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# Horses, nails, and messages: Three defense industries of the Ukraine war

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**ABSTRACT**
Major arms producing states and defense firms have struggled to supply the Ukraine war's massive demand for munitions. Key elements of the war—such as artificial intelligence-enabled analysis of data obtained from commercial surveillance satellites transmitted by the privately-owned Starlink network—have emerged from new providers as well as developed organically on the battlefield. Research failed to anticipate this due largely to the discipline's focus on the "defense industry" rather than three distinct "defense industries" highlighted in the war: platforms such as tanks, commodities such as artillery shells and loitering munitions, and militarized "tech" such as commercial satellites and artificial intelligence. Understanding each requires a distinct political economic approach. Using these three lenses, the article concludes that the United States retains advantages in all three industries, Europe risks regressing into a commodities producer, and China seeks to disrupt, rather than duplicate, American defense industrial advantages in technology.

**KEYWORDS** Ukraine; military technology; defense industry; space; defense economics

*For want of a message the battle was lost.*
*For want of a battle the kingdom was lost.*
*And all for the want of a horseshoe nail.*

Well into the second year of fighting in Ukraine, it remains clear that scholars, like the defense industry itself, need to shift focus given the failure to anticipate the amount and type of materiel required for a major conventional war, as well as for longer-term, ongoing competition between great powers. International politics, to borrow Harold Lasswell's famous definition, is in no small part a matter of who gets what weapons, when, and how. To better understand the defense industrial demands of this era scholars must focus on what, when, and how weapons are being produced, transferred, and used in Ukraine, as much as their historical concern over who buys and sells them.

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Of course, who produces major conventional weapons still matters. Perhaps the largest surprise is the poor performance of Russian equipment on the battlefield, its near-complete reliance on imported technology, and the dismal industrial future given Western sanctions on everything from machine tools to microchips. Robust European states' budget growth, such as the dramatic if still unrealized German *Zeitenwende*, coupled with the quick movement by the European Peace Facility specifically and the European Council broadly, appear poised to inject new life into a sleeping defense industrial giant. South Korea, Turkey, and Iran have transferred consequential capabilities into the theater. These trends were, however, already apparent in traditional measures of defense industrial prowess prior to the invasion.

On the other hand, the global defense industry and the states that dominate it have largely failed to deliver to either belligerent sufficient ordnance or the novel technologies required to rapidly and effectively complete a kill chain. The major global defense firms (the "prime contractors") are not known for their munitions output, and other key components of combat in Ukraine—such as AI-enabled analysis of data obtained from commercial surveillance satellites transmitted by the privately-owned Starlink network—have relatively little connection to primes or even governments.

To answer "why were we wrong?" about the war's industrial aspects, the article blames the discipline's focus on the "defense industry" rather than "defense industries." The central argument is that addressing what, when, and how weapons are made and transferred requires considering at least three distinctive political economies: *platforms* such as tanks, *commodities* such as artillery shells, and military *tech* such as commercial satellites and Artificial Intelligence (AI). Each industry plays a crucial role in Ukraine, and thus understanding the war's defense industrial implications requires applying three distinct approaches.

## Academic consensus before the Ukraine war

Research on the political economy of defense rests on its subject's particularity relative to most economic life. Arms producers, private or public, have a distinctive customer (a) and a unique product (the tools of state violence). Much of this work accordingly focuses on agents—the oligopolistic nature of the sellers, the demands of the military end user, and the monopsonistic nature of governmental buyers (Gholz & Sapolsky, 2021; Hartley, 2020). The research identified and supported the conclusion that the end of the Cold War, the rise of globalization, and especially modern conventional weapons' apparently inexorable rise in complexity, have placed the United States (US) in a uniquely advantaged position.

Scholars have long understood that the cost of producing weapons outstrips inflation (Hartley & Solomon, 2016). Explanations vary, but a major component underpinning this trend is that, whereas technology often makes increasing capability cheaper (personal computers being a classic example) the "unending competition for military advantage between buyers of weapons systems" inhibits this (Brauer et al., 2021, p. 12). This has led some defense economists to christen modern weapons as "Augustine goods," after the defense industrial executive who infamously predicted the US would be down to a single combat aircraft by 2054 (Augustine, 1997; Brauer et al., 2021; Markowski et al., 2023).

Continued U.S. market dominance of this complex product with limited civilian applications seems overdetermined (Neuman, 2010), due to massive defense budgets (especially military research and development), relatively autarkic supply chains (Brooks, 2005), economies of scale and network effects (Caverley, 2007), a robust industrial and operational ecosystem (Gilli & Gilli, 2016), and its near-constant fighting in wars. While China may have the financial capacity and political will to compete, it has its work cut out for it (Gilli & Gilli, 2019). Indeed China devotes most of its military resources to defending against U.S. conventional superiority in areas close to its borders, a relatively more modest task. Europe continues to struggle with collective action problems to generate the necessary research and economies of scale (Bergmann & Besch, 2023; Calcara, 2020; Kleczka et al., 2020). Other states pursuing self-sufficient defense industries despite the high economic costs and the need for foreign technology—Turkey and South Korea being prime examples—are branded as quixotic "technonationalists" (Bitzinger, 2015; Devore, 2013).

Even prior to the war, more policy- and tech-focused analysis has recently challenged this scholarly consensus, identifying potentially "disruptive" technology such as cyber weapons, AI, and uncrewed vehicles (see Raska, 2020 for an extensive overview). "Gold-plated" systems, even if uncrewed and AI-governed, are simply too expensive compared to competing, cheaper swarms (Hammes, 2016; Schneider & Macdonald, 2023). As one former senior U.S. Congressional staffer—now Chief Strategy Officer of defense tech firm Anduril Industries—argues, perhaps self-servingly, "Success will require a different kind of military, one built around large numbers of small, inexpensive, expendable, and highly autonomous systems" (Brose, 2019, p. 124).

Defense industrial scholars acknowledge that technologies such as AI may be "frame-breaking rather than just frame-bending advancements," but are skeptical that the defense industry's unique political economy will be overthrown, "as military buyers will resume their quest for the perfect swarm of drones to prevail over all other drones to be controlled by the most potent of all quantum computers available at the time" (Brauer et al., 2021, p. 13). The US and its prime contractors are uniquely skilled at incorporating subcontractors for everything from radars to windshields to software, via the esoteric art of systems engineering (Dombrowski & Gholz, 2006), and indeed have a head start of a decade or more over rival states and firms. The diffusion of world-changing technologies throughout the global economy does not necessarily correlate to a similar, even diffusion of military applications (Ding & Dafoe, 2023). Given the complexities of building modern military power, Gilli and Gilli (2016) predict that any type of drone system, including loitering munitions, would be dominated by the US for a long time to come.

Over the past two decades, the "who" has yet to be changed by any technological disruption. Rather than fundamentally reshape the overall global arms market (generally considered a proxy for defense industrial capability), the war has added further impetus to preexisting trends according to the Stockholm International Peace Research Institute (SIPRI, 2023), which, while not without limitations (Perlo-Freeman, 2018), remains the field's gold standard for data. Figure 1 shows that the US increased its arms exports by 14% in 2018–2022 compared to 2013–2017, while Russian exports dropped by 31% in the same period. The United Kingdom, France, Germany, and Italy jockey among themselves over a consistent fifth of the market. As a whole, the rest of the world's share has peaked, although South Korea was steadily gaining long before the Ukraine War. On the other hand, Turkey has never cracked SIPRI's top ten exporters, and will not do so this year either.

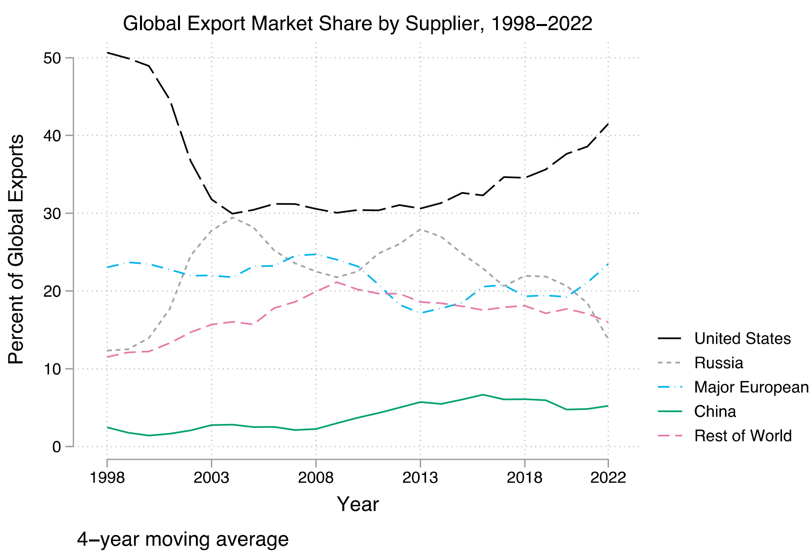


**Figure 1.** Global arms market share by exporting country (Source: SIPRI).

## What precisely did we get wrong?

The stability of the market for major conventional weapons misses some of the most important defense industrial facts uncovered in the Ukraine war, however. The world is relearning one of war's immutable lessons: ammunition runs out quickly. Ukraine's unexpectedly ferocious defense and counterattack would be impossible without leveraging many capabilities—commercial satellites, AI, social networks—that can be lumped under the amorphous but ubiquitous label of the "Fourth Industrial Revolution" or, more simply, "tech."

Smaller, cheaper, and attritable weapons have driven much of the war. In its initial phase, short-range, light, inexpensive and relatively simple anti-tank weapons provided by the West and adeptly adopted by Ukrainian fighters decimated Russian armor. At the same time, military drones such as Turkey's TB-2 as well as civilian versions such as those made by China's DJI played a vital role in both persistent surveillance and pinpoint attacks. Well into the conflict, the kit most required by Ukraine is the lowly 155 mm artillery shell.

At an approximate cost of $500–3,000 per round, Ukraine's consumption of 5,000 shells a day amounts to a relatively small share of the war's total expense (Beinart, 2022; Brady & Goethals, 2019). The approximate value of the 50 TB-2s Turkey claims to have supplied Ukraine is a mere $250 million (Zaman, 2022). The fact that a weapon's military usefulness is not captured by its price suggests the need to reconsider the field's research priorities.

The field also has difficulty anticipating and explaining a host of rapidly-evolving capabilities exhibited in the conflict. The provision of timely, secure, and accurate command and control, surveillance, communications, and targeting has helped the Ukrainian war effort immeasurably. Conversely, Russia's relative deficit in these capabilities has hamstrung its campaign. For example, Ukraine has created a remarkable and effective battle management network by using its pre-existing digital network GIS Arta to create "Uber for artillery," collecting data from many sources, providing "rapid calculation of firing options and alerting of firing units," and cutting targeting time "from twenty minutes to one" (Freedberg, 2023).

The novelty of the applications in Ukraine, the lack of prime contractors, and the plucky narrative of Ukrainian success against a reputed space and cyber behemoth have led many defense industrial outsiders (commercial and scholarly) to hail a stunning shift in warfighting that does not redound to great powers' favor (Blank et al., 2023; Shead, 2022) This has led technology-oriented observers to describe the conflict as the "first networked war" (Schmidt, 2022).

In short, research on the political economy of defense has missed many of the key capabilities driving the outcome to date. And the usual suspects in the defense industry have largely failed to provide them.

## Why we were wrong: The global defense industry

To understand where we went wrong, we should start with SIPRI's invaluable data on the global arms trade. A cursory inspection reveals that almost half of the market consists of aircraft. Incorporating transfers of ships and armored vehicles accounts for nearly three quarters. The data makes clear an embarrassing fact: The quantitative and qualitative analysis of the arms trade is largely the study of fighter aircraft (Brooks, 2005; Gilli & Gilli, 2019; Rounds, 2019). While important weapons, aircraft, much less ships, have not been the war's pivotal weapon.

The US continues to dominate arms transfers per standard measures, but these do not tell us much about the defense industrial forces shaping the war at the ground level due to a focus on platforms with big price tags not playing major roles. If seeking to identify what we got wrong, we must acknowledge that many of the most important components of the war in Ukraine—artillery rounds, loitering munitions, sensors, communications networks, and electronic warfare—register in SIPRI's data only occasionally or not at all (Perlo-Freeman, 2018).

## How to be less wrong: Global defense *industries*

This article argues for analytically dividing the defense industry into three categories, epitomized by the war's essential weapons: the tank, artillery and loitering munitions, and AI enabled by satellites. These industries are sufficiently vital to modern conflict, and sufficiently different in their political economies, to merit separate consideration.

### *Industry one: Tanks and other platforms*

As noted above, defense industrial research traditionally focuses on products like fighter aircraft and armored vehicles. While the global market for these advanced weapons has soard, their introduction onto the Ukrainian battlefield has been very gradual. Nonetheless, as Europe rearms against Russia, and the world anticipates a potential Sino-American clash, these weapons will continue to shape international politics.

Military platforms are complex systems of which the vehicle is but the most visible part. Tanks and fighters are platforms, but so are advanced missiles and drones. Platforms' distinctiveness is not based on price, but the process that makes them so costly: combining sensors, propulsion, communications, computing power, and destructive capability through an arcane and specialized discipline of systems engineering in which prime contractors specialize. They take a long time to develop and produce, and have huge economies of scale and network effects (Caverley, 2007).

The differences between three ongoing “sixth generation” fighter aircraft development programs are instructive. For the U.S. Next Generation Air Dominance fighter (NGAD), two prime contractors are competing to please a single customer that has successfuly built two fifth generation fighter programs. In contrast, in both the French-German-Spanish Système de Combat Aérien du Futur (SCAF) and the United Kingdom-Japan-Italy Global Combat Air Program (GCAP), a single prime contractor is catering to a consortium of customer-states, hoping to skip a generation to replace aircraft such as Eurofighter Typhoons and Mitsubishi F-2s (Martin, 2023). The U.S. Air Force (2023) has already spent $6 billion on NGAD research and plans on another $22 billion over the next five years. Having spent just $170 million up to 2022, SCAF countries have committed $3.3 billion through 2025 (Ministry of Defense 2022; Hemler, 2023). The United Kingdom has committed $2.5 billion of research to date (Martin, 2023). The US has been flying demonstrator aircraft since 2020, while GCAP and SCAF plan their first prototype flights in 2027 and 2029, respectively.

US domination of the market for platforms seems secure. In that sense scholars’ pre-Ukraine analysis holds up. While Ukraine’s supporters have not supplied tanks, aircraft, rocket launchers in the amount and at the speed Ukraine would like, this is largely due to supplier states’ political decisions. On the other hand, the US and its partners have failed to provide at scale many of the actual tools of war for which there is political objection and which their client state desperately needs. Clearly, the field got something wrong.

## *Industry two: Artillery rounds, loitering munitions, and other commodities*

Like the proverbial horseshoe nail, munitions both play a vital role in war and are essentially commodities. Artillery rounds, cheap drones, and even shoulder-launched missiles are comparatively simpler, largely interchangeable, and relatively low cost. Ammunition specifications are largely standardized; any 155 mm shell is more or less compatible with many different artillery barrels. Even more advanced and expensive munitions, such as shoulder-launched anti-tank missiles, are substitutable.

Whereas almost a decade ago, Gilli and Gilli (2016) envisioned drone warfare as the exclusive province of major powers, the Ukraine war is speeding an ongoing divergence between uncrewed aerial vehicles (UAVs) with the traits of a platform and those of a munition. Loitering armed munitions (LMs) and tactical surveillance drones have become cheaper and more plentiful, while more sophisticated surveillance drones (ISR) and uncrewed combat air vehicles (UCAV) rival crewed aircraft in their complexity. Most uncrewed systems operating in Ukraine are the former. Ninety percent of UAVs employed are lost (Zabrodskyi et al., 2022). One observer described the TB-2 as the "Kalashnikov of the 21st century," epitomizing both the weapon's ubiquity and its commodification (Tavsan, 2022).

As with platforms, munitions are largely provided by profit-seeking firms dealing almost exclusively with government clients. Unlike platforms, economic insights from civilian commodity markets will help us understand the future of munitions production and transfer. Manufacturers of commodity-like goods such as cement, lower-end semiconductors, and even solar panels tend to compete more on speed, scale, and cost rather than quality or product differentiation. The barriers to entry are relatively low as are profit margins. For these reasons, ammunition is generally produced not by the largest prime contractors but a mixture of state-owned arsenals, smaller firms such as South Korea's Poongsan and Slovakia's ZVS, and more diversified companies like Saab and Rheinmetall. Producers have little pricing power, and are often subject to the moves of "market makers," large actors on the buy side that serve as both consumer and intermediary for other buyers.

In commodities markets, soaring demand is often followed by its cratering, especially as peacetime militaries tend to short-change ammunition purchases to fund investments in larger, longer-term platforms (Sterenfeld, 2023). While firms may try to hold out for long-term contracts before building more production, it is hard for commodity producers to avoid boom and bust cycles.

Their political economic nature also makes it relatively hard to regulate these weapons. DJI insists that its drones are not designed for military applications, and the firm has refused to sell to either Ukraine or Russia. This did not prevent both sides from using the company's Mavic drones by the thousands this year.

The U.S. defense industrial base does not focus on commodities, despite having a tremendous latent capacity to produce them. The vast majority of additional funds appropriated in the war's wake are not for artillery rounds but for platform-like missiles like LRASM intended "for a higher-end fight" (Seligman & Hudson, 2023). Despite its relatively low priority, the US seeks to boost its pre-war monthly production of 155 mm shells from 3,250 to 90,000 by 2025 (Cancian, 2023). One small U.S. firm, only formed in 2017, developed the Phoenix Ghost LM specifically for Ukrainian forces (Copp, 2022), delivering 1,800 as of March 2023 (Mitchell &

Robertson, 2023). Along with 700 Switchblades, the vast majority of the initial tranche of LMs supplied to Ukraine came from the US.

Just because you need horseshoe nails does not mean you should make them yourself. The European Peace Facility (EPF) has dedicated €1 billion to reimbursing countries that can immediately donate ammunition in 2023 and another €1 billion to jointly buy newly produced ammunition the following year, a roughly comparable amount to the US' spending increase (European Defense Agency, 2023). These contracts will only go to European Union (EU) and Norwegian companies (Barigazzi, 2023). A separate €500 million from the EU budget, via the Act in Support of Ammunition Production, specifically targets building more 155 mm production capacity within EU members. Conversely, the US has already contracted with Australia, South Korea, Romania, and other states for munitions (Lubold et al., 2023). At the end of 2022, the U.S. Congress directed $1.3 billion, roughly what the EPF will spend in total this year, specifically towards purchasing foreign-produced munitions. Manufactured commodities are generally outsourced by the global North to the global South; it is not clear that munitions should work differently.

Observing both markets, the CEO of Nammo, Europe's largest munitions manufacturer, predicts "a longer route in Europe" to rebuilding the industry compared to the US, which is both "less protectionist" and has "more of a long-term view on the market" (Jakes, 2023). Munitions production is a relatively small percentage of the U.S. defense industrial base and the US military is a relatively small consumer. Nonetheless, the US can play the role of a commodities "market maker" because it is a very large buyer that can both increase production relatively cheaply and yet is happy to outsource manufacturing.

## *Industry three: Satellites, artificial intelligence, and other "tech"*

Whereas platforms are a highly specialized differentiated product and munitions are commodities, the economic nature of dual-use Fourth Industrial Revolution technologies remain unclear. The civilian as well as military market for these products is still developing and being contested. Their production and use pose what Gilli and Gilli (2016, p. 52) call "adoption" challenges; the weapons are not difficult to produce but the "infrastructural support" they require is a developing, complicated, and competitive ecosystem that ties together countries, primes, and other "tech" firms.

Because this market is rapidly evolving and data scarce, this section poses questions that the field should attack in understating this industry's unique political economy. First, what are the characteristics of these technologies? Second, what is the balance between governments and the firms that produce these technologies? The answers to these first two questions are necessary to begin addressing a third: Which states, if any, will dominate the industry?

The concept of a technology-enabled "kill chain" is of course not new, nor is the vital contribution to it made by information. In the 1970s, the US developed precision guided munitions and the intelligence and communications infrastructure needed to guide them as a means of "offsetting" a perceived Soviet conventional advantage in Central Europe (Adamsky, 2010, p. 59). A decade after this system's remarkable success in the first Gulf War, and building on rapid developments in commercial information technology revolution, serious military thinkers (Owens & Offley, 2000) predicated the impending U.S. ability to "lift the fog of war." The U.S. Defense Department's call for a "Third Offset" was a recognition that countries like Russia, China, and even Iran were also developing these capabilities, requiring the US to draw on "advanced technologies, such as artificial intelligence, cyber capabilities, unmanned systems, and machine learning" (Gentile et al., 2018, pp. ix–x).

Long before Ukraine, the Pentagon understood that, given these technological ambitions, it would have "to change how it did business, especially in relation to the acquisitions process—i.e., cultivating and acquiring new technologies, absorbing innovations, and developing entirely new operating concepts to make use of them" (Gentile et al., 2018, p. 3) to include transforming the defense industrial base to include commercial firms and technologies (Transforming the Defense Industrial Base, 2003; although see Dombrowski & Gholz, 2006 especially ch. 5). Nonetheless, it is undeniable that a new set of companies—some, like Anduril, specializing in defense and some, like Microsoft, almost entirely commercially-focused—have played prominent (and self-publicized) roles in Ukraine.

The once-simple military acronym C2 ("command and control") has now metastasized into C5ISR ("command, control, communications, computers, cyber, intelligence, surveillance and reconnaissance"). The acronym's ludicrous nature does capture both the increased importance and complexity of managing information in completing a kill chain. Ukraine has demonstrated the demand to incorporate them in novel ways on the modern battlefield, and has entailed a great deal of learning by Ukraine, Russia, and other observers.

Although this is by no means assured, this article assumes that, unlike tanks and artillery shells, satellites and especially AI approach the status of "general purpose technologies" (GPTs), akin to steam power or microelectronics. While successful, economy-wide GPT exploitation can radically change the global balance of power, here we focus on whether these GPTs reshape the production of military power and thus the nature of the defense industry (Ding & Dafoe, 2023; Horowitz, 2018).

In civilian applications, much less military ones, plausible economic cases can be made that such GPTs will be commodified (akin to electricity) or result in powerful near-monopolies (akin to Google). The tendency of GPTs to diffuse across entire economies, many security scholars argue, will "make it more difficult to maintain 'first-mover advantages' in applications of narrow AI. This could change the balance of power, narrowing the gap in military capabilities not only between the US and China but between others as well" (Horowitz, 2018). Other analysis suggests these technologies will exacerbate the rise of near-monopoly firms due to the self-reinforcing cycles that strengthen leading firms: the more users a company has, the more data it can access, allowing it to develop a better product that will attract even more users (Lee, 2018; Waters, 2023).

Consider Starlink, which has become Ukraine's military communications backbone. Affordable inhouse launch is but the first layer in parent company SpaceX's stack. Its 3,000 satellites are hard to destroy, its terminals are quickly transported and easily hidden, the beam linking the two is narrow and hard to jam, and the data stream can push large amounts of information to small tactical units (Hammes, 2023, p. 5). In 2021, Starlink satellites accounted for 81% of the number of American payloads launched into space, and 75% of the world's, giving a sense of both SpaceX's and the U.S. position in the market (Aerospace Security Project, 2022).

Perhaps even more important than the balance between tech companies and prime contractors is that between firms and their government customer/regulator. Future research must address two vital questions. Which balance of public and private results in the most successful military exploitation of these technologies? Given this first answer, what is the relative influence of the two parties over how, where, and when this technology is employed?

Kurth Cronin (2019) argues that military innovation no longer solely takes place within the government-dominated defense industrial base but instead in an open innovation system that includes commercial players. The director of U.S. European Command's "command, control, communications and computers/cyber" describes the

> step up in performance just because our commercial partners have been able to keep up with the technology and they're putting newer and newer capabilities and technology into place … The constellations that our commercial partners are putting up help fill in a whole bunch of gaps and make us more connected than ever. (Albon, 2022)

There is certainly a case that private companies (and private capital) are necessary, but probably not sufficient to complete many wartime kill chains. It seems clear that new firms will rise and their relationship with their government (or governments) will be contested. While analysts must address the potentially novel economics of "tech," the lens of good old-fashioned defense economics, which takes seriously the balance of power between the supplier firms and the government role as both buyer *and regulator* also has a place. If space and AI become increasingly competitive, with many firms offering similar services, this should shift bargaining power to governments. Even if public sources become an increasingly small percentage of firm revenue, governments still have powerful regulatory abilities, especially when it comes to security.

Will the military exploitation of these GPTs diffuse to China, the major European states, or even smaller countries? Tech enthusiasts certainly predict this, pointing out that "Ukraine's military is not burdened with the U.S. Defense Department's decades-old acquisition process and 20th century operational concepts. It is learning and adapting on the fly" (Blank et al., 2023). Again, the factors behind Ukraine's kill chain prowess are impossible to know at this stage given how intimately and secret are the ties between US government agencies, American firms, and Ukrainian forces. After all, since at least the 1970s, the US has, more than any other country, invested in the many components of information-intensive warfare.

For all of Ukraine's success, if any country is likely to overturn US military dominance in space and AI, it will be China. China clearly seeks to compete with the US in both. Xi Jinping has dedicated his party to making China a "space power in all respects" (Bowe, 2019). Kania (2021) synthesizes copious Chinese policy writing to argue that the People's Liberation Army (PLA) regards AI "as a unique opportunity to achieve an operational advantage."

In seeking the right balances between economy-wide and military-specific AI development, and between commercial and government research and production, the two countries take distinctive approaches. China's "civil–military fusion" policies, such as its use of massive and relatively centralized "guidance funds," have not been tested in either the global market or in battle. The US spends over twice as much on AI-related venture capital than does China (OECD, 2023). It is too soon to determine whether China's relatively top-down or the United States' relatively bottom-up approach will produce better security results, but the US does possess other advantages.

American information-intensive weapons and operational concepts are not only being tested and refined in Ukraine, they have been employed in combat over decades. The US is taking what it is learning from Starlink and other space firms to create a more robust space architecture, "concentric circles of linked SATCOMs networks — highly encrypted military constellations, slightly less secure SATCOM provided by allies, and unclassified commercial constellations" (Hitchens, 2023). One of the key components of successful AI models is training on massive amounts of *relevant* data. The

Ukraine War will likely be a huge source for many future algorithms. Perhaps Russia is collecting the data as well, although its resources to do so appear limited. China certainly does not have the same access to such information.

Ukraine has effectively exploited its significant civilian human capital for the military application of technology, a resource apparently not as abundant in Russia. The relevant global talent pool is most concentrated in the US, which enjoys a rich and deep space and AI workforce that outstrips any other country's (Human-Centered Artifical Intelligence, 2023).

Finally, the US is actively, and apparently successfully, impeding Chinese development in both AI and satellites with its CHIPS act (Kannan & Feldgoise, 2022; Miller, 2023). In the long run this may ultimately result in China developing its own capability to the detriment of the US economy and security. But China will certainly have to spend significant resources to indigenize this capability, and success is by no means assured.

Indeed, Kania (2021) assesses China's push into AI as largely a reaction to the decade-old US "Third Offset" strategy, which the PLA fears will produce a "new generational difference" in the United States' favor. It can perhaps best be said that China believes the US does not necessarily have the advantage yet or that this advantage may not be permanent.

## Conclusion

This article recommends considering the defense industry as three distinct political economies. In future study of the defense sector, we must become less wrong about the "what" is being made before we can definitely revisit the question of "who" makes it. The article thus only tentatively suggests the US will likely lead in each industry, albeit by different means. It concludes with brief speculation on the lessons for European and Chinese defense industrial prospects, which appear to be headed in opposite directions.

While many thinkers have identified an opportunity for a revitalized and rationalized European defense industry, much of the increased national spending is going towards US platforms, often subsidized by EPF reimbursement for states transferring older weapons to Ukraine (Kington, 2023). The biggest indigenous EPF investment appears to be munitions: €2 billion for artillery shells alone. While understandable given current demand, building production capability for a commodity is not a recipe for defense industrial prowess. Should it continue this path, EU industries will likely lag against the US in the two other, more politically useful political economies.

China, aware of both the varied links needed for a kill chain and US defense industrial prowess at their forging, may choose an alternative approach. While it may struggle to duplicate the American advantage across the range of industries, it may be more feasible to deny their synthesis.

One report (Fedasiuk et al., 2021) describes China's intelligentization push as an attempt at "breaking the combat cloud it strives to emulate." Dahm (2020) contrasts the two powers' differing approaches to AI, "The American military tends to focus on how AI can enable lethal attacks against opposing forces. Chinese strategists tend to argue that AI technologies should be used kinetically and non-kinetically to dominate information systems and networks, to effectively paralyze an opponent's joint force." The political economic reality of the contemporary defense industry suggests that it might be cheaper to simply break the US kill chain than replicate it.

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