

# AY 2022-2023 Industry Study

## Industry Report *Land Domain Platforms*

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## Executive Summary

Opportunities exist to boost innovation in the Land Domain Platforms (LDP) industry, which consists of markets for combat tracked maneuver/fires vehicles, wheeled sustainment vehicles, and medium/heavy vehicles. The end of the wars in Afghanistan and Iraq brought about a downturn in the industry as occurred during the post-Cold War era. However, due to a combination of factors that include rapid technological change, the U.S. strategic competition with China, and the Russo-Ukrainian War, the domestic and international context are in alignment to enact policies that will have long-term, positive effects on the LDP industry. Congress and DoD must work together to set conditions that foster innovation across the LDP industry to improve the production of systems necessary to dominate land domain threats out to 2040 and beyond.

The seminar identified three main areas requiring action to make the industry more responsive and innovative. These areas include creating consistent demand and flattening the lumpiness of the demand cycle, increasing innovation fed by a wide and diverse small business ecosystem, and increasing competition within the industry. Five policy recommendations will enable these ends. First, Congress and the DoD should initiate Security Cooperation program reforms to increase and stabilize the demand signal to the LDP industry. Second, Congress should expand multiyear procurement authorities for critical LDP and components, as multiyear authorities would provide more stability and predictability in demand, enable firms to purchase supplies in greater quantities at lower prices, and encourage capital investment to respond to demand. Third, Congress should provide DoD expanded reprogramming flexibilities to support the development and fielding of innovative and critical LDP. In addition, Congress should raise DoD authorities to reprogram funds in the year of execution and provide the MILDEPs the

authority to set up an innovation fund – with its aim to transition key innovative technologies from prototyping to further development and large-scale fielding. Fourth, Congress and DoD should harness the creativity and innovative power of small businesses through Small Business Innovation Research reform. Finally, Congress should reinvigorate antitrust enforcement with regard to mergers and acquisitions within the LDP industry to shield growing businesses from the anticompetitive conduct of large firms, promote industry competition, and support innovation. Protecting growing businesses from the large defense firms that prefer to buy them instead of competing with them is important to a healthy, vibrant LDP industry.

The 2022 National Security Strategy shrewdly observes that the United States is entering a decisive decade that will shape the future of the rules-based international order. Ultimately, these policy suggestions will make the most of this opportunity by energizing the LDP industry to ensure the United States is ready, along with its allies and partners, to dominate in the land domain against any adversary, in any theater, out to 2040 and beyond.

## **Introduction**

Despite the growing influence of cyber intrusions, space capabilities, air lethality, and maritime assets on global conflicts, Land Domain Platforms (LDP) remain essential to joint warfare. With the enduring need to exert control over the land domain and maintain logistical support, LDP are critical to deter adversaries and, if necessary, to prevail in combat. However, in an industry confronted with complex pressures and dilemmas, the DoD and Congress must make trade-offs to stimulate LDP industry innovation and maintain a technological edge in the context of dynamic strategic priorities, adversaries, and environments.

In 2023, the U.S. LDP industry, which produces and services combat tracked maneuver/fires vehicles, wheeled sustainment vehicles, and medium/heavy vehicles markets, has potential for a period of growth due to heightened geopolitical tensions and concomitant increased spending by the United States and its allies and partners. However, prior to this period, the industry experienced a significant decline that negatively affected both innovation and experienced labor. Moreover, the LDP industry is forecasting marginal near-term growth, due in part to a rising budget deficit and stagnating labor pool, that will negatively impact the advancement of future LDP. Research conducted by the LDP Industry Study Seminar of 2023 identified ways for the U.S. government to foster innovation across the industry to improve the production of systems capable of dominating against any adversary.<sup>1</sup> The team conducted research, financial analysis, and in-person interviews of the various United States, Chinese, Russian, and selected North Atlantic Treaty Organization (NATO)-partner firms to understand current industry practices related to the development, production, fielding, and sustainment of LDP. To conduct an impartial analysis of industry challenges and opportunities, the team members applied a variety of tools and frameworks such as strengths, weaknesses, opportunities,

and threats (SWOT) analysis,<sup>2</sup> Porter's Five Forces industry analysis model,<sup>3</sup> and the Structure, Conduct, and Performance (SCP) firm analysis model.<sup>4</sup>

The seminar also identified common industry trends that will affect the LDP industry over the next decade by utilizing applied research and data collected during the numerous briefings, meetings, and facility tours conducted. Analysis also included key findings regarding the health of the LDP industry, and policy recommendations to incentivize industry firms to innovate in the production of LDP to meet national security requirements. In sum, high entry barriers, industry concentration, and cyclical funding create challenges that will directly affect U.S. LDP firms without government intervention. Consequently, Congress and DoD must work together to set conditions that foster innovation across the LDP industry to improve the production of systems necessary to dominate land domain threats out to 2040 and beyond.

### **The Strategic Environment**

For the first time since the Cold War, the United States has a military, economic, and technologically advanced near-peer strategic competitor that poses a serious threat both globally and to the homeland (see Appendix D, Figures 1 through 7). The 2022 National Defense Strategy (NDS) identifies the People's Republic of China (PRC) both as the pacing challenge and the most significant strategic competitor to the United States, while also recognizing Russia as an acute threat.<sup>5</sup> An important aspect of China's military strategy is to amass and expand its national power to align the rules-based international order with the PRC's interests.<sup>6</sup> A senior Chinese military analyst<sup>7</sup> warns that deteriorating relations between the United States and China are raising the risk of a conflict in the region.<sup>8</sup> The evolution of U.S. policy from the Obama Administration's "Pivot to Asia" in 2011,<sup>9</sup> to the Trump Administration's "Great Power Competition,"<sup>10</sup> and now the Biden Administration's emphasis on "Strategic Competition,"<sup>11</sup> has



steadily transitioned U.S. priorities, strategy, and resources to the Indo-Pacific to deter and, if necessary, defeat the PRC.

Nevertheless, the United States continues to allocate substantial resources to counter Russia. In 2008, Russia invaded the Republic of Georgia for considering NATO membership. Russian forces pressured the Georgian capital, Tbilisi, to stop its NATO pursuit before eventually withdrawing to the separatist regions of Abkhazia and South Ossetia, which Russia still occupies today.<sup>12</sup> Additionally, in 2014, Russian troops invaded and annexed Crimea, a Ukrainian peninsula.<sup>13</sup> The 2008 annexation of Georgian territory and the 2014 annexation of Crimea demonstrated a consistent pattern of Russian malign activities and influence.<sup>14</sup> The tipping point occurred in February 2022 with Russia's invasion of Ukraine, solidifying the fact that the United States must continue to balance global strategic priorities even while seeking focus on the Indo-Pacific Region. With the PRC at the forefront, coupled with the need to support U.S. allies and partners against Russian aggression, the challenge is substantial.

No matter the theater, the land domain will be important. In the Indo-Pacific, although there will be a significant effort from the Navy and Air Force, the Army will be the "linchpin force" that enables the joint solution.<sup>15</sup> Moreover, the Russo-Ukrainian War demonstrates that European combat is likely to feature large-scale deployments of air and ground forces to deter and defeat Russian forces, including tanks, artillery, helicopters, and fighter aircraft. Alongside these expenditures, the United States continues to modernize its own military capabilities. The DoD fiscal year (FY) 2023 budget was \$813.3 billion,<sup>16</sup> with \$12.6 billion for land power to modernize the Army and Marines with more Joint Light Tactical Vehicles (JLTV), Armored Multi-purpose Vehicles (AMPV), M1 Abrams Tanks Modifications, and Amphibious Combat Vehicles (ACV).<sup>17</sup> Allocated in the FY24 budget and supplemental request is the purchase of an

additional 154 AMPVs, investments in Research, Development, Test and Evaluation (RDT&E) for the Remote Combat Vehicle's prototyping, and the Optionally Manned Fighting Vehicle (OMFV), which will replace the M-2 Bradley Infantry Fighting Vehicle (IFV) as part of the Next Generation Combat Vehicles.<sup>18</sup> Yet opportunity remains to implement policies for long-term, positive effects on the LDP industry.

The U.S. LDP industry seeks to expand its international sales to offset any future reductions of U.S. defense spending. Given the performance of Russian equipment in Ukraine, Russia is at risk of losing its market share. However, competition will be difficult with Germany at the high-end of the market, and with France and China at the lower end of the market (see Appendix D, Figures 8 through 11). There are also newcomer countries with rising armored vehicle sales, such as South Korea and Turkey, which will compete with more expensive and often slower U.S. industries. Nevertheless, the United States must be ready to prevail against competitors by being adaptable in the pursuit of innovation, to stay ahead of their capabilities. Unequivocally, the strategic environment is highly competitive, and the stakes are substantial.

### **Stakeholders**

There are many stakeholders that have interests in, and interactions with, the LDP industry. These entities have differing and often competing interests, resulting in complex and diverse perspectives on how the industry operates and evolves over time. However, stakeholders play important roles in shaping the success of the industry. The industry's progress often depends on the ability of these stakeholders to cooperate and seek out common interests. In this way, LDP industry stakeholders are highly interdependent. Major stakeholders include Congress, the DoD, the Department of State (DoS), allies and partners, firms, and local communities.

Congress significantly impacts the LDP industry through its legislative and regulatory powers which affect many aspects of the industry's business, including taxation, trade, and labor regulations. Importantly, Congress controls the federal budget and has the power to allocate funds for programs and initiatives that can benefit and incentivize the industry. In addition, Congress conducts oversight and investigations to ensure that the industry operates by the established regulatory framework and to consider necessary and desired industry-wide changes. Usually, members of Congress advocate for actions that benefit companies and industries in areas they represent. Therefore, the role of Congress as a stakeholder is significant, as its actions strongly impact the industry operations environment and prospects for development.<sup>19</sup>

The DoD also plays a critical role in shaping the overall landscape of the LDP industry. Procurement decisions and established policies significantly impact the market for LDP, influencing the strategies for the development and operations of the various manufacturers within the industry. The DoD sets requirements and specifications for ground vehicles and equipment and plays a central role in procurement. This includes issuing contracts, conducting testing, and overseeing the equipment's delivery and life cycle sustainment. DoD also stimulates industry innovation by investing in research and development (R&D) to advance LDP capabilities.

The DoS is an important stakeholder with direct impact on industry firms, as it is able to promote their products on the global market. Due to its crucial role in negotiating trade agreements with other countries, the DoS significantly affects the industry firms that rely heavily on foreign sales. The DoS is also the leading entity for all transactions within the Security Cooperation framework, including Foreign Military Sales (FMS) and Foreign Military Financing.<sup>20</sup> On the other hand, the DoS is also responsible for implementing and enforcing

sanctions and export controls that restrict trade with certain countries, which limits access to specific markets or prohibits sales of systems by the LDP industry.

Allies and partners are essential industry stakeholders and trading partners for the U.S. LDP industry. Direct Commercial Sales (DCS) rose 48.6% to \$153.7 billion in FY22 from \$103 billion in FY21, while FMS rose 49.1% to \$51.9 billion in FY22 from \$34.8 billion the previous year.<sup>21</sup> The defense procurement decisions of U.S. allies and partner nations have a huge impact on the LDP industry, especially when U.S. domestic demand for LDP decreases.

Defense firms and their complex supply chains consisting of small and large businesses are the most significant stakeholders, as they are the primary actors within the industry. Their actions and decisions impact the overall performance and direction for the development of the industry. As these companies compete for market share and customers globally, they must adapt to changes in the market to remain successful. They must differentiate themselves from competitors by offering distinctive products, sales and marketing strategies. By exploring new technologies and developing new products, companies aim to create opportunities for growth. However, since military sales are an instrument of U.S. foreign policy, restrictions of DCS to foreign countries negatively affect firms' revenue, decrease demand, and limit competitiveness in the global market. Firms seek to maximize their profits while maintaining adequate wages to attract a skilled workforce. Lastly, firms must balance investments in innovation and development with the need to provide a robust return on investment to their shareholders.

Local communities are the final major stakeholder in the LDP industry. The community refers to the location where the industry operates. The relationship between the Defense Industrial Base (DIB) and local communities is complex and multifaceted. Local communities have a vested interest in the success and sustainability of industries operating in the area. Local

companies create jobs and stimulate economic growth, thus increasing residents' prosperity and living standards. In addition, local communities usually provide the required workforce for the industry. Thus, the availability of skilled labor in a particular geographical area significantly influences the industry's operations and ability to scale production when necessary. Striking a balance between the interests of these stakeholders requires intensive collaboration to ensure that the LDP industry remains solvent and robust, while meeting the needs of U.S. national security.

### **U.S. LDP Industry Structure, Conduct, and Performance**

#### *Basic Conditions that Shape SCP*

There are four basic conditions that set the unique foundation for the LDP industry's SCP. First, the U.S. demand signal to the industry is cyclical in nature due to factors such as the U.S. acquisition process, the defense budget, and the perception of threats, as well as dynamic domestic and international context. As a result, orders from the LDP industry are lumpy, meaning inconsistent and often uncertain.<sup>22</sup> This lumpiness challenges the long-term profitability, sustainability, and stability of firms in the industry. Second, the overall demand is relatively inelastic.<sup>23</sup> In other words, LDP demand is less affected by changes in price. After all, the need to capture and control land, and the platforms that enable that capability, are relevant regardless of the theater.<sup>24</sup> Third, the risk of substitutes to most of the industry's products from other industries remains low. As Australian Major General Kathryn Toohey highlighted in 2019, "Tanks are like dinner jackets. You don't need them often, but when you do, nothing else will do."<sup>25</sup> Finally, there is an important, albeit inadequate, intersection within the LDP industry between defense-only and dual-use markets. This convergence creates fertile ground for increasing manufacturing scale, introducing different perspectives, and spreading new ideas that might otherwise remain locked out of the industry. Exploiting and expanding this intersection is an important charge for

DoD and Congress to enhance the LDP industry's ability to innovate and further enable the Joint Force to dominate the land domain.

### *LDP Industry Structure*

An examination of the LDP industry's structure reveals complex characteristics that have a wide range of effects on innovation. For instance, in the defense market of tanks and armored vehicle manufacturing, the industry is an oligopoly, with General Dynamics, BAE, and Oshkosh owning over 87% of the market share.<sup>26</sup> While an oligopoly with large firms has potential to benefit innovation because of the substantial resources available for R&D and large-scale production, it can also be counterproductive to innovation because it has lower competition, reduced creativity, less cognitive diversity, and risk aversion that constrains investment in R&D.<sup>27</sup> In contrast, the dual-use nature of wheeled sustainment vehicles, demonstrated by the global market for heavy-duty truck manufacturing, results in a more competitive market structure with many firms.<sup>28</sup> The commercial-side of the market increases manufacturing throughput opportunities by enabling economies of scale.

Next, the defense market is a monopsony, with the U.S. government being sole buyer for most types of LDP. However, the DoD is unable to independently set the quantity it purchases due to oversight and direction from Congress, and therefore the monopsony power decreases to the benefit of large firms that can withstand the uncertainty.<sup>29</sup> At the same time, the monopsony sparks concern in firms about rejection by the sole-buyer that adds risk to firms' pursuit of disruptive innovation.<sup>30</sup> As a result, established firms in the industry tend to produce familiar solutions in the form of lower risk, sustaining innovations. This highlights the value of industry outsiders, like Force Protection Inc. in the case of the Mine-Resistant Ambush Protected (MRAP) vehicle, that are more likely to bring creativity and innovative ideas into the industry.<sup>31</sup>

Finally, LDP industry barriers to entry, which include high capital investment costs, specialized skills, established relationships, and heavy government regulation, favor entrenched firms over new entrants.<sup>32</sup> These factors oppose innovation because they lower competition, protect the status quo, and restrict the flow of new ideas and expertise from entering the industry. Thus, the LDP industry's structure reveals that there are strong, inherent impediments to innovation.

### *LDP Industry Conduct*

Although the conduct of the LDP industry has variations between the defense-only and dual-use segments of the industry, the industry's structure is the common element that drives conduct. First, the monopsony aspect of the LDP industry creates a unique environment for R&D. In a commercial market with many buyers, the R&D of companies like Tesla, Apple, and TikTok center on disruptive innovation to capitalize on the next big product, or service, to expand market share and profit. However, in the LDP industry, R&D connects to the DoD's requirements in order to attract funding from its customer. Firms have little incentive to conduct R&D on disruptive projects or technologies since DoD requirements drive R&D funding, DoD funding lines, and DoD programs. In 2018, DIB contractors received \$74.6 billion of science, technology, and R&D funding from the DoD, while those same contractors only spent only \$5.3 billion on independent R&D.<sup>33</sup> Unless there is a dual-use commercial aspect to a technology, there is little incentive for LDP industry firms to conduct R&D toward disruptive innovations with their own funds.

As the industry's sole customer for most types of LDP, DoD also drives industry conduct with regard to pricing behavior. Federal law, and the Federal Acquisition Regulation (FAR) part 15.403-3, require contractors to submit certified cost and pricing data on contracts valued over \$2 million.<sup>34</sup> The FAR also puts a 15% cap on profit in cost contracts for experimental

development and research work, and a 10% limit for production and other activities.<sup>35</sup> As a result, the industry conducts business in a manner commensurate with low profit margins on most projects. Limitations on profit are a disincentive to industry risk-taking. Subsequently, firms design systems geared for long-term sustainment through the original equipment manufacturer as this creates stable and long-term profit with lower competition.

Like R&D, firms operating in the LDP industry are reluctant to invest in production facility modernization unless a government contract provides direct funds, or there is a dual-use aspect to that investment. Field studies to the Lima tank plant operated by General Dynamics Land Systems (GDLS), Oshkosh Defense facilities, and Allison transmission production facilities all provided examples of this conduct. The M1 tank transmission production line at Allison showed no visible investment in modernization since the original setup in the late 1970s, except those funded directly by the Army program office. The same was true for GDLS Tank production facilities. Only at Oshkosh Defense, with variants of military trucks running on the same production line as commercial trucks, was firm investment and modernization evident.<sup>36</sup>

Mergers and acquisitions (M&A) are a tool used by firms in the LDP industry to annex capabilities and maintain market share. Due to the concentration of the industry, and high barriers to entry, the firms in the industry use M&A to absorb smaller companies that have innovative or competitive concepts. The LDP industry also uses M&A for horizontal integration to expand product lines, or vertical integration to assimilate firms that are responsible for key components in the supply chain. For example, Force Protection Inc. was an innovative company pursuing survivability solutions for vehicles that the large prime contractors were not considering. After successfully bringing MRAP vehicles to the military market, GDLS bought out Force Protection Inc. in 2011.<sup>37</sup> While this conduct might appeal to a subset of small firms



that are exclusively motivated to innovate wildly with the hopes that a big firm will buy them, overall, this conduct eliminates industry competition and therefore constrains innovation.

Another aspect of the LDP industry's conduct, litigation, is also driven by government policies. The FAR provides firms multiple opportunities to file protests, disputes and appeals with the U.S. government. The option exists to file protests before contract award, or even after contract award, with the Government Accountability Office (GAO) and/or in the U.S. court of Federal claims.<sup>38</sup> These opportunities create an environment that promotes a slow and methodical approach for both the U.S. government and the firms operating in the industry when negotiating and implementing contracts. Protests delay program initiation, as well as capability production and fielding, as firms that lose contract awards have no disincentives to file a protest. Overall, the conduct of the firms, driven by government policies, limits innovation and competition.

#### *LDP Industry Performance*

Examination of the U.S. LDP industry's performance also illustrates issues with the health of the industry. First, due to combat operations in Iraq and Afghanistan, the LDP industry demand and revenue was very high from late 2010 through 2018. However, the end of combat operations in Iraq and Afghanistan have decreased LDP industry revenue and demand. Moreover, recent increases in the cost of raw materials now pose a threat to profitability. For instance, with sales contracts between firms and customers set before manufacturing begins, increases in steel costs will erode a firm's profit margin. Exports represent a significant part of the industry, accounting for about 18.3% of the industry's revenue.<sup>39</sup> Since 2021 the increased security concerns in the European and Indo-Pacific regions generated an increased demand from the U.S. military and increased overall defense spending. The recent increase in demand for industry

products, combined with restructuring caused by the wind-down from the previous decade's wars, has led industry profit, measured as earnings before interest and taxes, to decline only slightly from 11.8% of revenue in 2017 to 11.2% in 2022.<sup>40</sup> From 2017-2022 the number of industry firms increased annually at 3.5% to sixty-three locations.<sup>41</sup> During that same timeframe, employment in the industry grew at an annualized rate of 6.3% to 12,623 workers.<sup>42</sup> Federal funding for defense is also expected to grow at an annualized rate of 0.3% through 2026.<sup>43</sup> The military is investing in three major programs that will contribute to growth in industry revenue during this period, which includes the ACV and the AMPV under development by BAE Systems, as well as the JLTV under Oshkosh (the more heavily armored replacement for the Humvee fleet). Finally, forecasts show industry exports growing at 0.4% annually through 2026 to \$857.3 million.<sup>44</sup> Due to likely growth in industry revenue, forecasts also show the number of industry firms increasing, rising at 0.5% per year to forty companies by 2026.<sup>45</sup> However, industry profitability, despite the positive expectations of increasing demand, is uncertain due to the unpredictable prices of raw materials in international markets.

### **Analysis Of China, Russia, and Germany Defense Industries**

With a solid understanding of the U.S. LDP industry, it is useful to compare the respective DIBs of China, Russia, and Germany, understanding that China represents the pacing challenge, Russia the acute threat, and Germany a key allied nation affecting European security. Despite areas of limited information, the team analyzed each of these nations through the SCP model and distilled their strengths and weaknesses within the LDP market.

#### *China's Defense Industry*

As the tensions increase in the Indo-Pacific, China views air, sea, cyber, and space domains as more critical than the land domain in a future fight. This leaves the key role of the

PRC's ground tracked and wheeled fleet to primarily defend domestic borders, support humanitarian efforts, and counter terrorist attacks. In 2009, the PLA downsized by over 700,000 ground forces, contributing to a 55% reduction between 1997 and 2018.<sup>46</sup> This shift in resources allowed for modernization focus on maritime reach, air lethality, and munitions. Still, China remains the largest military ground force with significant advances in technology. In 2018, the PLA reinvested in Type 15 Light Battle Tank while maintaining their Type 96A and Type 99 tanks.<sup>47</sup> These provide the capability to traverse contested terrain, and are well-postured for offensive land operations in Taiwan, if necessary. Despite shifting focus to other domains, by 2022, China modernized 60% of its main battle tank (MBT) fleet, and continues to invest in the innovation and technology of tracked and wheeled vehicles.<sup>48</sup>

China's fast growing Gross Domestic Product (GDP) is a source of immense power. In 2021, China's GDP ranked second in the world at \$17.73 trillion (see Appendix D, Figures 1 and 2).<sup>49</sup> Comparatively, U.S. GDP was \$23.32 trillion (see Appendix D, Figures 1 and 5).<sup>50</sup> Importantly, at \$4.86 trillion, China's manufacturing output was a major portion of its GDP.<sup>51</sup> This amount is nearly double the \$2.5 trillion output generated by United States manufacturing during the same period,<sup>52</sup> and a source of notable advantage for China's DIB.

Currently, China's DIB produces an estimated \$95 billion in revenue annually. By comparison, U.S. DIB revenue is near \$712 billion. As the fourth largest global arms exporter over the past decade (see Appendix D, Figures 8 and 11), China exported \$16.6 billion in arms across Asia and Africa.<sup>53</sup> In 2023, China announced a defense budget of \$225 billion.<sup>54</sup> Less than 50% of China's industrial base contributes to defense, but most that do are dual-use. Eight of the top fifteen firms competing in the DIB are State Owned Enterprises (SOE).<sup>55</sup> Of the eight key SOE defense firms, two produce LDP. China North Industries Group Corporation (NORINCO)

and China South Industries Group Corporation (CSGC) are industry leaders, grossing \$2 billion annually.<sup>56</sup> Of note, both firms count on Russia as a key trade and investment partner.

China seeks to broaden innovation through a military – civilian fusion (MCF). A relatively new construct, China established the Central Commission for Integrated Military and Civilian Development in 2015. PRC President Xi Jinping initiated the rubric for MCF as part of the “National Development Strategy.”<sup>57</sup> Under this strategy and MCF, nurtured relationships between government, military, and civilian leaders gain buy-in on defense innovation. While China continues to work through friction points, the end-state goal of MCF is to spread the capability of the DIB. Accordingly, if necessary, civilian firms can easily transition to support a wartime mission and production. Moreover, SOEs make up most defense production firms, and this allows for directed funding, government influence over production rates, and innovation. However, MCF is shaping the environment to encourage competition outside of SOEs to allow for greater technological advancements. With a direct line to the Chinese Communist Party (CCP), there is a shorter ‘flash to bang’ to provide new equipment at a lower cost.

Conversely, SOEs also limit innovation. SOEs have low profits that do not help recruit and retain quality personnel. China’s DIB does not generally attract new tech graduates because rigid direction by the CCP leaves limited room for outside thinking. With the heavy hand of the CCP in the SOEs, non-SOEs lack incentives to contract with the government. China is also still heavily dependent on the United States and other nations to supply the DIB. A final weakness is the declining workforce population. The “One Child Policy” stunted China’s population for years. China will face substantial manpower availability issues over the next decade.<sup>58</sup>

China’s exploitation of MCF poses a significant threat to U.S. national security, whether singularly focused on the land domain or concentrating efforts across multiple domains.

Identified within the 2022 National Security Strategy<sup>59</sup> (NSS) and NDS<sup>60</sup> as the U.S. military's pacing challenge, Xi pledges to make China the "new choice" as the emerging alternative to Western democracies.<sup>61</sup> Therefore, the United States must dedicate resources to education, technology innovation, and partnerships with industry and academia to maintain a winning edge.

### *Russia's Defense Industry*

Historical experience leaves Russia with the impression it is surrounded by enemies with few natural barriers to impede invasion. Notable invasions into Russia by the Mongols in the 13<sup>th</sup> century, Napoleon in 1812, and Hitler in 1941 demonstrate its historical vulnerability stemming from its geopolitical position.<sup>62</sup> As such, Russia has always has been, and always will be, a land-focused military. Therefore, a large segment of the Russian DIB will remain focused on supplying the military with LDP for use internally and against nations near Russia's periphery.

A strong economy is a key enabler to a strong DIB, as government revenue allows procurement of defense-related items. Russia ranks eleventh in its size of GDP at \$1.78 trillion (see Appendix D, Figures 1 and 3).<sup>63</sup> Significantly, even though Russia has the eleventh largest economy in the world, its DIB is the world's second largest conventional arms exporter, behind only the United States.<sup>64</sup> In fact, Russia and the United States account for more than 50% of all global arms exports.<sup>65</sup> Russia's most successful defense exports include aircraft, air defense systems, helicopters, armored personnel carriers (APC), tanks, and IFVs.<sup>66</sup> Russia has sold these systems to sixty countries, with 43% to the Southeast Asia Pacific region, and 23% to the Middle East and North Africa.<sup>67</sup>

Russia has conducted several industrial defense reforms since 1991.<sup>68</sup> The Russian DIB consolidation provides more centralized control by the Russian Federation, while increasing firm output despite a general absence of competition.<sup>69</sup> Russia's ten largest defense firms collectively

made over \$15 billion in revenue.<sup>70</sup> The size and ability of these defense firms to export globally make the defense industry one of the largest and most important sectors in the Russian economy. Importantly, SOEs make up most of the Russian DIB. As the Russian government owns most of the DIB, it operates under the Ministry of Defense (MoD). The MoD sets priorities and defense spending, while working through *Rosoboronexport* as the intermediary for all arms exports.<sup>71</sup> Before the war in Ukraine, Russia was a price-setter of its major defense systems sold abroad.<sup>72</sup> However, due to sanctions, Russia is now a price-taker, and this reduces Russia's ability to generate the revenue required to modernize its military while providing arms sales abroad.<sup>73</sup>

From the structural perspective, corruption and mismanagement hinder Russia's ability to modernize its factories.<sup>74</sup> Furthermore, like China, an aging Russian population is a significant challenge that will limit available personnel for the workforce, likely resulting in overall production losses.<sup>75</sup> Despite these issues, the Russian DIB increased sales from 2016 to 2020, capturing nearly 20% of global arms exports (see Appendix D, Figures 9 and 11).

Russia and China have historical ties that result in dependency on each other's defense market. China relied on Russia to modernize its military from 2000 to 2010 as the second largest arms importer, reaching 18% of total Russian arms sales.<sup>76</sup> The current trade relationship features Russian reliance on China for machine tools and electronic components, while China depends on Russia for aircraft engines, missiles, air defense systems, and submarine and rotary-wing aircraft technologies.<sup>77</sup> Recently, however, China's growing economy and burgeoning production capabilities have decreased its reliance on Russian arms.<sup>78</sup> Moving forward, China will continue to leverage any Russian technology that it cannot produce itself. Besides China, one-third of Russia's arms sales go to India, with the remaining sales to Egypt, Algeria, and Vietnam.<sup>79</sup>

The performance of the Russian defense industry will continue to vary due to two key factors. First, sanctions will impact Russia's ability to export essential parts and replacement systems to its international customers. Second, Russia's defense industry will focus inward to service current war requirements by sourcing parts from countries like Iran and North Korea.<sup>80</sup> This will impact Russia's ability to produce hypersonic missiles, and advanced fighter jets, while challenging quality control, cost, schedule, and performance goals.

Overall, the defense industry remains a critical sector of the Russian economy. Challenges regarding efficiency, modernization, and maintaining commitments abroad will force Russia and China to work together to counter sanctions. The current demand for Russian arms exports helps to maintain a constant production requirement, bolstering a surprisingly capable defense industry. At the same time, filling the gaps left by the reduction in Russian arms sales due to Russo-Ukrainian War blowback is an opportunity to improve the U.S. national security posture by increasing production and arms exports, as well as improving interoperability of those allies and partners who have been historically reliant on Soviet and Russian arms systems, through transition to U.S. military systems.

### *Germany's Defense Industry*

Unlike Russia and China, which rely heavily on SOEs, government subsidies, and centralized government control to manage and drive their respective DIBs, Germany's DIB is a collective of firms, each of which is relatively isolated. Also, unlike the collaboration between research organizations and government agencies that Russia and China both foster, German defense firms must operate without government-enabled collaboration and support.

Consider, for instance, the German civil clause of *Zivilklausel*, which is a voluntary self-declaration preventing German universities from engaging in defense research and cooperating

with the defense industry. The clause originated at the University of Bremen, in 1986, and now includes more than seventy universities of applied sciences.<sup>81</sup> Moreover, Angela Merkel's 2005-2021 tenure as German Chancellor witnessed the neglect and progressive downward slide of the *Bundeswehr* as a result of the glaring political realization that all things military were a "vote loser."<sup>82</sup> Simply put, there still exists in Germany a cultural antipathy towards the military, as well as political and social constraints in pursuing technological advancements pursuant to military applications.<sup>83</sup> In spite of this suboptimal environment, the German DIB thrives.

In 2023, there are nearly 200 German defense-related firms, eight of which are recognized as "major," spanning diverse areas such as aerospace, land systems, marine, propulsion, and ammunition.<sup>84</sup> In general, the German DIB is experiencing sales growth due in part to the Ukraine crisis.<sup>85</sup> This growth bodes well for a DIB that already employs 135,000 personnel, and commands over \$13 billion in value-creation annually.<sup>86</sup> Importantly, the Federation of German Security and Defense Industries (BDSV) recently noted that small and medium sized companies account for more than half of the value created by this industry.<sup>87</sup>

Germany's international armaments sales are also robust. In 2022, Germany was the fourth largest arms exporter in the world, and has maintained a global position of at least fifth in market share of major weapon systems over the past five years (see Appendix D, Figures 8 through 11).<sup>88</sup> The Leopard 2 MBT, for instance, is currently used by twenty-two countries, and Rheinmetall now plans to add a manufacturing plant in Ukraine.<sup>89</sup> A 2020 German DIB strategy paper noted value in arms exports to NATO, due to higher production runs, labor skill, strengthening DIB competition, and benefits from interoperability.<sup>90</sup> It is no wonder that the German government finally acknowledged in 2020 the relevancy of the German DIB and its



importance to security.<sup>91</sup> Clearly, the success of Germany's international sales, and the German DIB overall, must be the result of something that supersedes government support.

Innovation is the key ingredient that makes German defense firms successful. In a business environment that demands high-quality and tactical overmatch for its customers to succeed, German defense products are in demand globally. German DIB products are renowned for their innovations. In a recent visit to the Krauss-Maffei Wegmann (KMW) firm by the LDP Seminar Team, KMW emphasized that innovation and product quality differentiate their firm.<sup>92</sup> Recognizing the need for both modularity and interoperability, KMW developed the Boxer 8x8 tactical system. This innovative system of weapon platforms is a Boxer chassis with the ability to substitute multiple modular turrets based upon mission requirements – such as APC, IFV, Artillery Gun, and other tactical options. Similarly, the Leopard 2 utilizes the “LEGO” compatibility concept for its customers, so that A7 components work on A4 models. Finally, KMW claims that its mobile artillery systems are also capable of shooting while on the move.

The Land Domain Seminar Team visit to American Rheinmetall was also impressive. Noting the fact that this firm is partnering with General Motors Defense to convert the HX3 into a Common Tactical Truck (CTT) candidate for the U.S. Army, Rheinmetall is clearly seeking to break into the U.S. defense market. Perhaps more significant was the discussion on the joint German/French Main Ground Combat System to replace the Leopard 2 and Leclerc MBTs by 2035, which will feature a 130mm main gun.<sup>93</sup> The improved velocity will add 50% more kinetic energy to the long-rod penetrator round, ensuring that the main gun will be able to defeat all armored vehicles for the foreseeable future.<sup>94</sup>

In February 2020, Germany published a refreshed DIB strategy that identified key technological areas essential to future German capabilities. The plan emphasized the importance

of national efforts, or working through European or transatlantic cooperation under bilateral or multilateral arrangements, to cultivate these capabilities.<sup>95</sup> These areas are protection, sensors, protected and armored vehicles, cryptology, artificial intelligence, naval shipbuilding, cyber and electronic warfare, and information technology and communications hardware. In other words, German engineering is here to stay, and German defense firms intend to become the global suppliers of choice if they can continue to demonstrate superior quality and innovativeness.

### **Recent Battlefield Lessons and Implications for the DIB**

The 2020 Nagorno-Karabakh War, and the Russo-Ukrainian War, provide important lessons for land domain operations. First, despite the higher risk exposure to the MBT on the contemporary battlefield, it will remain an essential component of European land warfare for the foreseeable future. The combination of mobility and firepower remains compelling.<sup>96</sup>

Nevertheless, MBTs must rely upon technology to increase their survivability. The protective suite of non-explosive reactive armor (NERA), space/cage armor, and explosive reactive armor, coupled with sloped geometry, remain vital to defend MBTs against main-gun kinetic penetrator rounds and ATGM/RPG shaped charge rounds. Moreover, the use of active protection systems (APS) – both hard and soft kill – are essential. Finally, top-down protective systems and enhanced top-down armor are necessary to neutralize attacks from above by Unmanned Aerial Systems (UAS) and sophisticated munitions.

With battlefield trends that currently favor the defender, the need for combined-arms maneuver, solid coordination, and stringent cooperation during offensive operations will be critical to tactical mission success – as the poor showing of the Russian Army in Ukraine demonstrates.<sup>97</sup> The likelihood of degraded communications will place a premium on the quality of lower-echelon leadership, the practice of mission command, and fostering leader initiative to

the maximum extent possible. It will also demand more disciplined tactical fieldcraft in areas such as camouflage and dispersion. Similarly, leveraging realistic, high-intensity battlefield training is paramount for combat, combat support, and combat service support elements in the active, reserve, and national guard components, due to the heightened lethality facing all battlefield units. Tactical leaders must also understand how to mass effects without massing units in a way that fosters a target-rich opportunity for an adversary, and they must screen and cover all battlefield maneuver to mitigate tactical risk.

Additionally, although threats from the air are unfamiliar to U.S. forces, they will be a significant factor on the future battlefield in the form of UAS, or loitering munitions. Therefore, the need for full-spectrum air defense that incorporates kinetic interceptors, electronic warfare, counter-drone drones, and short range air defense (SHORAD) platforms will be necessary. Leaders must account for this new reality in their task organization, and in their tactical planning.

Perhaps the most critical lesson from recent European combat is the need to protect logistics systems and commodities from the point of need all the way back to the production site. Continuous protection of fuel dumps, ammunition sites, and supply convoys both within and outside the theatre of war will be necessary, as adversaries will have the potential to track all movement and, therefore, there will likely be no place to hide. For example, early in the Russo-Ukrainian War, Ukrainian artillery regularly interdicted Russian ammunition sites marshalled near rail debarkation points as they awaited truck transport to the front lines. Finally, with respect to DIB logistics, it will be key to determine essential commodities requiring long lead times and consider stockpiling to sustain prolonged conflict at modern consumption rates.

### **Strategic Relevance of Armament Exports**

The export of arms is a key source of demand to the U.S. DIB. The world's largest arms exporters between 2017-2021 were the United States, Russia, France, China, and Germany (see Appendix D, Figures 8 through 11).<sup>98</sup> Together these nations made up 77% of exports worldwide.<sup>99</sup> In 2022, the U.S. LDP industry had 634 tanks, 2,658 armored vehicles, and 401 artillery systems on order, or pending orders, from foreign countries.<sup>100</sup> Understanding the importance of demand, it is essential to consider the impact of U.S. export policies and processes on the LDP industry. Armament exports are an extension of foreign policy and increases U.S. influence. According to the NSS, U.S. alliances and partnerships are the most important strategic assets that will promote global peace and stability.<sup>101</sup> The NDS also emphasizes that the United States will work closely with allies to improve “readiness and preparedness” using exports and international armaments cooperation initiatives.<sup>102</sup> The two primary methods to export armaments are FMS, which is the sale of U.S. arms to a foreign country through the U.S. government, and DCS, which is the direct sale of arms from a U.S. firm to a foreign government with the approval of the U.S. government.

#### *FMS Relevance Within the LDP Industry*

The ability of the United States to sell defense articles to allies and partners is critical to building and maintaining the requisite skills and experience that enable a vibrant LDP industry. Firms within the LDP industry depend on FMS to generate income during periods of low U.S. demand. As a result, U.S. firms must aggressively advocate for overseas arms sales to offset shrinking military budgets.<sup>103</sup> Moreover, FMS creates economies of scale that often reduces the overall cost of the end item. For example, FMS had a positive impact on U.S. firms that produced Tactical Wheeled Vehicles after the wars in Iraq and Afghanistan. As U.S. demand declined after the redeployment of major combat elements, FMS to coalition partners helped

maintain industry production capacity.<sup>104</sup> The LDP industry relies on FMS, as an extension of U.S. foreign policy, to bolster demand. However, the United States must streamline its FMS process, or customers will turn to nations with more timely and efficient FMS processes.

A slow and bureaucratic FMS process causes many LDP industry customers to take their business to other countries. Even though the United States is the world's largest arms exporter,<sup>105</sup> U.S. market dominance is at risk due to the time it takes, on average, to execute FMS cases. Specifically, some European customers now rely on South Korea for their FMS needs. For instance, South Korea recently closed a “mega deal” to sell Poland its K2 tank and various other LDP.<sup>106</sup> South Korea is also on contract to provide Australia with its K9 howitzer.<sup>107</sup> The lengthy U.S. FMS process is also a disincentive to potential customers and a detriment to LDP industry demand. Currently, a standard FMS contract takes eighteen months to award on average.<sup>108</sup> Thus, instead of deterring the pacing challenge and acute threats by quickly delivering key defense capabilities to U.S. allies and partners, this inefficient model deters the customers needing U.S. support. To make matters worse, in a self-defeating cycle, the longer it takes to close FMS cases, the larger the FMS backlog becomes. A growing FMS backlog further increases the delay of U.S. exports of key capabilities to its allies and partners.

Beyond the multitude of process issues, pandemic-related supply chain factors and the Russo-Ukrainian War also contributed to an accumulation of U.S FMS cases. Currently, there is a backlog of \$14.2 billion worth of military equipment purchased by Taiwan in 2019.<sup>109</sup> Due to the severity of the logjam, and its implications on Taiwan's military capability, the Secretary of Defense established a tiger team to provide recommendations to improve the FMS process.<sup>110</sup> The team of experts concluded that the United States “needs a modernized, strategic FMS system capable of addressing the current and future threat environment – one built to deliver critical

capabilities to international partners as quickly and concurrently as the U.S. armed forces.”<sup>111</sup> Accordingly, a streamlined FMS process will enable firms within the LDP industry to keep their production lines running during lulls in U.S. demand. However, the United States must implement policy to address an outdated and complex FMS process.<sup>112</sup> The DoD should focus on creating a timely FMS acquisition process, approving technology releases in a more transparent manner, and integrating exportability considerations early in the lifecycle.

### *DCS*

DCS is another way nations procure defense articles and services from the United States. The Arms Export Control Act authorizes U.S. allies and partners to procure defense articles and services directly from defense firms. DCS is unique from FMS because the U.S. government is not involved in the transaction. However, there are many restrictions that limit the list of military items sold through the DCS process. Certain categories of military items, and the sensitive nature of the technologies, are only exportable on a government-to-government basis.<sup>113</sup> Just as FMS cases increased, DCS authorizations increased from FY21 to FY22 by 49%, due mainly to the Russo-Ukrainian War.<sup>114</sup> DCS has the potential to be a faster process than FMS because there are less bureaucratic hurdles.<sup>115</sup> However, the speed of DCS depends largely on the negotiations between the customer and the firm.

## **Policy Recommendations**

The preceding assessment and analysis of the U.S. LDP industry points to three main areas requiring action to make the industry more responsive and innovative in an era of constant technological change and strategic competition. These areas are creating consistent demand and flattening the lumpiness of the demand cycle, increasing competition within the industry to drive responsiveness, innovation and modernization, and increasing innovation fed by a wide and

diverse small business ecosystem. Below are five recommendations for Congress and DoD that target these areas. Importantly, all of these policy options are budget neutral, which is particularly important if future U.S. defense budgets flatten or decline.

*Recommendation #1: Security Cooperation Reforms to Increase and Stabilize the Demand Signal to the LDP Industry.*

Several key Security Cooperation program reforms will increase and stabilize the demand signal to the LDP industry. First, changes should align the FMS contracting procedures with FMS tailored, FAR-based contracting processes. To accomplish this, DoD should request from Congress an FMS contracting authority. The process would require an open and transparent dialog between the U.S. government, industry, and the foreign partner. The revised contracting process should also rely heavily on indefinite-delivery/indefinite-quantity (ID/IQ) contracts. ID/IQ contracts are advantageous in the anticipation of recurring needs.<sup>116</sup> ID/IQ contracts are also faster to execute because there is no need to write a new contract for every FMS case. Instead, the contracting officers only need to execute delivery, or task orders, to an existing contract. Next, DoD must hire additional contracting officers, through increased FMS funding fees, dedicated exclusively to FMS cases. Input from LDP industry firms highlighted that the DoD's contracting workforce is too small, and FMS programs are not the priority in most contracting offices.<sup>117</sup> Given the 3.2% administrative fee associated with each FMS case,<sup>118</sup> a small and reasonable increase to this fee will enable DoD to hire more contracting professionals. The contracting professionals will focus solely on FMS actions, reduce the current FMS backlog, streamline the process, and enable an increase in demand.

Additionally, the U.S. government must better balance protecting its technological superiority with an efficient FMS process. To streamline the technology release process, DoD

must first align the existing technology release policies.<sup>119</sup> There are several stakeholders involved in the lengthy release approval process. Over time, each stakeholder created policies, and decision-making criteria, without centralized guidance. As a result, the differences that exist between the various approval offices lead to disagreements that prolong the approval process.<sup>120</sup> To address this issue, the DoD must establish a centralized release authority comprised of representatives from the three military departments (MILDEPs). The representatives' purpose is to improve efficiency in resolution of internal disagreements to expedite technology release.<sup>121</sup>

DoD must also re-evaluate “FMS Only” criteria. The DoS, assisted by the Defense Security Cooperation Agency, the Defense Technical Security Agency and MILDEPs, should reevaluate the current FMS Only designation criteria to identify more defense articles that are “low-risk” technologies.<sup>122</sup> A shorter FMS Only list will allow U.S. partners and allies to procure more defense articles utilizing DCS. Finally, there is no centralized method for DoD to track lifecycle exportability from acquisition milestones through security cooperation requirements to Anti-Tamper plans and cost.<sup>123</sup> Accordingly, centralizing all exportability-related functions under the Under Secretary of Defense for Acquisition and Sustainment will allow DoD to design exportability into the process from the beginning, and maintain it all the way to the finished product, to increase LDP exports.<sup>124</sup> This centralization will also eliminate duplication of efforts among various stakeholders. These reforms will improve the demand signal to the LDP industry.

*Recommendation # 2: Expand Multiyear Procurement Authorities for Critical Land Domain Systems and Components to Enhance Demand Stability.*

Shifting demand and a lack of long-term orders are common reasons identified by defense firms for not expanding infrastructure, not investing in modernized manufacturing processes, and not being able to quickly fill orders. During the seminar's field studies and



meetings with defense firm's leadership in the United States and Germany, they identified shifting demand and lack of long-term orders as issues for their industry. This problem has received more attention recently due to the extensive number of munitions sent to support Ukraine and the need to backfill U.S. stocks. In the 2023 National Defense Authorization Act (NDAA), Congress provided authority to use multiyear contracting authorities for 17 munition types of various quantities specified in the NDAA. Two specific reasons Congress identified in this legislation for expanding the authorities were to "provide the defense industrial base with predictable production opportunities and firm contractual commitments" and "increase and expand defense industrial base capacities."<sup>125</sup> Congress should implement similar authorities for crucial land domain systems that do not have overlapping commercial use, such as armored vehicles, IFVs, and MBTs. Multiyear authorities provide stability and predictability in demand, enable the DIB to purchase supplies in greater quantities at lower prices, and encourage capital investment to respond to demand.

Currently, the contracting and funding method used for most acquisition programs is annual orders based on full funding. Under this process, the DoD contracts for one year's worth of items after Congress and the President approve the annual funding in the yearly authorization and appropriations bills.<sup>126</sup> Before the award of this annual contract, defense firms take on financial risk if they order long lead items, hire new personnel, or invest in their production capabilities. This process leads to long delivery times after the award of the contract.<sup>127</sup>

Under multiyear procurement authority, DoD can use a single contract for procurement across two to five years. Funding appropriations still occur annually, but by granting the multiyear procurement authority, Congress and the DoD signal to the DIB that future years' funding will be available. Multiyear contracting also contains a cancellation penalty that requires

DoD to pay a contractor for costs incurred if DoD cancels the contract. This process should result in contractors purchasing supplies early and in bulk, resulting in cost savings as well as incentivizing investments in productivity enhancements, strengthening the DIB.<sup>128</sup> Historically, advocacy for multiyear contracts centered on cost savings. The discussion on the cost savings that an expanded multiyear procurement authority goes back many years. In 1969 a commission on government procurement recommended expanding multiyear procurement authorities to achieve cost savings, and in 1981 GAO provided the same recommendation to Congress based on expected cost savings.<sup>129</sup> Increased innovation and productivity in the DIB is another reason for pursuing multiyear authorities and needs greater emphasis.

Congress is reluctant to provide multiyear procurement authorities because it limits their control and ability to adjust the budget and procurements on an annual cycle. When Congress provides those authorities, they are precise, naming the programs and specific quantities. DoD has the same concern over lack of flexibility and the ability to adjust. Oversight is a valid concern, but Congress still maintains the ability to review, monitor and supervise the implementation of the multiyear contracts, as well as the ability to phase in multiyear procurement across the timeframe and programs of its choosing. Furthermore, the experience backfilling munitions sent to Ukraine illustrates that the United States cannot wait for an emergency to rejuvenate the DIB. The nation needs a responsive and modern DIB able to ramp up quickly. Expanding multiyear procurement authorities to selected LDP, and long lead time items, will properly incentivize the DIB and lead to greater resilience.

*Recommendation # 3: Provide DoD, and the Services, Expanded Reprogramming Flexibilities and a Transition Fund to Enable Year of Execution Funding Moves and Allocations to Support Innovative Technology and Prototype Transitions.*

To develop and field material capabilities in the DoD, three distinct systems must align the requirements development process also known as the Joint Capabilities Integration and Development System (JCIDS), the Adaptive Acquisition Process (AAP), and the Planning, Programming Budgeting and Execution (PPBE) process. In 2020, DoD issued a revamped acquisition policy, the AAP, that provides six distinct pathways to speed up the acquisition process and deliver capability to the warfighter faster. The new middle-tier and software acquisition processes bring capabilities to the field much faster, providing the acquisition community with increased authority.<sup>130</sup> In the 2016 NDAA, Congress provided flexibility to the requirements process by allowing DoD to conduct prototype and some limited fielding activities without a formal JCIDS requirement.<sup>131</sup> These changes increase responsiveness and innovation. However, this highlights the need for similar tailoring of the PPBE process. At least two years remain between identifying an innovative idea and programming formal funding.

To support the development and fielding of innovative and critical LDP, Congress should raise DoD authorities to reprogram funds in the year of execution and provide the MILDEPs the authority to set up an innovation fund. The aim is to transition key innovative technologies from prototyping to further development and large-scale fielding. The authority to reprogram funds in the year of execution allows DoD to build upon success and accelerate innovative programs by applying additional resources that other programs may not be able to use effectively. This ability to move money based on performance and priorities is prevalent in the commercial market. The current reprogramming policy established by the 2021 Defense Appropriations Act requires DoD to return to the four congressional committees House Appropriations Committee, House Armed Services Committee, Senate Appropriations Committee, and Senate Armed Services Committee for approval of any funding reprogramming action greater than \$10 million, or 20% of the funding

line, whichever is less.<sup>132</sup> Since 1970, the DoD reprograms less than 2% of its budget annually, with recent years below 1%. Flexibility in this area will drive innovation and speed up capability fielding. A recent report by the Atlantic Council Commission on Defense Innovation Adoption recommends an increase of the threshold to \$40 million for RDT&E funds and \$100 million for procurement funds.<sup>133</sup> The council also recommends changing the process from pre-approval by the Congressional committees to allow the DoD to notify the committees of the reprogramming actions, with Congress having a 30-day window to either request a briefing or reject the action.<sup>134</sup> These recommendations raise the thresholds to a reasonable level, based on the size of the DoD budget and the cost of major weapons systems, while preserving for Congress the visibility on reprogramming actions and ability to reject or influence those actions.

Due to funding policy constraints, innovation also suffers from the inability of DoD to respond quickly to prototypes or innovative ideas in the year of budget execution. Army Futures Command is investing in multiple exercises to demonstrate innovative technologies and capabilities. However, under the current process, an operationally relevant technology demonstrated successfully in those exercises must go through the budget process for further development and scaling. Congress should provide the DoD, via the NDAA and subsequent appropriations bill, the authority for the Services to set up a fund dedicated to furthering the development and scaling production for operationally relevant and demonstrated prototype technologies.<sup>135</sup> Congress can cap the fund amount and require the Services to allocate money to that fund, to reduce risk of unjustified budget growth. Ultimately, by Congress providing additional flexibility to reprogram funds, and the establishment of a transition fund, it will provide much-needed agility to the PPBE system that will increase innovation and expedite the delivery of important capabilities to the warfighter.

*Recommendation #4: Harness the Creativity and Innovative Power of Small Businesses Through Small Business Innovation Research (SBIR) Reform.*

Several improvements to the SBIR program will ensure small businesses return as the engine for DIB innovation. To begin, it is important to highlight that small business participation in the DIB is down by more than 40% over the past decade.<sup>136</sup> Although it is not common knowledge, many small business ideas in the areas of defense, medicine, energy, transportation, and agriculture, become products and services that dramatically change how people live. For instance, the rapid development of vaccines for COVID-19 started in a small business.<sup>137</sup> Losing small business participation in the DIB is devastating to innovation. As the first part of the solution, Congress should change the SBIR statute, 15 U.S. Code Section 638, to increase the program phase I and II limits by a factor of three to \$500,000 and \$3 million, respectively.<sup>138</sup> Increasing the phase limits will make the DoD more attractive to small businesses, incentivize the return of these businesses into the DIB,<sup>139</sup> and better compete with large Venture Capital (VC) firms. With the high levels of technological complexity and uncertainty involved in developing future LDP capabilities, raising phase limits will offset the financial risk for businesses associated with these projects. By lowering the threshold of risk, more small businesses will compete to work for DoD, and make meaningful contributions in the LDP industry. Second, Congress should expand the definition for uses of SBIR program funding by the companies to mirror some of the flexibility afforded by VC. The divergence between the VC and the DoD approaches for utilizing funds are significant detractors to small business participation with DoD.<sup>140</sup> The VC approach provides more freedom to the small business to achieve broad cooperative and business aims in the interest of profit, but DoD only pays for specific R&D to deliver a particular product for acquisition.<sup>141</sup> While the U.S. government will

not be able to match the flexibility of VC, allowing DoD and small businesses additional discretion on how they use SBIR funds could spark innovations, both expected and unexpected. Additionally, Congress should allow additional SBIR funds, beyond phase I and II limits, to cover small business cybersecurity protection.<sup>142</sup> Cybersecurity expenses are a detractor to small businesses that might otherwise work with the DoD, but ensuring cyber protection for the innovative work small businesses produce is critical to national defense. It is counter to U.S. interests to allow the engine of innovation to power the CCP or other malign actors that seek to exploit cyberspace vulnerabilities. However, adequate cybersecurity is costly, therefore the use of SBIR funds to this end will be worthwhile. This effort should complement current efforts by the president to provide a comprehensive cybersecurity policy, particularly for companies contributing to national security efforts.<sup>143</sup> Finally, the U.S. Army must streamline a system of soldier feedback on the products and ideas that small businesses develop.<sup>144</sup> Maintaining a robust, yet nimble, feedback loop will leverage the perspective, ingenuity and expertise of soldiers, and the flexibility and adaptability of small businesses to quickly iterate on innovative LDP products.

Overall, enacting these policy suggestions to reform SBIR will revitalize one of the most successful government-to-private partnership programs in U.S. history. These reforms will encourage the entry of new start-ups, and their diverse ideas, to foster innovation in the production of LDP.

*Recommendation # 5: Reinvigorate Antitrust Enforcement for M&A Within the LDP Industry to Promote Competition and Foster Innovation.*

A final policy suggestion is to reinvigorate antitrust enforcement for M&A within the LDP industry by requiring the Under Secretary of Defense for Acquisition and Sustainment to

send a list of firms and important technological areas, associated with the LDP industry, to the Global Investment and Economic Security Directorate (GIESD).<sup>145</sup> Consequently, this list must increase scrutiny for LDP industry M&A decisions, particularly involving firms beyond the size of a start-up, to inhibit anticompetitive conduct that is counter to a vibrant industry and national security interests. Since the meeting between then-Deputy Defense Secretary William Perry and corporate executives from across the DIB, now referred to as “the last supper,” industry consolidation precipitated the creation of enormous defense contractors.<sup>146</sup> Accordingly, the sheer size of these defense contractors affords them substantial power to buyout smaller firms, undermine growth of human capital in the DIB, and eliminate competition.

While there are instances where M&A are advantageous to the health of the LDP industry, such as when companies with key intellectual property would otherwise become insolvent, there are also situations that cause industry to become stagnant. As firms become dominant, they often fail to commercialize their inventions due to mismatches in culture, motivation, or vision that constrain innovation.<sup>147</sup> This policy option will not only focus antitrust mechanisms toward the LDP industry to counter the trend of increasing market concentration that undermines competition, it will also resist the tendency for large companies to take over smaller businesses without capitalizing on their innovations.<sup>148</sup> For historical perspective, the GIESD denied Lockheed’s M&A with Northrop Grumman in 1998 to maintain DIB competition.<sup>149</sup> Denial of large firm M&A prevents monopolies, and guards against defense contractors that are too big to allow to fail. However, there is also value in denying M&A of small businesses into large firms because it protects the human capital, diverse perspectives, and risk tolerance that contribute to innovation. While there are valid concerns that the prevention of LDP industry M&As will be a disincentive to those startups that exist to seek a profitable M&A

into a large firm instead of continuing to grow, there are alternative paths to profitability beyond M&A for small businesses that better align with national security interests. For instance, small businesses that do not want to grow can still license their intellectual property to larger firms to take advantage of large-scale manufacturing, while preserving their human capital and diverse perspectives that improve innovative potential of the LDP industry.

### **Conclusion**

The policies of Congress and DoD must carefully incentivize the U.S. LDP industry to stimulate innovation in the systems necessary to dominate future land domain threats. No matter the theater, the land domain and the systems employed within it will remain important to joint operations. Moreover, rapidly evolving technologies emphasize the need for the United States to be adaptable and innovative to ensure LDP overmatch against potential adversaries.

Unfortunately, there remain significant obstacles to fostering innovation and revitalizing the U.S. LDP industry. First, the U.S. demand signal to the industry is inconsistent and often uncertain. Additionally, unless there is a dual-use aspect to a particular technology, there is little incentive for the LDP industry firms to conduct R&D toward disruptive innovations with their own funds, as DoD requirements drive R&D funding. Finally, firms operating in the LDP industry are reluctant to invest in production facility modernization unless a government contract provides direct funds or there is a dual-use aspect to that investment.

Due to the Russo-Ukrainian War, a significant opportunity exists for the U.S. LDP industry to expand its international sales and improve the requisite demand signal that is a gateway to innovation. Security Cooperation program reforms will enable the United States to increase sales of defense articles to allies and partners and revitalize the LDP industry. However, a slow and bureaucratic FMS process loses LDP industry customers and reduces demand. The



United States cannot afford to continue in this manner, as competition is intense with Germany at the high-end of the market and France and China at the lower end. Moreover, Chinese and Russian SOEs afford them the competitive advantages of directed funding, government influence over production rates, and R&D underwriting to allow for faster technological advancements. Thus, Congress and DoD must adapt to set policies that incentivize firms to be innovative in producing the LDP necessary for overmatch in the land domain out to 2040 and beyond.

To accomplish these ends, the LDP Industry Study Seminar of 2023 has offered recommendations that target three obstacles to industry innovation. First, to create consistent demand and smooth out the lumpiness of the demand cycle, Congress and the DoD should initiate Security Cooperation program reforms, and expand multiyear procurement authorities for key LDP. Second, to support the development and expeditious fielding of innovative and critical LDP, Congress should enhance DoD reprogramming flexibilities, and set up an innovation fund. Lastly, to promote industry competition and foster innovation, Congress and DoD should unleash small businesses as the engine for industry innovation through SBIR reform, while protecting that engine through reinvigorated antitrust enforcement for LDP industry M&As. The 2022 NSS shrewdly observes that the United States is entering a decisive decade that will shape the future of the rules-based international order.<sup>150</sup> Ultimately, these policy suggestions will make the most of this opportunity by energizing the LDP industry, to ensure the United States, along with its allies and partners, are ready to dominate in the land domain against any adversary, in any theater, out to 2040 and beyond.

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## **APPENDIX A: Russia-Ukraine**

Ending the Russo-Ukrainian War is essential to stabilizing the situation in Europe, relieving the strain on U.S. resources, and focusing efforts to compete with China. Western countries and Ukraine might seem to have a common view of what conditions must exist to proceed to peace talks.<sup>1</sup> However, reality shows that perceptions of success vary depending on the strategic location and level of involvement in the conflict. The lack of an unequivocal common position on understanding success may result in no accepted solutions. Furthermore, unrealistic Russian prerequisites for peace talks that include Ukrainian neutrality, and a refusal to join the European Union, add to the complexity.<sup>2</sup> Instead of peace, the outcome to the Russo-Ukrainian War will be a protracted ceasefire, as in the case of Russia annexing part of Ukraine in 2014 or the conflict in Korea, creating a continued demand for systems provided by the Land Domain Platforms (LDP) industry.

As the world's most powerful democracy, the United States must view success from a global perspective, preventing a single power from dominating any region.<sup>3</sup> The implicit goal in the 2022 National Security Strategy (NSS) is for Ukraine to resist Russia's continued aggression through an active defense that weakens Russian forces to the point where its leaders recognize the futility of further hostilities. This is a necessary condition. The second determinant of success for the United States is to create a sustainable regional balance of power by providing European allies with the requisite military capabilities to actively deter Russia from using invasion as a future foreign policy option. This means, in practice, that the European members of the North Atlantic Treaty Organization (NATO) will assume primary responsibility for the defense of Europe, with the United States acting as the defender of last resort.<sup>4</sup> This approach is consistent with the NSS.<sup>5</sup> In his interview for the National Broadcasting Company, Jake Sullivan, U.S.

National Security Advisor, summarized this position when he said, "What we want to see is a free and independent Ukraine, a weakened and isolated Russia, and a stronger, more unified, more determined West."<sup>6</sup> This outcome will provide the United States with the freedom of maneuver to deal with the challenge of an increasingly aggressive China.

President Zelensky described the Ukrainian perspective on success in his 10-point peace plan that he presented during the G20 summit in November 2022.<sup>7</sup> From all the requirements, the three most crucial aims from the Ukrainian perspective are restoration of territorial integrity, withdrawal of Russian forces, and establishment of a special tribunal to prosecute war crimes. The most important and, at the same time, the most challenging is the restoration of Ukraine's territory, which includes all terrain occupied since Russian aggression in 2014. According to President Zelensky, this condition is "not up to negotiations."<sup>8</sup> The unspoken measure of Ukraine's success will be maintaining the long-term support of Western countries in prolonged conflict, which will be necessary for restoring territory in the future and continuing sanctions.<sup>9</sup>

A European perspective on success depends upon geographical location. Central European countries see Russia as an imminent threat. They are actively working to increase their military strength and alliances, while countries further west are generating a more measured response, with economic considerations taking a higher priority over increasing military capabilities. Finland's accession to NATO, and the anticipated future finalization of Sweden's accession, strengthens the alliance and increases the need for military interoperability.<sup>10</sup> For European countries, success is a two-fold situation in which Russia cannot conduct aggressive actions using classic warfare measures in the foreseeable future, and the preservation of an independent and free Ukraine. In addition, nations on the eastern flank of NATO view an



increased, modernized, lethal, and strategically-deployed NATO force as a necessary end state of this conflict to deter future Russian malign actions.

In this situation, maintaining unity and coherence will be crucial. The United States should continue to support Ukraine until it can independently counter Russia's aggression, support the building of new capabilities by the countries on NATO's eastern flank, and steadily empower European nations to own the responsibility for ensuring European security. Maintaining alignment between the United States and Western allies in support of Ukraine is a challenge. Domestic political and economic considerations, and other international crises, are bound to weaken allied resolve. Accordingly, the current definitions of success for all parties are likely unachievable, and a protracted ceasefire along lines less than pre-2014 borders is probable.

This end state will drive demand for the U.S. LDP industry to satiate the increasing armament requirements in Europe, especially along the eastern flank of NATO, and rebuilding the Ukrainian Army. In the United States, there is a tremendous opportunity to modernize land domain forces based on the lessons learned in the Russo-Ukrainian War, in conjunction with the depletion of U.S. weapons stockpiles, to bolster programs such as the Optionally Manned Fighting Vehicle, M1 Abrams upgrades, Armored Multi-Purpose Vehicle, and Common Tactical Truck.

## APPENDIX A ENDNOTES

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## **APPENDIX B: Acknowledgements**

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The views and arguments expressed herein do not reflect an official position of the Eisenhower School, the National Defense University, or the U.S. Department of Defense. Further, official documents referenced in this paper do not constitute the originating offices' endorsement of conclusions drawn from or recommendations made about those documents.

## APPENDIX C: Acronyms

AAP	Adaptive Acquisition Process
ACV	Amphibious Combat Vehicle
AMPV	Armored Multi-Purpose Vehicle
APC	Armored Personnel Carrier
APS	Active Protective Systems
BDSV	Federation of German Security and Defense Industries
CCP	Chinese Communist Party
CSGC	China South Industries Group Corporation
CTT	Common Tactical Truck
DCS	Direct Commercial Sales
DIB	Defense Industrial Base
DoD	Department of Defense
DoS	Department of State
FAR	Federal Acquisition Regulation
FMS	Foreign Military Sales
GAO	Government Accountability Office
GDLS	General Dynamics Land Systems
GDP	Gross Domestic Product
GIESD	Global Investment and Economic Security Directorate
JCIDS	Joint Capabilities Integration and Development System
JLTV	Joint Light Tactical Vehicle
ID/IQ	Indefinite-Delivery/Indefinite-Quantity
IFV	Infantry Fighting Vehicle
LDP	Land Domain Platform
KMW	Krauss-Maffei Wegmann
M&A	Merger and Acquisitions
MBT	Main Battle Tank
MCF	Military-Civilian Fusion
MILDEP	Military Department
MoD	Ministry of Defense
MRAP	Mine-Resistant Ambush Protected
NATO	North Atlantic Treaty Organization
NDAA	National Defense Authorization Act
NDS	National Defense Strategy
NERA	Non-Explosive Reactive Armor
NORINCO	China North Industries Group Corporation
NSS	National Security Strategy
PPBE	Planning, Programming, Budgeting, and Execution
PLA	People's Liberation Army
PRC	People's Republic of China

OMFV	Optionally Manned Fighting Vehicle
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
SBIR	Small Business Innovation Research
SCP	Structure, Conduct, Performance
SOE	State Owned Enterprise
SWOT	Strengths, Weaknesses, Opportunities, and Threats
UAF	Ukrainian Armed Forces
UAS	Unmanned Aerial System
VC	Venture Capital

## APPENDIX D: Figures

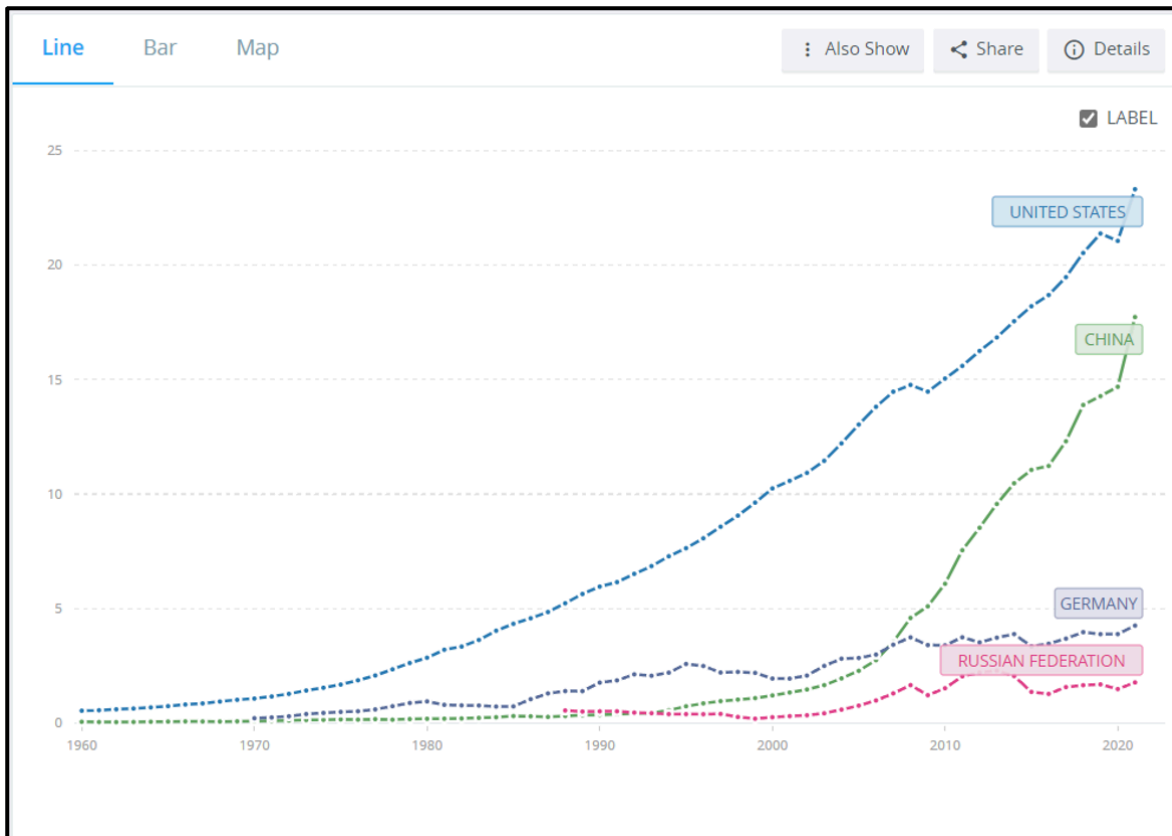


Figure 1. GDP 1990-2021 (United States, China, Germany, Russian Federation)<sup>1</sup>

Although both the United States and China have enjoyed steady GDP growth for decades, German and Russian GDP growth has been inconsistent. As of 2021, the U.S. GDP reached \$23.32 trillion, China \$17.73 trillion, Germany \$4.26 trillion, and Russia \$1.78 trillion. GDP underpins National Defense, as it provides the revenue stream for defense spending through public tax.

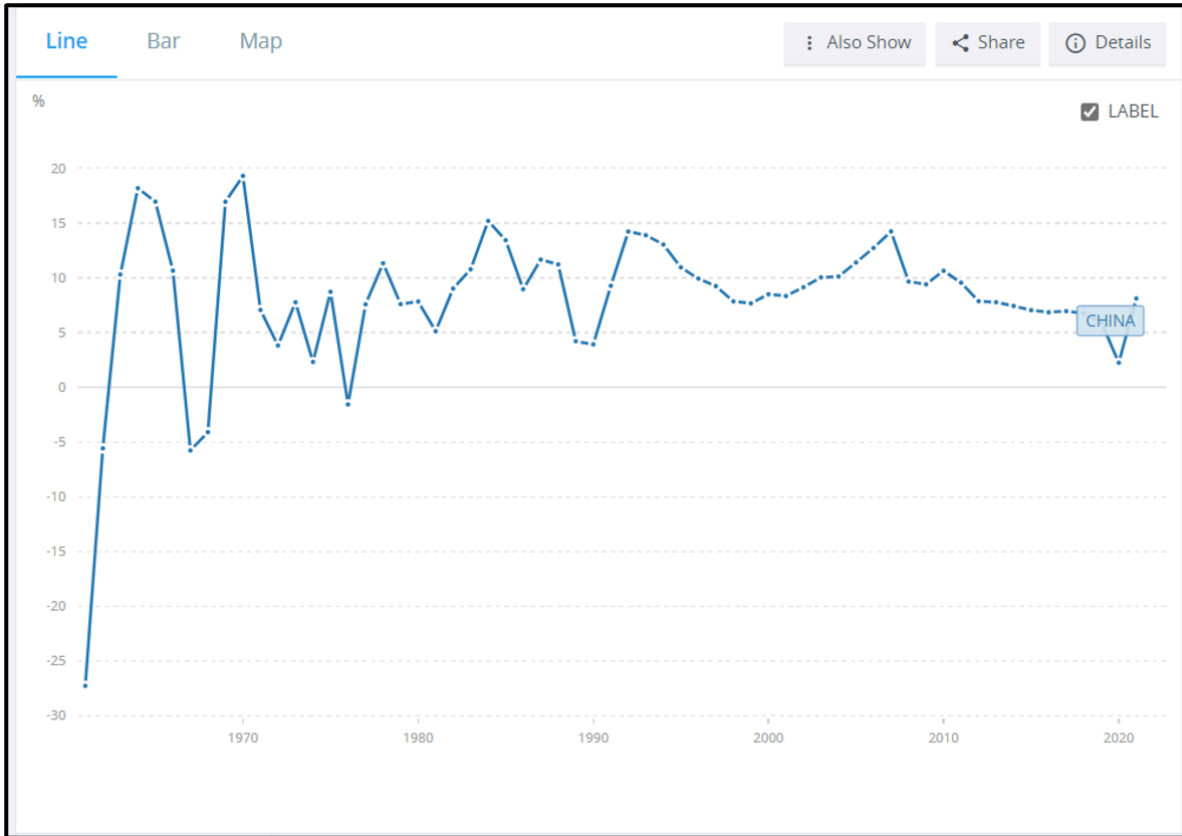


Figure 2. GDP Growth/Annual %, 1960-2021 (China)<sup>2</sup>

China's GDP growth rate has been one of the most consistent of all major countries and has averaged a robust 8% over the past decade. China's 2021 GDP growth rate was 8.1%.



Figure 3. GDP Growth/Annual %, 1990-2021 (Russian Federation)<sup>3</sup>

Russian GDP growth rate has been inconsistent and was recently impacted by COVID-19 as well as international sanctions stemming from their aggressive actions in Crimea and Ukraine. Russia's 2021 GDP growth rate was 4.7%.



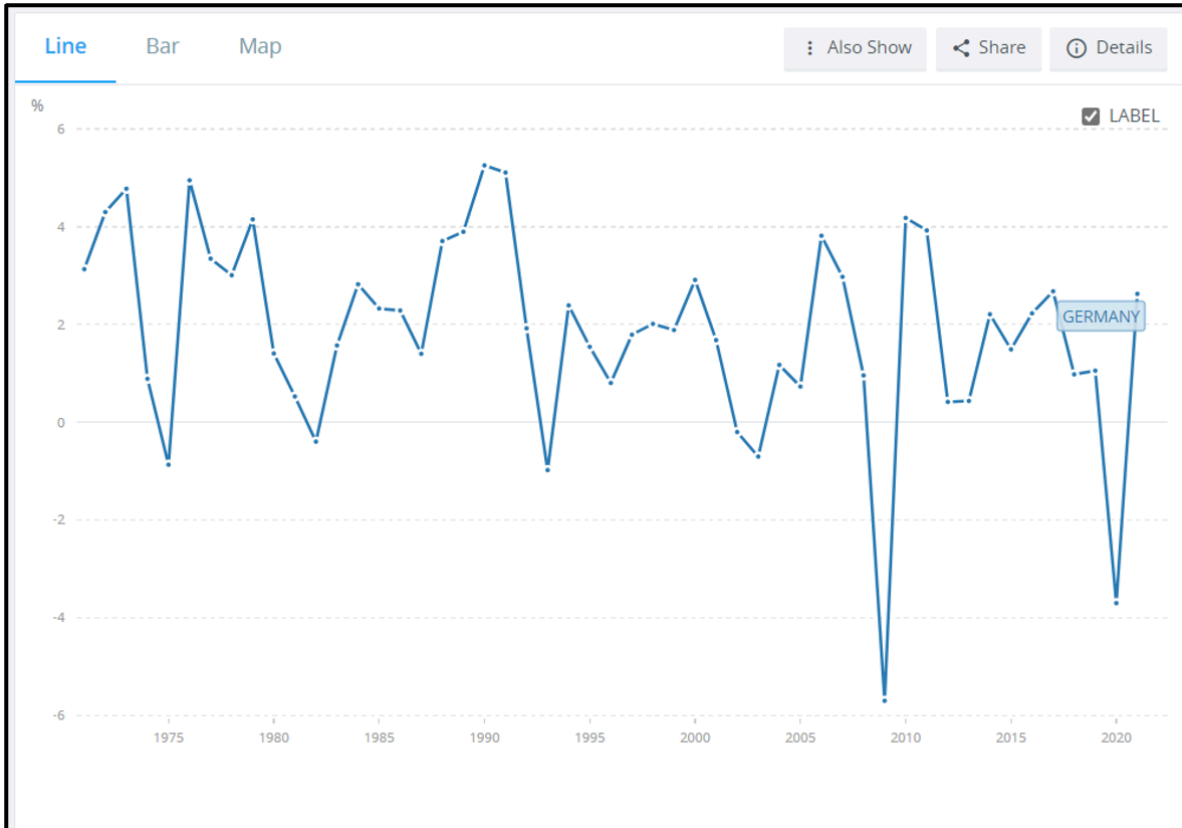


Figure 4. GDP Growth/Annual %, 1970-2021 (Germany)<sup>4</sup>

German GDP growth rate has also been inconsistent and was recently impacted by COVID-19. Germany's 2021 GDP growth rate was 2.6%.

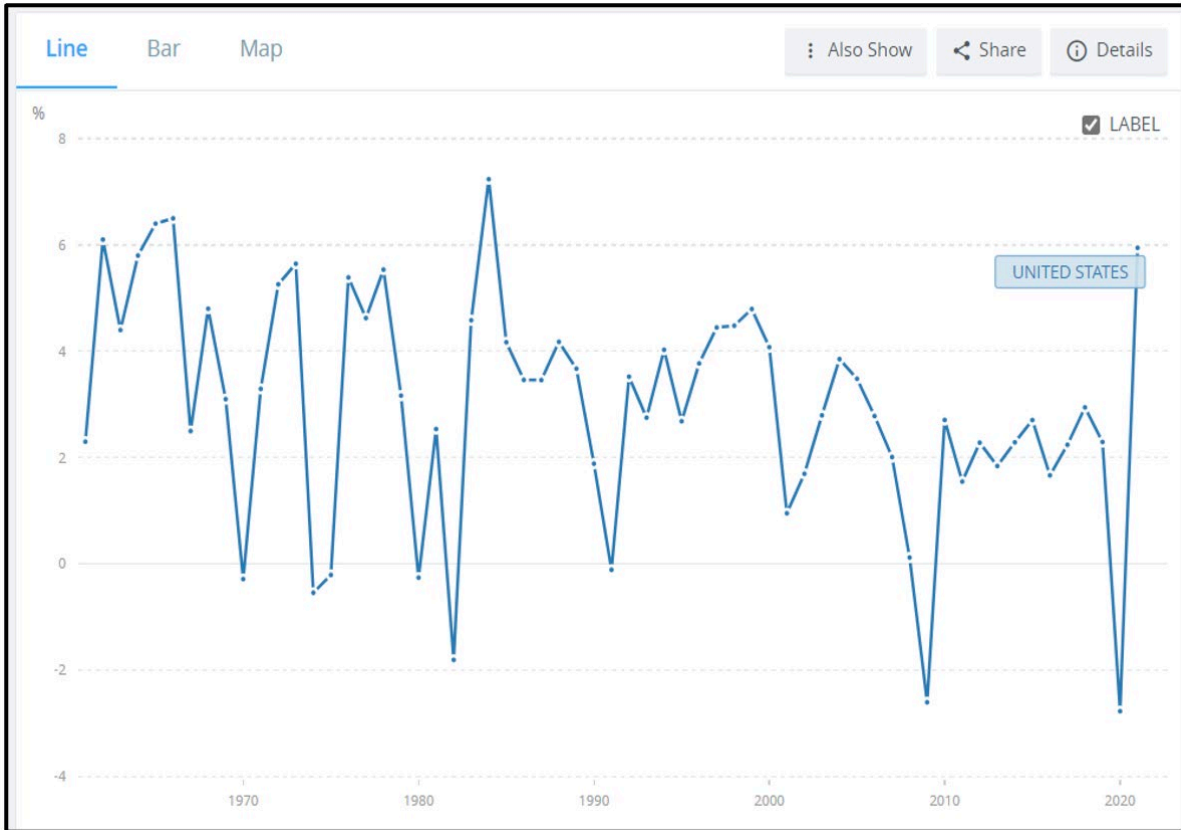


Figure 5. GDP Growth/Annual %, 1960-2021 (United States)<sup>5</sup>

U.S. GDP growth rate has also been inconsistent but generally remained positive for the past five decades. Like many other countries, the U.S. was also impacted by COVID-19. Nevertheless, U.S. 2021 GDP growth rate bounced back to 5.9%.



Figure 6. Military Expenditure (% of GDP) 1990-2021 (United States, China, Germany, Russian Federation)<sup>6</sup>

Although Russia has spent a greater percentage of its GDP on military expenditures than other major countries since 2015, this does not translate into greater overall military spending due to its smaller GDP. Nevertheless, Vladimir Putin is demonstrating his commitment to military capacity. In contrast, both China and Germany remain at a spending rate that is approximately half of the United States by percentage of GDP. As of 2021, Russia spent the equivalent of 4.1% of its GDP on its military, the United States spent the equivalent of 3.5% of its GDP on its military, China spent the equivalent of 1.7% of its GDP on its military, and Germany spent the equivalent of 1.3% of its GDP on its military. The obvious defense spending increase by the United States over the first decade of the 21<sup>st</sup> century was due to wars in Afghanistan and Iraq.

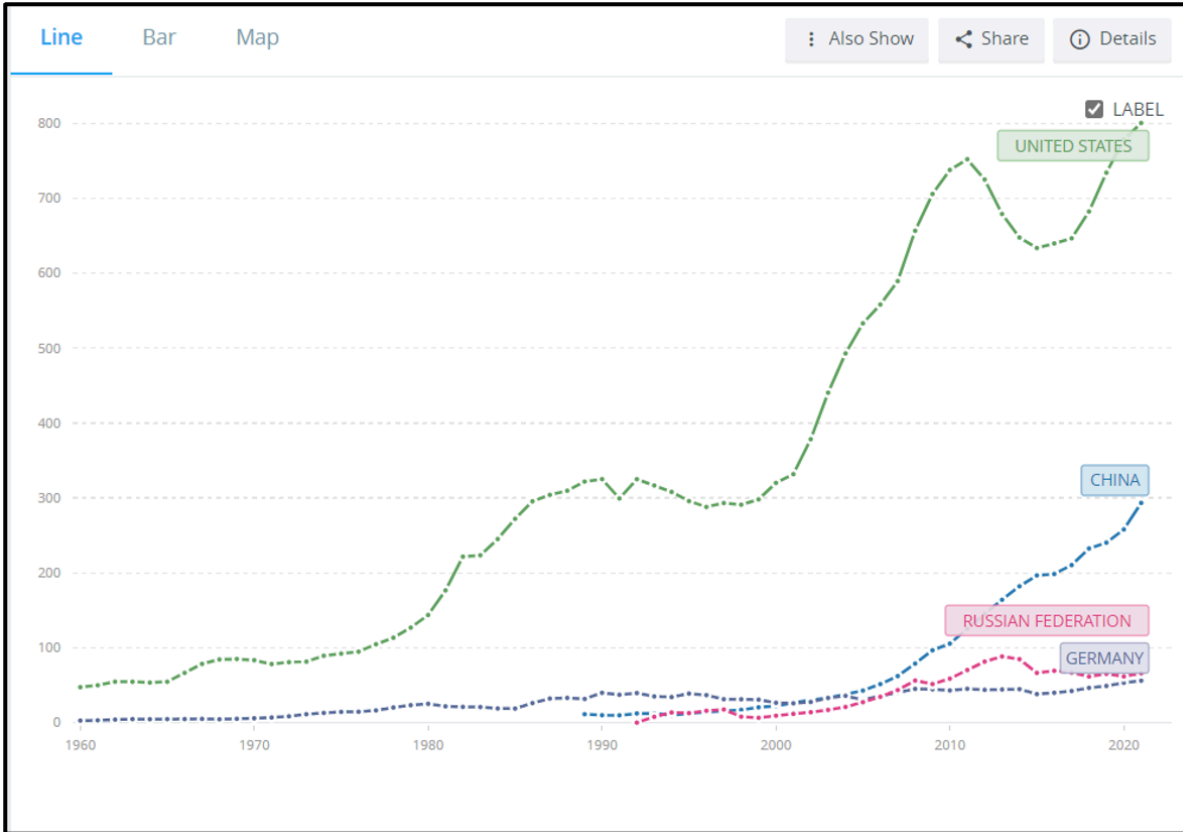
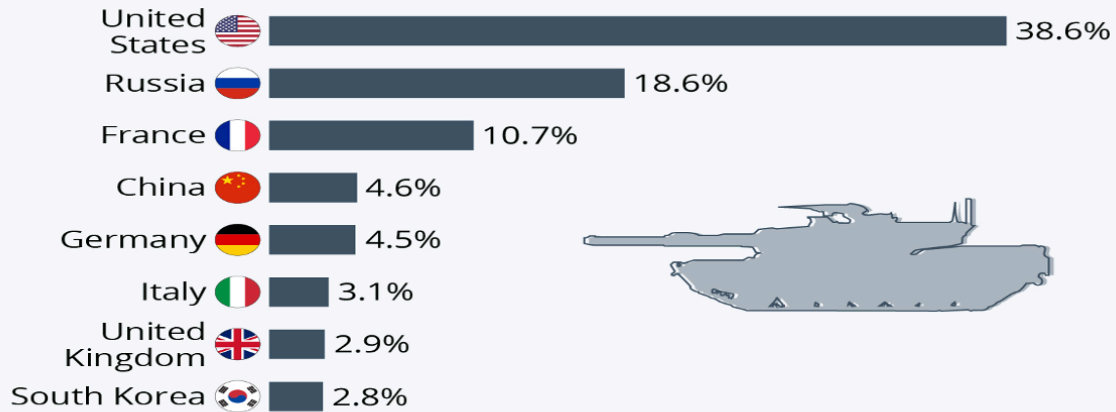


Figure 7. Military Expenditure (current USD) 1990-2021 (United States, China, Germany, Russian Federation)<sup>7</sup>

This figure demonstrates the greater reality of recent military expenditure, with both the United States and China rapidly increasing their overall military spending, whereas Russia and Germany remain relatively consistent. While at some level military spending translates to capacity, this does not answer the question of military innovation and potential deployment of future land domain platforms that may provide overmatch on the battlefield. As of 2021, the U.S. executed \$800 billion on military spending, China executed \$293 billion on military spending, Russia executed \$65 billion on military spending, and Germany executed \$56 billion on military spending.

# The World's Biggest Arms Exporters

Countries responsible for the biggest shares of global arms exports from 2017 to 2021



Source: Stockholm International Peace Research Institute



statista

Figure 8. Global Arms Exporters (Top 8 Countries) 2017-2021<sup>8</sup>

The United States and Russia have dominated arms exports for decades. This helps to stimulate their respective industries when domestic military spending is not as robust. France is also a major player in arms exports. Interestingly, China and Germany have recently remained neck-and-neck, but Germany is a country with a population of 80 million and China 1.4 billion.

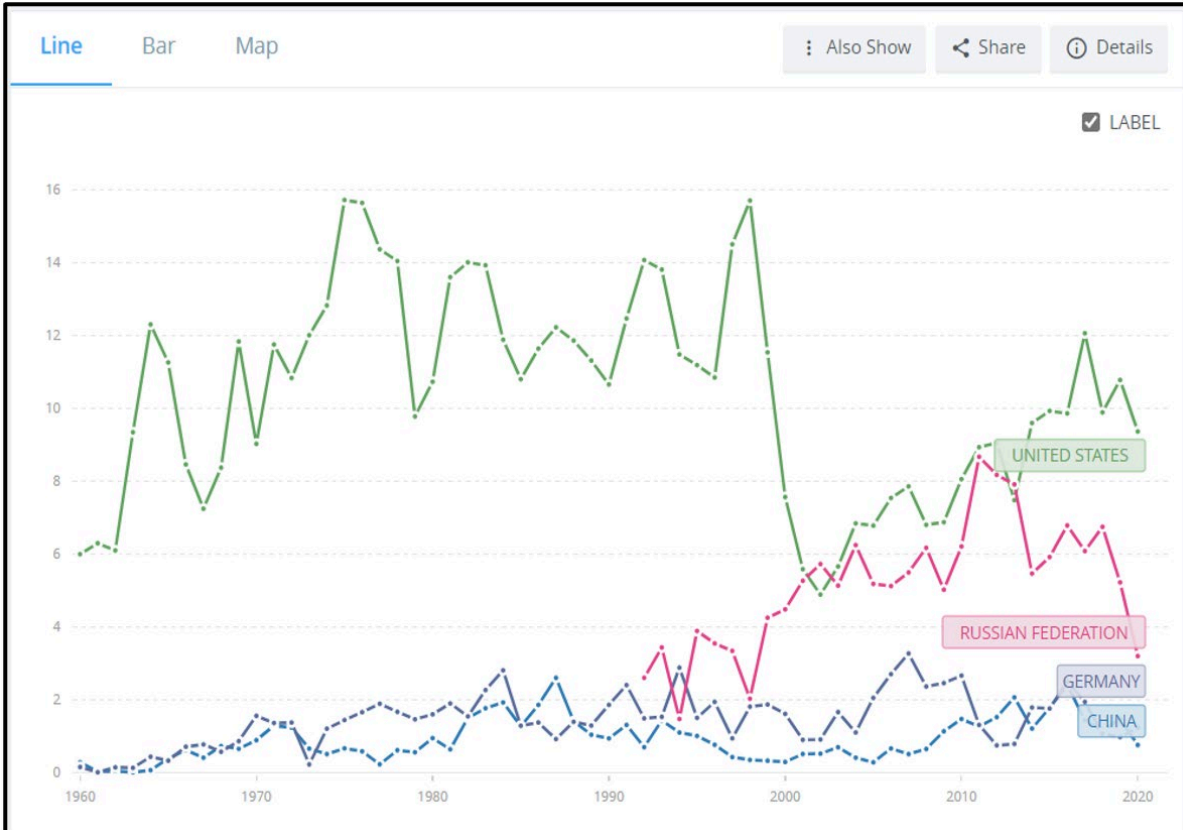


Figure 9. Global Arms Exporters 1990-2021 (United States, China, Germany, Russian Federation)<sup>9</sup>

Over the past two decades, both the United States and Russia had been on an aggressive upward trend with respect to arms exports that curtailed in 2020 due to COVID-19. Germany and China have been relatively constant in their export sales. As of 2021, the United States exported \$9.37 billion in military arms, Russia exported \$3.2 billion in military arms, Germany exported \$1.23 billion in military arms, and China exported \$760 million in military arms.

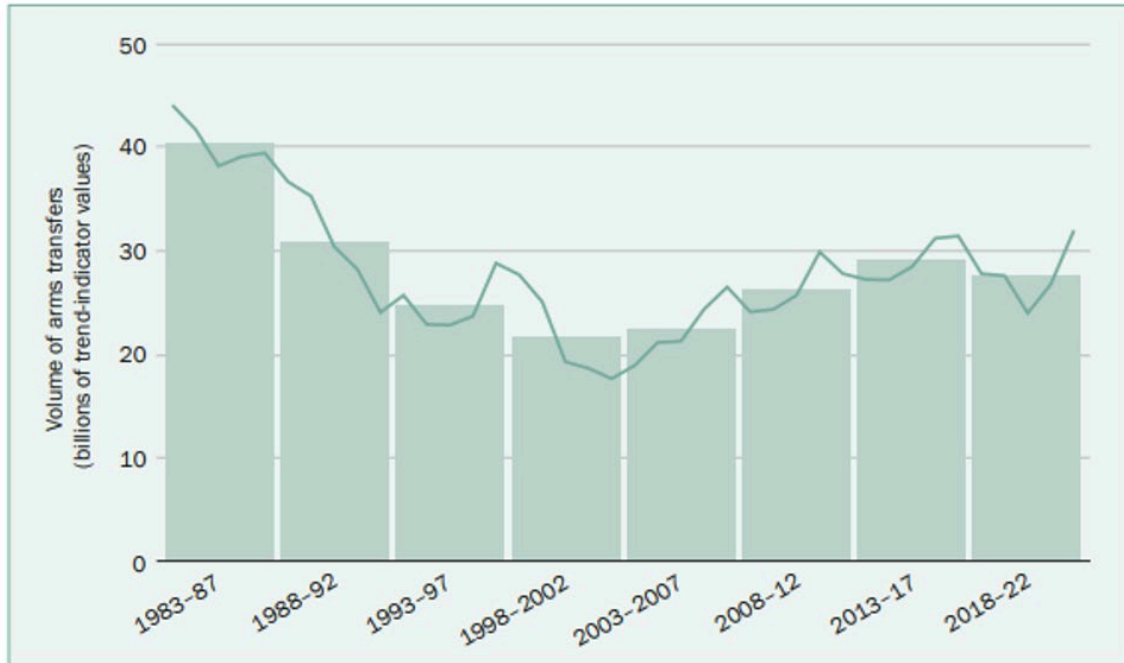


Figure 10. Global Arms Exports 1983-2022 (Five Year Trend Analysis)<sup>10</sup>

Although global arms sales had been trending downward, a dramatic upswing has recently occurred, which is attributed to Russia's recent aggression in the Ukraine.

**Table 1. The 25 largest exporters of major arms and their main recipients, 2018–22**

Percentages below 10 are rounded to 1 decimal place; percentages over 10 are rounded to whole numbers.

Exporter	Share of global arms exports (%)		Per cent change from 2013–17 to 2018–22 <sup>a</sup>	Main recipients and their share of exporter's total exports (%), 2018–22					
	2018–22	2013–17		1st	2nd	3rd			
1 United States	40	33	14	Saudi Arabia	19	Japan	8.6	Australia	8.4
2 Russia	16	22	-31	India	31	China	23	Egypt	9.3
3 France	11	7.1	44	India	30	Qatar	17	Egypt	8.0
4 China	5.2	6.3	-23	Pakistan	54	Bangladesh	12	Serbia	4.5
5 Germany	4.2	6.1	-35	Egypt	18	South Korea	17	Israel	9.5
6 Italy	3.8	2.5	45	Qatar	24	Egypt	23	Türkiye	12
7 United Kingdom	3.2	4.7	-35	USA	20	Qatar	16	Saudi Arabia	7.7
8 Spain	2.6	2.5	-4.4	Australia	35	Saudi Arabia	19	Belgium	12
9 South Korea	2.4	1.3	74	Philippines	16	India	13	Thailand	13
10 Israel	2.3	2.6	-15	India	37	Azerbaijan	9.1	Philippines	8.5
11 Netherlands	1.4	2.1	-39	USA	27	Mexico	11	Tunisia	7.4
12 Türkiye	1.1	0.6	69	Qatar	20	UAE	17	Oman	13
13 Sweden	0.8	0.9	-16	USA	25	Pakistan	24	Brazil	15
14 Switzerland	0.7	1.0	-34	Australia	21	Denmark	14	Spain	13
15 Australia	0.6	0.3	64	Canada	35	Chile	31	USA	13
16 Canada	0.5	0.6	-9.4	Saudi Arabia	49	UAE	22	USA	4.9
17 Ukraine	0.5	1.7	-70	China	48	Saudi Arabia	13	Thailand	7.5
18 UAE	0.4	0.4	-5.8	Egypt	28	Jordan	27	Algeria	15
19 Poland	0.4	0.1	168	Ukraine	95	Nepal	1.2	Ecuador	0.6
20 Belarus	0.3	0.5	-37	Serbia	33	Viet Nam	25	Uganda	14
21 South Africa	0.3	0.3	6.7	UAE	27	USA	21	India	15
22 Norway	0.3	0.6	-55	USA	27	Ukraine	15	Lithuania	14
23 Brazil	0.3	0.2	35	France	25	Nigeria	15	Chile	12
24 Belgium	0.2	0.1	212	Saudi Arabia	35	Canada	28	Pakistan	21
25 Jordan	0.2	0.2	14	USA	61	Egypt	26	Armenia	7.0

UAE = United Arab Emirates.

<sup>a</sup> Figures show the change in volume of the total arms exports per exporter between the two periods.

Source: SIPRI Arms Transfers Database, Mar. 2023.

Figure 11. Global Arms Exports 2018-2022 (Top 25 Exporters)<sup>11</sup>

Several interesting points are evident from this table. Note that: (1) China remains a major customer for Russia, (2) U.S. global share has increased by 7% over the last five-year period, (3) Russia/China/Germany/UK have lost a significant market share within this industry, and (5) South Korea has experienced dramatic growth in this industry.



## Appendix D ENDNOTES

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<sup>1</sup> “GDP,” Macrotrends/The World Bank, accessed May 17, 2023, United States available at <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=US>, China available at <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=CN>, Russia available at <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=RU>, Germany available at <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=DE>.

<sup>2</sup> “GDP Growth (annual %) – China,” Macrotrends/The World Bank, accessed May 17, 2023, <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=CN>.

<sup>3</sup> “GDP Growth (annual %) – Russian Federation,” Macrotrends/The World Bank, accessed May 17, 2023, <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=RU>.

<sup>4</sup> “GDP Growth (annual %) – Germany,” Macrotrends/The World Bank, accessed May 17, 2023, <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=DE>.

<sup>5</sup> “GDP Growth (annual %) – United States,” Macrotrends/The World Bank, accessed May 17, 2023, <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=US>.

<sup>6</sup> “Military Expenditure (% of GDP),” Macrotrends/The World Bank, accessed May 17, 2023, United States available at <https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=US>, China available at: <https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=CN>, Russia available at: <https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=RU>, Germany available at: <https://data.worldbank.org/indicator/MS.MIL.XPND.GD.ZS?locations=DE>.

<sup>7</sup> “Military Expenditure (current U.S. dollars),” Macrotrends/The World Bank, accessed May 17, 2023, United States available at <https://data.worldbank.org/indicator/MS.MIL.XPND.CD?locations=US>, China available at: <https://data.worldbank.org/indicator/MS.MIL.XPND.CD?locations=CN>, Russia available at: <https://data.worldbank.org/indicator/MS.MIL.XPND.CD?locations=RU>, Germany available at: <https://data.worldbank.org/indicator/MS.MIL.XPND.CD?locations=DE>.

<sup>8</sup> Katharina Buchholz, “The World’s Biggest Arms Exporters,” Statista, March 14, 2022, accessed May 17, 2023, <https://www.statista.com/chart/18417/global-weapons-exports/>.

<sup>9</sup> “Arms Exports (SIPRI trend indicator values),” Macrotrends/The World Bank, accessed May 17, 2023, United States available at <https://data.worldbank.org/indicator/MS.MIL.XPRT.KD?locations=US>, China available at: <https://data.worldbank.org/indicator/MS.MIL.XPRT.KD?locations=CN>, Russia available at: <https://data.worldbank.org/indicator/MS.MIL.XPRT.KD?locations=RU>, Germany available at: <https://data.worldbank.org/indicator/MS.MIL.XPRT.KD?locations=DE>.

<sup>10</sup> Peter D. Wezeman, Justine Gadon, and Siemon T. Wezeman, “Trends in International Arms Transfers 2022,” Stockholm International Peace Research Institute, March 2023, accessed

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May 17, 2023, 2, <https://www.sipri.org/publications/2023/sipri-fact-sheets/trends-international-arms-transfers-2022>.

<sup>11</sup> Ibid, 3.