post-Cold War peace dividend” has significantly diminished the Department of Defense’s buying power. This reduction in domestic demand led many American suppliers to merge with other (sometimes foreign) firms or leave the defense sector completely. Global suppliers have filled the void, resulting in a situation where the DoD must now rely on foreign sources for many of its weapons systems. Where studies find there to be extremely high risk to our weapons systems and/or the domestic weapons industry, the government might consider repatriating certain capabilities. That could take the form of subsidies and incentives for private sector capital investment, or government-owned facilities that are subsequently leased to contractors to operate. This approach should be considered where there are single-source foreign suppliers of critical items, when an adversary controls the vast



majority of global supply, or with extremely long-life systems for which future obsolescence-related challenges are almost guaranteed.

Depot Reform

Title 10 U.S.C. § 2466 requires that at least half of all defense maintenance dollars be allocated to government depots. This requirement reduces performance incentives and should be repealed in order to allow more flexibility, competition, and surge capacity in support of our weapons systems. The current law is too restrictive, and makes it extremely challenging to obtain waivers to the 50% statutory requirement. Changing this section of Title 10 would help incentivize industry to invest in maintenance facilities, equipment, and skills due to the increased availability of government contracts for this purpose. Increased competition from the private sector may also lead government facilities to operate more efficiently.

If Congress is unsuccessful at repealing Title 10 U.S.C. § 2466, then the waiver process should be streamlined and expanded to allow granting of multiple-year waivers, upon approval from the Office of the Secretary of Defense (OSD). Depots are an important part of our overall defense industrial capacity, but they are in need of modernization investments. Continued investment will pay dividends well into the future as new weapons systems are being designed for “organization to depot” (O to D) maintenance. This concept will increase the required throughput capacity of existing depots and demand a more agile, adaptive, and flexible partnership with the private sector to accommodate operational surge requirements. Failure to achieve this could severely degrade our future weapons system readiness across the uniformed Services.



ACQUISITION PROCESS

PRE-AWARD

The recommendations identified below will help the Department of Defense improve the weapons acquisition process, by making it more “industry-friendly” while also improving outcomes for the warfighter. From initial requirements to acquisition strategy to source selection, there is ample room for improvement at almost every step of the way. These specific recommendations seek to make the pre-award portion of defense contracting more efficient and effective, while providing better value for the American taxpayer.

Increased Use of Commercial Off-the-Shelf (COTS)

While many defense-related requirements are unique to that sector, there are others that have significant overlap with the commercial market. The Army’s modular handgun system (MHS) is an example of the latter. Although the MHS requirements were Joint Requirements Oversight Council (JROC) approved, they should be adjusted to match the commercial market and practices. Special interests tend to support the need for unique design features – a symptom of traditional DoD reluctance to accept that purely commercial designs and features may actually meet, or exceed, mission requirements. Admittedly, the DoD performs a one-of-a-kind mission requiring innovative and cutting-edge technologies, but the MHS is not a fifth-generation fighter aircraft. The MHS acquisition strategy demonstrates how the current requirements generation process, even when followed, risks not addressing the true needs of the warfighter.

The handgun is a commercially available item that has been produced in the tens of millions of units. They come in a variety of styles, calibers, colors, attachments, and performance results. Ammunition, which is arguably just as, if not more, important than the handgun itself, is available in a plethora of choices. The Army’s reluctance to consider the MHS as a commercial purchase or specify an existing, interoperable caliber well-suited to military missions continues to prompt debate both inside and outside the DoD. A commerciality determination would save the Army acquisition schedule, critical funding, development costs, testing time, and performance risks by choosing one or more handgun(s) already available to the public. More importantly, it would save precious taxpayer dollars and significantly reduce the cost for firms to compete for the contract, therefore increasing competition. The MHS acquisition has been controversial since its inception and it is unlikely to be awarded or fielded in its current state. This illustrates why, when available, commercially available solutions should be given strong consideration.

Earlier Industry Input

The current Joint Capabilities Integration and Development System (JCIDS) process, which should be responsive to both the U.S. government’s strategic and tactical objectives, does not actively seek out or account for input from industry. Unless an unsolicited request for proposal prompts acquisition attention, it generally isn’t until after an analysis of alternatives has been completed and a material decision determination is made that industry is granted any



transparency into the DoD's needs. Once the process reaches this stage, industry involvement is reactive vice proactive, and it becomes more costly – requiring proposal teams to work requests for information and deploying personnel to industry days. While major defense contractors keep established teams for these purposes, vectoring their efforts to monopsony buyers like the DoD becomes a high-risk endeavor with less attractive payoffs than those available in the commercial sector. DoD's reluctance to consider on-going industry research and development efforts and available capabilities earlier in the process inadvertently and unnecessarily limits the analysis of alternatives (AoA). That analysis can't consider options of which DoD is not yet aware. Involving industry earlier in the JCIDS process, before the AoA, would allow DoD to better capitalize on industry's on-going independent research and development (IRAD) initiatives, provide a more complete range of alternatives for the government to consider, and possibly uncover cost-saving COTS solutions.

Source Selection Criteria

Both the globalization of our supply chain and the proliferation of threats from near-peer states and non-state actors alike require a new approach to supply chain security. In defense procurement, we need to recognize and assess the total risk to our weapons systems. As part of our risk mitigation, the Department of Defense, and other members of the national security apparatus, should incorporate a more deliberate supply chain risk assessment into their acquisition processes. Each weapon and weapons systems will have a distinct risk profile based on its intrinsic vulnerabilities, who might want to attack it, with what means, and the potential harm such an attack might cause. For high-risk programs, supply chain risk could be considered during source selection, forcing companies to view supply chain security as a competitive advantage worth investing in. Acquisition strategies could be tailored to different tiers of risk profiles, with funding to “redesign areas that are most vulnerable while low-risk areas can take advantage of substitutions, emulation, and possibly refurbished parts,”¹⁴ as a cost-saving measure. These risk-based decisions should also impact future sustainment activities and budgets, and aid in planning for potential obsolescence that could introduce future supply chain risk to the program.

POST-AWARD

Just as with the pre-award recommendations above, there is room for improvement even after requirements are validated, the acquisition strategy is set, and a contractor/supplier has been selected. The items below seek to reduce unnecessary financial burdens on industry, minimize risk, and reduce schedule slippage.

Streamlined Cross-Service Testing

As industry attests, one of the most costly elements of the Defense Acquisition System (DAS) is testing: range time, assets, documentation, personnel, and equipment.¹⁵ To positively impact the overall cost of a program, restructuring test requirements will offer significant savings. Combining test events and procedures, effective use of simulations to predict test outcomes, and reductions in the amount and duration of testing will save the program cost and



schedule and not necessarily at the expense of increased risk. Industry conducts a host of different tests during their development of weapons and weapons systems. An example of where streamlined testing would be appropriate is the MHS. Approximately 20 million guns were sold commercially in the United States in 2015. The sheer size of this market demonstrates the ability of the small arms industry to produce effective weapons. If that were not the case, market forces would push under-performing companies out of business. The two year testing requirement imposed on the MHS exposes the Army's lack of foresight and adds unnecessary testing expenses that serve as a disincentive for companies looking to compete.

Consistent with Department of Defense Instruction (DoDI) 5000.02, DoD should more aggressively pursue opportunities to modify test evaluation master plan requirements and to reduce the number and duration of developmental and operational test events. These modifications are especially appropriate when purchasing commercial items that have already undergone extensive commercial test procedures, such as the MHS. On more complex, non-COTS, acquisitions, DoD should rely more on modeling and simulation in lieu of traditional testing when practical, for rehearsal and outcome predictability, thereby limiting the number of actual test events necessary for validation. While these recommendations are consistent with DoDI 5000.02, enacting them will require a deliberate effort to influence the interpretation and implementation of the instruction.¹⁶

Reduce the Reporting Burden

As industry continues to suffer from both growing costs and fewer contract awards, opportunities to alleviate expensive reporting burdens should be made available. Detailed cost reporting requirements in the Federal Acquisition Regulation (FAR) force companies to invest heavily in specialized accounting systems before they can participate in government acquisition.¹⁷ Reporting detailed cost data and complying with post-award reporting requirements necessitate certified cost accounting (or earned value management) systems that many companies don't require for their commercial business. In some cases, the size of the company and cash flow challenges limit their ability to invest in something without a guaranteed (or at least likely) payoff. For these companies, the decision to make these capital investments must be made before they can even bid for certain government contracts. These systems take time to procure and implement, and personnel responsible for their integration and execution need to be trained. To alleviate some of these burdens, the government should accept the use of COTS accounting solutions. In addition, acquisition strategies should seek fixed price contracts that avoid unnecessary development costs and reporting requirements to be borne by industry.

Level Out Purchases Across Multiple Years

Multi-year procurement (MYP) contracts have been one way the DoD has realized cost savings on major weapon system acquisitions. MYP contracts require, among other things: a mature design and a stable requirement.¹⁸ As the DoD makes progress toward its auditability goal, their improved (and still improving) systems should allow them to more accurately account for inventories and to observe historical purchase patterns. This, in turn, will make forecasting a



reasonable demand for certain inventory items more achievable. As the government's ability to properly forecast need improves, MYP contracts should be considered for recurring requirements like ammunition, handguns, and hellfire missiles. While it may never be realistic to predict five years' worth of inventory with 100% reliability, purchase trends should allow the government to reasonably estimate annual need. MYP contracts offer the contractor opportunities to negotiate long lead items and other material input earlier and at more advantageous prices and quantities, and to forecast production runs (machining, tooling, staffing) in a more proactive manner. The predictability of a MYP contract allows industry to better plan personnel and training needs, and avoids sudden surge orders from overwhelming contractors' capacity. All of these benefits help companies control costs, which eventually result in savings for DoD as well.



RESEARCH AND DEVELOPMENT

The United States spent a staggering \$137 billion on research and development in 2015 and is poised to surpass \$145 billion in 2016.¹⁹ These figures represent some of the largest annual investments in our nation's history, second only to 2009 and 2010 in which the American Recovery and Reinvestment Act of 2009 injected additional funding to aid in economic recovery. Of these vast annual investments, research and development (R&D) spending on national defense has comprised more than half of all annual federal R&D spending in all but three years since 1955 – 1966, 1978, and 1979. In those three years, national defense R&D spending was only slightly less than half (49.2%, 49.7%, and 48.9%, respectively) of the national R&D budget.²⁰

The need for national research and development is clear – it provides critical technological advances to the defense, health, economic, energy, agricultural, education, and transportation sectors. These technologies not only increase the standard of living for American citizens, they spur the economic engine through intellectual property rights and the resulting international trade. Additionally, R&D is critical to maintaining the domestic weapons industry which, without innovation, will become stagnant and lose international market share to those able to create newer and more effective weapons systems. However, the opportunities that arise from R&D efforts come at a cost to the American taxpayer in the form of increased taxes or national debt. Additionally, without an increase in the annual deficit, increases in R&D spending must be paid for by reducing funds for other efforts. At some point, the government must place a limit on the seemingly infinite potential R&D efforts. It is within these bounds that the national defense R&D efforts must become more efficient and streamlined in order to maximize these scarce resources.

Streamline the Management of DoD Laboratories

Since 1990, multiple efforts have been made to streamline the Defense Laboratory Enterprise.²¹ The most enduring of the efforts is the Tri-Service Science and Technology (S&T) Reliance, or Project Reliance, which began in December 1990 as a result of Secretary of Defense (SECDEF) Cheney appointing a special group to investigate options for consolidating DoD functions.²² This effort resulted in the Air Force consolidating 14 laboratories into four in 1991 and a consolidated Army Research Lab headquarters being established in Maryland in 1992.²³ Project Reliance has since been renamed Reliance 21, and still works to align S&T efforts within DoD to make the most out of critical S&T resources. Led by an S&T Executive Committee (ExCom), Reliance 21 provides oversight and guidance to the DoD S&T workforce through the management of 17 distinct Communities of Interest (COI) which apply to more than one Service or agency.²⁴

While the goal is to enable the ExCom to provide oversight of each COI, the end result is that services still have control over their labs and the funding associated with them. Additionally, there are several service-specific programs that fall outside of the 17 COIs and, as such, are also outside the purview of the ExCom.²⁵ Further complicating the management of R&D efforts



within the defense research enterprise is the fact that each service has a different model for how its laboratories are organized and managed.

Centralize Control of the Defense Research Enterprise

The most important decision the DoD can make regarding the defense research enterprise is the consolidation of the management, governance, funding, and operation of the laboratories under a single office under the direct purview of the SECDEF. Centralized control will provide the requisite oversight to eliminate redundancies between laboratories. As part of this reorganization, the DoD must establish a strategy-driven S&T process which will set priorities and allocate funds. These priorities must take into consideration the critical capabilities desired by the Combatant Commanders via the Joint Staff, and be validated by OSD, similar to how the Joint Capabilities Integration Development System (JCIDS) process is used to evaluate defense acquisition requirements. These critical capabilities should then be aligned with service strategies, which will ensure continuity of requirements from development through acquisition.

Consolidate Facilities/Minimize GOCO Arrangements

Several studies have suggested the conversion of DoD laboratories into government-owned, contractor operated (GOCO) facilities in order to cut costs associated with maintaining them.²⁶ However, it is important to remember that the capabilities of defense laboratories must remain free of commercial pressures which may influence procurement decisions. By allowing a contractor to operate the lab, they would be privy to new technologies and be better positioned to influence decisions regarding further development or even procurement. As such, the continued maintenance of government-owned, government-operated facilities is a must, but consolidation actions must be taken.

Modernize Facilities after Laboratory Consolidation

The existing research enterprise is highly distributed and aging, with many laboratories in desperate need of modernization. By taking the Reliance 21 COI efforts further, service laboratories must be allocated based on functional areas such as land, electronic, maritime, and aviation, based on existing core competencies of the laboratory. While a consolidation of the research enterprise will entail reductions in both personnel and facilities, the restructuring effort must remain focused on increasing the effectiveness of the enterprise rather than potential cost savings. Even though effectiveness, not cost savings, is the driver for consolidation, a smaller research enterprise will cut maintenance costs and decrease security vulnerabilities while creating a smarter and more agile research enterprise.²⁷ Security concerns must be part of this discussion, especially in the case of nuclear weapons-related research.

Increase Alignment of DoD RDT&E and Industry IRAD Efforts and Funding

For the DoD to remain competitive through technological superiority, it must make smarter decisions on how it utilizes its existing R&D funding. In the current and future fiscally



constrained environments, it is unlikely R&D funding will continue to increase and will require DoD to find ways to make the most of current funding levels. As a monopsony buyer, the DoD must make clear decisions about what technologies it wants to develop and provide the necessary incentive for industry to partner with defense laboratories to further develop, test, and manufacture them.

Recognize Areas of Industry Superiority

A first step in effective use of R&D resources is to capitalize on commercial technologies that are already more advanced than existing military research. This will require DoD to be proactive in reaching out to industry and discussing technologies that will be critical to future defense capabilities. Once the research enterprise governance is centralized, the Office of the Secretary of Defense (OSD) will be much better positioned to provide in-depth access to key weapon requirements. This insight will be key to the weapons industrial base being able to focus S&T and IRAD spending to address the requirements in which OSD is most interested rather than having to make assumptions about desired technologies. In conjunction with this effort, DoD must use a strategy-driven S&T process to establish priorities for research funding allocation.

Capitalize on Existing Technologies

To maximize the use of development funding, OSD must solicit industry participation in rapid prototype experimentation. This approach would further develop those technologies that have completed basic (6.1 and 6.2) research in the defense laboratories but have been shelved due to a lack of applied (6.3 and 6.4) research funding to demonstrate functionality. Accepting risk in intellectual property rights in order to partner with industry will accelerate the creation of the prototypes necessary to validate the technology. By fast-tracking the relaxation of intellectual property right requirements, the DoD will enable the weapons industry to capitalize on their Science and Technology (S&T) and IRAD investments by developing alternative uses for new technologies.

Exploit Dual-Use Technologies

Military planners have myriad options to choose from when selecting next generation technologies. By selecting and funding those technologies which may also provide useful civilian applications, such as energy efficiency improvements, power generation and storage, and electronics, DoD can entice companies that do not normally work with the military to collaborate on solving technological problems.

Incentivize Industry

Increased engagement would improve our ability to identify opportunities for industry to partner early with federally funded research and development centers (FFRDCs). Congress could provide tax incentives to lower the risk for industry involvement in desired programs. An



additional avenue to generate industry interest would be to guarantee follow-on participation (traditional contracts for applied development and production) for fielding the technology.



TARGETED IMPROVEMENTS

The weapons industry involves myriad considerations which can be individually assessed to find ways to improve the stability of the industry. While not possible to examine every aspect of the industry, this paper addresses some of the more significant problems that were commonly repeated during visits to both domestic and international industry partners and proposes corrective measures.

Rare Earth Elements

Rare earth elements have become a critical concern for the weapons industrial base because they are used in the production of goods that are important for national security.²⁸ Although the U.S. was the leader in global production of rare earth elements from the 1960s through the 1980s, increasing labor costs and strict environmental policies have left the U.S. with zero current capacity.²⁹ Exacerbating the lack of domestic capacity is the fact that China now controls 99% of the world's supply of rare earth elements (REE) which are characterized as critical materials.³⁰ Foreign control of these materials exposes the U.S. to vulnerability in the weapons industry as well as leading to abnormally high influence of these countries. For weapons producers that rely on REE raw materials, losing access to the supply could completely halt production.

Codify the Critical Rare Earth Elements List

Complicating the management of these materials are the varied interpretations of what exactly qualifies as a critical material. For example, there are concerns about materials such as platinum, tellurium and other rare earth minerals because they are essential to the manufacture of products in key high-growth sectors, including defense, clean energy, electronics, etc.³¹ However, DoD has refused to list these critical materials by name, as evidenced by its inability to meet Congress' 2011 direction to identify which rare earth elements are critical to national security. Agreeing on which materials belong on this list has been problematic.³²

The Strategic Materials Protection Board (SMPB) must designate which, if any, rare earth elements are critical to national security in order to provide a standardized understanding of these materials within the U.S. government, particularly within the DoD. Once designated, the SMPB must analyze the impact to national security if the supply of these materials is interrupted, and develop a plan to ensure a secure supply is maintained.³³

Re-establish Rare Earth Capabilities within the United States

The U.S. government must invest in a refinement facility in the continental U.S. which is capable of mining and refining rare earth elements. This facility does not need to remain in continuous operation, but must be capable of being activated on short notice if global supplies become limited. Once established, this facility should be used to increase existing stockpiles of critical materials in conjunction with purchases from the global market. Once stockpiles are of sufficient quantity, the facility can be placed in an inactive status.



Invest in Allied Rare Earth Extraction and Refining Capabilities

Supporting the growth of rare earth element extraction in allied nations provides an additional hedge against a monopolistic and adversarial foreign supplier. Both Australia and Canada extract rare earth elements, but at very low volumes.³⁴ Through capital investment in the extraction operations in these countries, the increased capacity could provide the necessary supply of materials until a U.S. extraction capability can be brought online.

Standardizing Weapon Energetics

The U.S. defense weapons industrial base which manufactures precision guided munitions (PGMs) has historically been unable to keep up with war time demand for air-launched PGMs. At this time, government-owned, contractor-operated (GOCO) Holston Army Ammunition Plant (HAAP) is the single source producer of energetics used in U.S. military PGMs, such as the multi-Service Joint Direct Attack Munition (JDAM). In addition to HAAP being the sole supplier of Insensitive Munitions Explosives (IMX) energetic material, the Navy and Air Force currently use a different energetic fill in each service's munitions. Additionally, the cyclical nature of procurement for these munitions creates significant problems for suppliers to provide the needed materials during surges after years of low or no procurement. Although the industrial base is not optimized to handle surge demand during unplanned air power intensive conflict, there are several actions which can be taken by both the weapons industry and DoD to ensure warfighter requirements can be met.

Establish a Common Explosive Fill for All Services

Utilizing a common explosive fill across the board for all military branches will lead to more efficiencies in procurement and production while also providing enhanced munitions capability.³⁵ Consolidation of multiple service requirements and the ability to produce a single bulk energetic would benefit the military industrial base greatly by increasing economies of scale. The next generation insensitive explosive fill, AI-IMX-101 has been tentatively agreed to by all Services and Office of the Secretary of Defense (OSD)³⁶, but budgeting, testing and production timelines must be increased to accelerate fielding of the new fill.

Stabilize Munitions Procurement

The DOD is currently using Overseas Contingency Operations (OCO) funding to procure munitions expended in combat which is not budgeted for in the Program Objective Memorandum (POM) and only provides one-year funding with zero ability to forecast. The DoD needs to provide a strategic forecast to industry, with a focus on decreasing the current replenishment timeline. To aid in this effort, the U.S. should share forecasting methods with allies and partners and encourage them to forecast PGM requirements in order to provide industry with a more stable procurement demand.



Standardize Testing Requirements for Formula Changes

Whether driven by the desires of the end user or the availability of materials, changes in the chemical composition of energetics requires significant time and funding to certify them for use in U.S. munitions. DoD should consider the safety and feasibility of an alternate approach to retesting every weapons system when new formulations are developed. One alternative is to test the new formulation to verify like characteristics to the previously approved formulation. Once verified, provide broad approval for use of the new formulation and eliminate the requirement for individual programs to retest. The cost of this common testing could be equally shared between the explosive manufacturer and the program. The Cartridge/Propellant Actuated Device (CAD/PAD) industry expressed a similar recommendation to the Department of Commerce as a method to improve alternate product sourcing by reducing the length and cost of product qualification.³⁷

Create and Maintain an Overseas Contingency Stockpile

The probability of U.S. support to unknown contingency operations in the volatile, unknown, complex, and ambiguous global environment America faces today is high. An overseas contingency PGM stockpile would provide a buffer for surges in expenditure rates, help to even out the frequency of erratic DoD munitions spending, mitigate Combatant Command (COCOM) risk, and reduce logistical requirements to support wartime munitions needs. The stockpile could also have the added benefit of allowing more time for U.S. munitions suppliers to increase production in times of unforeseen conflict.³⁸ The lack of an established overseas stockpile to buffer contingency events also affects current readiness, since munitions originally allocated for training, testing, and evaluation are routinely moved into the crisis Area of Responsibility (AOR). An overseas munitions stockpile would hedge against the reallocation of needed test and training munitions for contingency operations.

Repair Part Standardization

As part of DoD's efforts to reduce costs, it continuously looks for suppliers to provide replacement parts at the lowest possible cost. These efforts have created a significant number of after-market parts manufacturers and suppliers who offer parts at a lower cost than what may be offered by the Original Equipment Manufacturer (OEM). The opaque and lengthy supply chain responsible for delivering these after-market parts makes it difficult to verify the adherence of the parts to OEM drawings and standards. The result is that some parts may not meet OEM specifications and, as a result, cause the weapon to malfunction. These malfunctions present a significant risk to the warfighter and also damage the reputation of the weapon supplier, since most malfunctions are accredited to the weapon instead of the faulty repair parts. To minimize these events from occurring, the Defense Department should limit the number of non-OEM repair parts allowed into the supply chain by ensuring strict quality assurance standards are maintained for all parts, and that non-OEM parts are clearly labeled as such. Clear labeling will serve to inform the warfighter and supply chain, thereby enabling manufacturer feedback and protection of OEM reputation.



NUCLEAR ENTERPRISE IMPROVEMENTS

As China expands to join Russia in attaining near-peer conventional forces that erode U.S. military advantages, it has forced the U.S. to focus on its strategic nuclear arsenal to maintain an adequate deterrent. However, the current arsenal is slowly eroding because of internal constraints in addition to those written into the nuclear Non-Proliferation Treaty (NPT). Current modernization efforts of the nuclear triad, consisting of air-, land-, and sea-based assets, focus on the delivery system and do not propose updating the nuclear device itself. Tritium production, which is critical to maintaining the boosted nuclear weapons stockpile, is becoming a concern. The U.S. now relies on the use of a single nuclear plant to irradiate Tritium-Producing Burnable Absorber Rods (TPBARs) to supplement the tritium recovered from deactivated nuclear weapons in order to resupply the remaining nuclear weapon stockpile. By addressing the atrophying infrastructure which supports the nuclear enterprise, the U.S. will be better positioned to maintain its nuclear advantage against China, Russia, and others who may threaten the United States or its allies.

Improve Existing Nuclear Infrastructure

Plutonium is managed in only one location, Los Alamos National Laboratory (LANL), which includes the surveillance, storage, and processing of this material. LANL is an aged facility which requires upgrades to meet safety requirements to continue processing for weapons maintenance.³⁹ In 2014 the National Nuclear Security Administration (NNSA) developed a strategy to fund infrastructure upgrades and construction while repurposing facilities for research.

As the number of nuclear weapons being deactivated continues to dwindle, the amount of tritium able to be recycled from these weapons, coupled with existing tritium production capabilities, will be insufficient to meet the 2800-gram annual requirement.⁴⁰ The Savannah River Site (SRS), a GOCO facility which is the sole supplier of tritium for the U.S. nuclear arsenal, is working with the Tennessee Valley Authority (TVA) to expand TPBAR use in more reactors in an effort to increase tritium production.⁴¹ While this approach may meet some of the demand, it places complete reliance on the availability of a single power plant for production of tritium.

Although the NNSA recognized the need for improvements to some of the existing nuclear infrastructure, the plan will not begin work until fiscal year 2019, which does not provide the requisite level of urgency needed to improve these facilities.⁴² Improvement projects must be started as soon as possible and the breadth of the improvements should be expanded to include the entire nuclear enterprise.

Re-Establish Government Tritium Production

The SRS previously possessed the ability to generate tritium via an on-site reactor which has been deactivated. To reduce reliance on the TVA reactors, only possible because they are state-owned, and meet the future annual tritium production demand, the U.S. should re-activate



the reactor at SRS. Alternately, R&D funds could be apportioned to research the possibility of a replacement for tritium to boost the yield of U.S. nuclear weapons. Identifying a replacement substance, with a half-life significantly longer than tritium, would reduce the need to constant replenishment and reduce the reliance on the TVA for tritium production.

Develop New Uses for Nuclear Material

The U.S. should re-consider the potential uses for nuclear weapons and limited testing of new nuclear designs. While controversial on both the domestic and international fronts, this change in mindset will have the advantage of placing increased reliance on the nuclear enterprise as well as sending a strong signal to would-be aggressors of our resolve to use nuclear weapons if necessary. The development of new Special Atomic Demolition Munitions (SADM)s, which were employed during the Cold War, but eliminated from the U.S. inventory in the late 1980s, would send a compelling message to Russia and other adversaries, about the U.S.'s willingness to respond.



CONCLUSION

Recognizing the vast array of organizations, processes, stakeholders, and materiel that comprise the domestic weapons industry, it is impossible to address the full range of issues, even with the robust list of recommendations contained in this report. Improving the health of the industry will take dedicated efforts across both the public and private sectors. But more importantly, it will take time. The approach here was not to “cure all the ills” but to identify a number of actions that, taken individually or together, would incrementally move the domestic weapons industry toward a more stable, viable, and profitable future.

The United States is not alone in addressing many of these challenges. Interactions with foreign counterparts uncovered a number of similar challenges in other markets: shrinking defense budgets, a lack of technical expertise, and aging facilities in need of modernization. As we enter an era of increasingly interdependent defense activities, the U.S and our allies need to maximize the efficiency and effectiveness of each nation’s military-industrial complex in order to maintain global stability and support our shared national security goals.

The Weapons Industry Seminar makes the recommendations contained in this report in an attempt to streamline processes, incentivize private investment, save taxpayer dollars, and deliver superior capabilities to our warfighters. This requires robust research and development, competition in the global market, and a smarter approach to defense acquisition. Ultimately, these improvements will help maintain the United States’ position as a technologically superior and global military power.



RECOMMENDATIONS

The following list of recommendations summarizes the body of this paper. They are listed according to which entity within the Iron Triangle has the responsibility to implement each of them. An asterisk (*) indicates shared responsibility among more than one entity. More details about each can be found by referring to the appropriate sections above.

DEPARTMENT OF DEFENSE

- Increase the use of commercial off-the-shelf (COTS) solutions where possible
- Seek industry input on requirements prior to the Analysis of Alternatives
- Use supply chain security as one of the source selection criteria
- Streamline testing requirements where solutions are COTS or shared across Services
- Reduce post-award accounting reporting burden through the use of COTS systems
- Level out multi-year procurement to maintain capacity and reduce costs *
- Centralize control of the defense research enterprise
- Consolidate facilities/minimize GOCO arrangements
- Modernize and consolidate laboratory facilities
- Recognize areas of industry superiority
- Capitalize on existing military and civilian (dual-use) technologies
- Incentivize industry to work with FFRDCs *
- Codify the critical rare earth elements (REE) list
- Incentivize the establishment of REE capabilities within the U.S.
- Establish a set of common explosive fills for all Services
- Stabilize munitions procurement *
- Standardize testing requirements for energetics formula changes
- Create and maintain an overseas contingency stockpile *
- Limit supplies of non-OEM parts *
- Improve existing nuclear weapons enterprise infrastructure *
- Re-establish government tritium production *
- Develop new uses for nuclear material *

CONGRESS

- Repeal the \$1 million Congressional Notification threshold for arms exports
- Consolidate responsibility for all defense and national security-related items under the Department of Commerce
- Ensure treaties do not infringe on U.S. Constitutionally protected rights
- Provide incentives for items imported via ISO 28001 accredited companies *
- Incentivize industry to invest in the repatriation of critical capabilities *
- Repeal Title 10 U.S.C. § 2466 to provide increased flexibility in depot maintenance
- Re-establish REE capabilities within the U.S. *
- Incentivize investment in Allied REE extraction and refining capabilities *



- Stabilize multi-year procurement funding *
- Improve existing nuclear weapons enterprise infrastructure *
- Re-establish government tritium production *
- Fund development of new uses for nuclear material *

INDUSTRY

- Invest as required to obtain ISO 28001 accreditation in supply chain security
- Invest in the repatriation of critical capabilities *
- Exploit existing civilian technologies to fill military requirements *
- Invest in and partner on REE capabilities in Allies nations *
- Clear, traceable labeling of repair parts to facilitate OEM specification verification



LIST OF ACRONYMS

AoA	Analysis of Alternatives
AOR	Area of Responsibility
ATT	Arms Trade Treaty
CAD	Cartridge Actuated Device
COCOM	Combatant Command
COI	Community of Interest
COTS	Commercial Off-the-Shelf
DAS	Defense Acquisition System
DOC	Department of Commerce
DoD	Department of Defense
ECR	Export Control Reform
ExCom	Executive Committee
FAR	Federal Acquisition Regulations
FFRDC	Federally Funded Research and Development Center
GOCO	Government-Owned, Contractor-Operated
HAAP	Holston Army Ammunition Plant
IMX	Insensitive Munitions Explosives
IRAD	Independent Research and Development
ISO	International Organization for Standardization
ITAR	International Traffic in Arms Regulations
JCIDS	Joint Capabilities Integration and Development System
JIMTP	Joint Insensitive Munitions Technology Program
JROC	Joint Requirements Oversight Council
LANL	Los Alamos National Laboratory
MHS	Modular Handgun System
MYP	Multi-Year Procurement
NNSA	National Nuclear Security Administration
NPT	Non-Proliferation Treaty
OCO	Overseas Contingency Operations
OEM	Original Equipment Manufacturer
OSD	Office of the Secretary of Defense
PAD	Propellant Actuated Device
PGM	Precision Guided Munition
POM	Program Objective Memorandum
R&D	Research and Development
RDT&E	Research, Development, Testing and Evaluation
REE	Rare Earth Elements
S&T	Science and Technology
SECDEF	Secretary of Defense
SMPB	Strategic Materials Protection Board
SRS	Savannah River Site
TPBARs	Tritium-Producing Burnable Absorber Rods
TPP	Trans-Pacific Partnership



TVA
USML

Tennessee Valley Authority
United States Munitions List



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