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Comparison of Defense Acquisition Efficiency in the United States and China

March 2025

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Thesis Advisors: Raymond D. Jones, Professor
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Department of Defense Management

Naval Postgraduate School

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ABSTRACT

Since the 1950s, China has pursued economic and military dominance, leveraging alliances, intellectual property theft, and rapid technological advancements to strengthen its defense capabilities. Meanwhile, the United States has faced defense industrial base consolidation, bureaucratic stagnation, and prolonged conflicts in the Middle East, challenging its ability to maintain a technological edge. If current trends persist, China could surpass the United States in defense acquisitions. This thesis evaluates whether China is more efficient than the United States in defense acquisition and identifies areas where U.S. acquisition efficiency can improve, regardless of comparison.

Using a framework developed in a Naval Postgraduate School thesis, this thesis assigns efficiency scores to both countries across ten acquisition categories. A hypothetical weighting scenario examines how acquisition efficiency might shift in the event of an imminent U.S.-China conflict. Findings indicate that the United States remains more efficient overall, but China outperforms in cost efficiency. Areas in which the United States can improve include cost, acquisition workforce, resource allocation, and the defense industrial base. By addressing these inefficiencies, the United States can strengthen its defense acquisition system and sustain its technological advantage in an evolving strategic landscape.

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ABOUT THE AUTHOR

Captain Eliza Fiorelli is graduating from the Naval Postgraduate School with a Master of Science Management through the Defense Systems Analysis (DSA) curriculum. She earned a Bachelor of Science degree in Arabic with a minor in French from the U.S. Naval Academy in 2018. From April 2019 to May 2021, Capt Fiorelli served as the Production and Analysis Officer at Marine Aircraft Group 11 (MAG-11), 3rd Marine Aircraft Wing (3D MAW). Between May 2021 and May 2022, she took on the role of Intelligence Officer-in-Charge for Marine Fighter Attack Squadron 232 (VMFA-232), where she deployed on a Unit Deployment Program (UDP) to Marine Corps Air Station Iwakuni, Japan and Anderson Air Force Base, Guam. From May 2022 to June 2023, Capt Fiorelli served as the Assistant Intelligence Officer at MAG-11. Her military education includes Weapons and Tactics Instructor Course (2021), Air Intelligence Officer Course (2019), Tactical Intelligence Officer Course (2019), and The Basic School (2019). Capt Fiorelli's awards include the Navy and Marine Corps Commendation Medal and the Navy and Marine Corps Achievement medal. After graduation, Capt Fiorelli will report to Marine Corps Systems Command to be a cost estimator for the Marine Air Ground Task Force (MAGTF) Command and Control (C2) program.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAF	Adaptive Acquisition Framework
AESA	active electronically scanned array
AI	artificial intelligence
AiDA	Acquisition in the Digital Age
APUC	average procurement unit cost
AUC	average unit cost
AW	acquisition workforce
CBA	Capabilities Based Assessment
CCP	Chinese Communist Party
CMC	Central Military Commission
CPFF	cost-plus-fixed-fee
CRS	Congressional Research Service
DARPA	Defense Advanced Research Projects Agency
DAS	defense acquisition system
DAU	Defense Acquisition University
DAWIA	Defense Acquisition Workforce Improvement Act
DDG	Arleigh Burke-class guided missile destroyer
DF-26	Dong Feng-26
DIB	defense industrial base
DIU	Defense Innovation Unit
DoD	Department of Defense
DoDI	Department of Defense Instruction
EDD	Equipment Development Department
FAR	Federal Acquisition Regulation
FFP	firm-fixed-price
FY	Fiscal Year
FYDP	Future Years Defense Program
FYP	Five-Year Plan
GAO	Government Accountability Office
GDP	Gross Domestic Product

GNA	Goldwater-Nichols Act
ICD	Initial Capabilities Document
IDDS	Innovation Driven Development Strategy
IOC	Initial Operational Capability
JCIDS	Joint Capabilities Integration and Development System
JROC	Joint Requirements Oversight Council
LRHW	Long-Range Hypersonic Weapon
LRIP	low-rate initial production
MCA	Major Capability Acquisition
MCF	military-civil fusion
MOF	Ministry of Finance
MOSA	Modular Open System Approach
MRO	Military Representative Officer
MSG	Military Strategic Guidelines
MTA	Middle Tier Acquisition
NPC	National People's Congress
NPS	Naval Postgraduate School
NSS	National Security State
O&S	operating and support
OSD CAPE	Office of the Secretary of Defense, Cost Assessment and Program Evaluation
OT	Other Transaction
OUSD (A&S)	Office of the Under Secretary of Defense, Acquisition and Sustainment
PLA	People's Liberation Army
POM	Program Objective Memorandum
PPBE	Planning, Programming, Budgeting and Execution
PRC	People's Republic of China
R&D	research and development
RCS	radar cross section
RDA	research, development and acquisition
REE	rare earth element
S&T	science and technology

SOE	state-owned enterprise
STEM	science, technology, engineering and math
SWP	Software Acquisition Pathway
TEL	transporter erector launcher
WEDS	Weapons Equipment Development Strategy

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I. INTRODUCTION

A. PROBLEM STATEMENT

The defense acquisition process of the People's Republic of China's (PRC) is progressing at a pace that may surpass that of the United States'. This prospect has significant strategic implications for global security and the balance of international power. According to the Department of Defense's (DoD) *2023 Report on the Military and Security Developments Involving the PRC*:

> The PRC's national strategy is to achieve "the great rejuvenation of the Chinese nation" by 2049. The strategy is a determined pursuit of political, social, and military modernity to expand the PRC's national power, perfect its governance, and revise the international order in support of the PRC's system of governance and national interests. (DoD, 2023b, p. II)

China's military has a fleet of 370 ships, the largest in the world, including three aircraft carriers. The country also has a growing fleet of fourth- and fifth-generation fighter aircraft equipped with advanced beyond-visual-range air-to-air missiles, as well as ground-based and air-launched missile technologies that rival those of leading international producers (DoD, 2023b). Furthermore, China has made significant investments in information operations, space and counterspace capabilities, nuclear deterrence, and chemical and biological research (DoD, 2023b). With these advancements, China has adopted an increasingly confrontational stance in the Indo-Pacific region and beyond. The Chinese maintain a consistent naval, coast guard, and civilian presence in the South China Sea, regularly deploy air assets into the Taiwanese Air Defense Identification Zone, and conduct "coercive and risky" air intercepts of U.S. and allied aircraft (DoD, 2024a, p. 135). These observations raise an important question: if China's defense acquisition system continues to produce weapon systems at its current rate and caliber, will its willingness to act provocatively also escalate? If current trends persist, will China surpass the United States in key areas of defense technology and production capacity? This could undermine U.S. military dominance, alter the world order, and embolden China to pursue global military superiority in more forceful and kinetic ways.

Since the end of the Cold War, defense acquisition in the United States has become risk-averse and mired by bureaucracy. Defense acquisition programs often face cost overruns and bureaucratic delays which hamper the timely and cost-effective fielding of equipment to warfighters. The U.S. Navy, for example, trails China in ship production, maintaining a fleet of fewer than 300 ships (LaGrone, 2025). While the United States operates 11 aircraft carriers compared to China's three, China has built all of its carriers within the last 15 years—each one more efficient and capable than the last (Sharma, 2025). Wong et al. (2022) identify four trends that influence defense acquisition: geopolitical change, globalization, changing national priorities, and advancing commercial technologies. These factors have placed immense stress on the foundational assumptions of the U.S. acquisition system today (Wong et al., 2022).

For much of the post-Cold War era, the U.S. government underestimated China's rise as a peer competitor. As Aaron L. Friedberg discusses in his book, *Getting China Wrong*, Western democracies, led by the United States, instituted engagement policies with China with the goal of "ever-deepening commercial, diplomatic, scientific, educational, and cultural ties between China and the West" (Friedberg, 2022, p. 1). Friedberg argues that this approach underestimated the Chinese Communist Party's (CCP) ability to maintain power, failed to recognize its determination to control domestic affairs, and overlooked its significant ambitions to reshape the global order (Friedberg, 2022). China's leaders view its system of government as superior to Western systems, and given the military and economic success it has seen in the last decade, they are likely to remain confident in that belief and continue pursuing policies that reinforce it (Friedberg, 2022).

B. RESEARCH QUESTIONS

It is important to consider that China's acquisition system faces inefficiencies and lags in areas such as operational and workforce experience, critical technology building, and administrative processes to manage its large and cumbersome defense industrial base (DIB). China's leadership also faces the challenge of balancing the transition to a market-based economy, with the authoritarian desire to retain tight control. The question is whether the United States can reform its defense acquisition system to meet its broader strategic intentions with China in time to counterbalance China's rapid military advancements.

This thesis attempts to answer the following questions:

1. To what extent is China outpacing the United States in defense acquisition?
2. What factors of efficiency can the United States improve upon to maintain a strategic and technological edge?

This thesis concludes that China is not outpacing the United States in defense acquisition overall. The only category in which China maintains an edge is the cost to acquire weapon systems. The United States maintains the edge in every other efficiency category this thesis analyzes. Areas of acquisition efficiency in which the United States can improve, within the scope of this thesis, are cost of weapon system acquisitions, training of the acquisition workforce (AW), the resource allocation system's ability to maximize value for money, and the capacity of the DIB.

C. METHODOLOGY

The framework used for data analysis in this report was developed by a Naval Postgraduate School (NPS) student, Lieutenant Commander Matthew Lorge, in his thesis titled, *Comparison of Naval Acquisition Efficiency between the United States and China*. Lorge's (2018) thesis is discussed in depth in the literature review and data analysis chapters of this thesis. This section discusses the highlights of the framework, and whether it can be applied to compare acquisition efficiency across multiple sectors, and between two different countries (the United States and China).

Lorge (2018) creates a framework to compare acquisition efficiency of different countries. His framework is based on ten factors of acquisition efficiency that were culled in his literature review and compares countries' acquisition systems either overall, or within a specific defense sector. In Lorge's literature review, he primarily looks at existing research on U.S. acquisition efficiency, the Chinese acquisition system, and comparisons of acquisition systems. Lorge then uses these three broad categories to form an initial list of 27 efficiency factors, and then narrows down that list to ten factors. Lorge's ten factors and their descriptions are outlined in Table 1.

Table 1. List of Acquisition Efficiency Factors. Adapted from Lorge (2018).

Acquisition Efficiency Factor	Description of Scoring Metric
Cost	Cost to produce selected systems
Schedule	Rate of production of selected systems
Performance	Operational effectiveness and suitability of selected systems
AW	Accessibility of training and organization of the workforce
Contracting	Contractor incentivization and accountability
Resource Allocation	Consideration of affordability and reaching maximum value
Innovation	Original and indigenous production
Industrial Base	Capability and capacity to meet objectives
Requirements System	Generated requirements meet strategic goals
Operations and Support (O&S) Costs	Consideration of and planning for O&S cost management for acquisitions

Lorge (2018) then assigns metrics for each efficiency factor, and a score is generated for each country in each efficiency category. Once each factor has been assigned a score, the scores are added up to get a total acquisition efficiency score. The country with the most points is deemed more efficient in defense acquisition. The purpose of the framework, however, is to identify weak parts of the acquisition process and pinpoint areas of improvement for each country being analyzed. An addition to Lorge's framework is added at the end of Chapter IV of this thesis, which introduces weighting to the factors. A weighted score (1–5) is applied to each factor based on level of importance in an evolving geopolitical context. The purpose of the hypothetical weighting scenario is to determine how efficiency factors would be prioritized leading up to a potential conflict, and how that would affect the countries' overall acquisition efficiency scores.

Some metrics in the framework call for quantitative data and others rely on qualitative data; therefore, the methodology of these differing data sets must vary. The qualitative efficiency factors are "the acquisition workforce, contracting, the resource allocation system, innovation, the industrial base, the requirements system, and O&S costs" (Lorge, 2018, p. 85). Qualitative metrics must have clear and concise language so the framework user operates with the least amount of subjectivity possible. The quantitative efficiency factors are cost, schedule and performance. In Lorge's thesis, he analyzes acquisition system efficiency in the naval shipbuilding sector, in which he compares five ships of the same class for each country. This thesis broadens Lorge's framework to compare three critical weapon systems: a naval destroyer, a fighter aircraft, and a long-range missile system. The purpose of this adaptation is to provide a way to look at a wider range of systems across the military services, so as to better evaluate an overall acquisition system. By applying both qualitative and quantitative analysis, this approach ensures a balanced evaluation of acquisition efficiency, while addressing the nuanced differences in data availability and metrics between the two nations' defense acquisition systems.

For the purpose of continuity and accuracy, Lorge's list of efficiency factors (Table 1), as well as the scoring metrics, will remain the same in this thesis. The previously discussed framework is applied, and any recommended changes to the list of efficiency factors are addressed in Chapter V of this thesis. Reasons for recommended changes to Lorge's efficiency factors include but are not limited to:

- Further insights gained in the defense acquisition and DIB research community since 2018
- Contextual variations across countries
- Technological advancements
- Policy shifts
- Methodological improvements
- Differences in authors' professional judgment

D. SCOPE AND LIMITATIONS

This research examines the defense acquisition systems of China and the United States by comparing their efficiency in developing and delivering military systems. These systems were selected because of their strategic importance and the complex operations they represent within each nation's acquisition system. Efficiency is evaluated through the application of Lorge's (2018) framework, which emphasizes the identification and scoring of factors affecting acquisition efficiency. The goal of this research is to assess whether China is surpassing the United States in defense acquisition efficiency and to highlight inefficiencies within the U.S. system that could be addressed to maintain its strategic advantage. A secondary objective is to test and refine Lorge's framework so that future studies can use it to apply to and compare other systems or nations.

This study is subject to several limitations. The research relies on English-language sources, which may result in the loss of nuance from translated Mandarin documents or incomplete access to relevant information. Next, the analysis draws on substantial prior research and available data, but some critical insights remain classified or inaccessible, particularly regarding China's acquisition practices. In the same vein, by nature of the inaccessibility of some Chinese data, there is risk that the results naturally bias in favor of the United States. A mitigation structure is in place, with clear and concise metrics for qualitative data, and this point will also be dually noted in Chapter V. Lastly, as cultural and institutional differences shape defense acquisition processes, care has been taken to avoid imposing U.S.-centric assumptions onto China's system. As noted in *Chinese Military Modernization*, "The danger in comparative studies lies in the inclination to ignore those uncommon cultural assumptions which make traditions profoundly different" (Lane et al., 1996, p. 21). This study remains cognizant of these differences to ensure an equitable and accurate comparison.

II. BACKGROUND

A. HISTORY OF DEFENSE ACQUISITION IN THE UNITED STATES AND CHINA

Since World War II, U.S. defense acquisition priorities have continually adapted to meet the demands of various global conflicts. The 2024 Commission on Defense Innovation Adoption emphasizes that maintaining technological superiority over adversaries has been crucial for ensuring national security (McNamara et al., 2024). During the Cold War, U.S. acquisition efforts were largely focused on countering Soviet influence, particularly in Korea and Vietnam, while also fueling an arms race in nuclear and space technologies. This period saw a boom in technological innovation, as civilian advancements like the invention of the computer and founding of the systems engineering discipline contributed to defense modernization. After the Cold War ended, however, the U.S. defense budget was significantly reduced—from 65% of federal discretionary spending in 1987 to 50% during the 1990s (Wong et al., 2022). After almost two decades of nuclear development, the space race, and ballistic missile procurement in direct response to the Soviet threat, the United States turned its focus inward. During the period following the Cold War, the development of research and innovation hubs like the Defense Advanced Research Projects Agency (DARPA) and Lockheed Martin's Skunkworks gained momentum. The Goldwater-Nicholas Act (GNA) which was an acquisition reform attempting to "address systemic deficiencies in military chain of command, personnel management, and acquisition stemming from a lack of inter-service integration," was also instituted in 1986 (Wong et al., 2022, p. 25). The GNA was the first of many proposed acquisition reforms instituted in the 1990s, 2000s, and 2010s that would do little to improve efficiency in acquisition processes. Instead, many of these acquisition reform acts contributed to bureaucratic stagnation, program delays, and cost escalation the U.S. acquisition system is accustomed to today.

Meanwhile, during the Cold War, China faced significant challenges as it transitioned from an agrarian economy to one that required technological advancements to build its military capacity (Saunders & Wiseman, 2011). From its inception in 1949, the PRC relied heavily on foreign technology transfers, particularly from the Soviet

Union, which facilitated Sino-Soviet defense cooperation between 1950 and 1961 (Saunders & Wiseman, 2011). In their article "Build, Buy, or Steal: China's Quest for Advanced Military Aviation Technologies," Phillip Saunders and Joshua Wiseman (2011) discuss how the Soviet Union held considerable leverage in this relationship, recognizing China's dependence on external sources for advanced military technology. This cooperation laid the foundation for China's defense capabilities, though the Sino-Soviet split in 1961 left China without a clear path for continued military development (Saunders & Wiseman, 2011). The second half of the 1960s marked the beginning of a 10-year Cultural Revolution in China, which significantly affected the defense sector (Saunders & Wiseman, 2011). The Cultural Revolution and its aftermath made clear to Chinese leadership the importance of self-sufficiency in defense industry production due to the variability of geopolitical relationships. Because China lacked technological sophistication, its leadership recognized the need to open up the country's economy to the world, hence Deng Xiaoping's Open Door policy instituted in 1978 (Saunders & Wiseman, 2011). The 1970s and 1980s were also the period in which Chinese leadership recognized the importance of a dual-use economy, where private sector innovation could be applied militarily and vice versa (Saunders & Wiseman, 2011, p. 27). China launched its 863 High-Technology Research and Development (R&D) Plan in March of 1986, which underscored the importance of high-technology fields like bioengineering, space, automation, etc. Surprisingly, during the 1980s, the West and China engaged in cooperation, primarily with the goal of mutual deterrence of Soviet power. This cooperation, known as the "Peace Pearl initiative" gave China some insight into advanced avionics capabilities for their aircraft, among other armament capabilities (Saunders & Wiseman, 2011). After the Tiananmen Square massacre in 1989, however, the H. W. Bush administration placed heavy sanctions on China (Saunders & Wiseman, 2011). Throughout this period of turmoil and stagnant growth in China's history, it became clear that Chinese leadership understood where their system was lacking, and were able to institute goal-oriented plans to attempt to remediate their deficiencies.

While China sought to address economic stagnation during the post-Cold War years, the U.S. defense budget declined, which led to downsizing of both active-duty military and civilian personnel in the acquisition field. Due to this change in the workforce, by the mid-1990s, the DoD started to rely on contractors to perform many of the acquisition support functions, but did not reduce the workload in any significant way (Lieberman, 2001). This shift initiated the gradual deterioration of government workers' robust experience in the acquisition workforce and created inefficiencies due to limited personnel (Lieberman, 2001). In 1993, the DoD instituted "a change in reimbursement policy, under which it would reimburse its suppliers for some restructuring in costs in accordance with established criteria" (Brady & Greenfield, 2010, p. 290). This change in policy likely affected the DIB, causing a significant number of mergers and acquisitions that led to a massive consolidation of industry (Brady & Greenfield, 2010). Figure 1 shows mergers and acquisitions in the U.S. economy and in the defense sector, highlighting the potential relationship between DoD policy changes and defense industry consolidation (Brady & Greenfield, 2010). These consolidations, although cost-reducing, also resulted in less competition among defense firms. As Frank Kendall highlights in his article, "Getting Defense Acquisitions Right," "The trend toward fewer and larger prime contractors has the potential to affect innovation, limit the supply base, pose entry barriers to small, medium and large businesses, and ultimately reduce competition" (Kendall, 2017, p. 96). Although a main contributor to the consolidation of the DIB in the 1990s, the DoD policy change was not the sole reason for the shift. The U.S. economy as a whole was trending towards consolidation of firms in order to lower costs, streamline processes, and promote technological change (Brady & Greenfield, 2010).

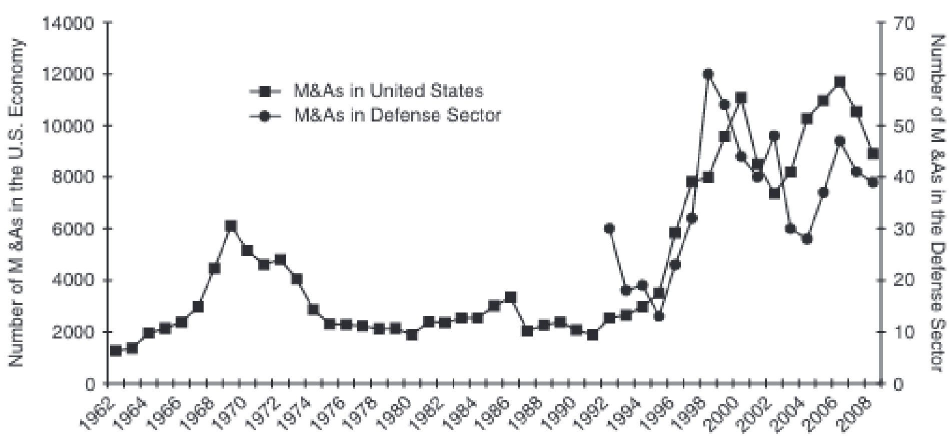

Figure 1. Mergers and Acquisitions in the U.S. Economy and in the Defense Sector. Source: Brady & Greenfield (2010).

China kept a watchful eye on the United States during the 1990s, and began to develop plans and initial capabilities in its DIB to replicate, rival, and in some cases, directly counter U.S. capabilities. The acquisition model China used at this time was absorptive-statist, which implies acquiring foreign technologies and reverse engineering the systems—what the Chinese refer to as "'re-innovation'" (Cheung, 2018a, p. 2). In 1993, most of China's large defense ministries moved out from underneath state control and became corporations, also known as state-owned enterprises (SOEs), but this had little impact on how they did business (Medeiros et al., 2005). This transitional, bureaucracy-heavy period hindered the Chinese DIB's ability to be efficient, innovative, and autonomous. A lack of financial incentivization and poor contracting methods for SOEs also led to inefficiency within the overall acquisition system (Medeiros et al., 2005). At the end of the decade, China instituted its most influential reforms yet. The reforms were intended to provide better funding for weapons acquisition, encourage commercialization of defense SOEs, use access to foreign knowledge and experience (primarily from the Soviet Union and Israel) to advance their own technology, and institute influential reforms aimed to help with efficiency and effectiveness in production (Medeiros et al., 2005).

After the terrorist attacks on September 11, 2001, the United States focused its defense resources and attention on counterterrorism. Most, if not all defense innovation initiatives were driven by short-term requirements, and fielded to the warfighter with all deliberate speed. Despite the wars in Iraq and Afghanistan, between 1998 and 2008–a time of increased defense budget and spending–the number of military and civilian personnel performing acquisition activities decreased by 14% (DiNapoli, 2015; Wong et al., 2022). This required an even greater reliance on contractors to manage defense acquisition programs, and a greater need to close the knowledge gap of government workers in this field (Wong et al., 2022). It was not until 2009 that Secretary of Defense Robert Gates called for a rebalance of the workforce to increase the number of government personnel in the acquisition field. The Weapon System Acquisition Reform Act: A Focus on Cost and Schedule, initiated in 2009, attempted to rectify the cost issues that emerged from the GNA by elevating positions at the Pentagon (Sullivan, 2012). The

2000s marked a time of incremental defense innovation with the initial fielding of the F-22 Raptor in 2005 and the early-stage development of the Joint Strike Fighter program.

At the turn of the twentieth century, China began major reforms to move further toward a market-driven economy. These reforms were initiated to interface and compete with world economic leaders, and defense SOEs were relieved of debt and became profitable by the early 21st century (Cheung & Mahnken, 2023). China also placed a heavy emphasis on the institution of long-term plans. The 2006 *Quadrennial Defense Review Report* stated, "of the major and emerging powers, China has the greatest potential to compete militarily with the United States and field disruptive military technologies that could over time offset traditional U.S. military advantages absent U.S. counter strategies" (DoD, 2006, p. 29). In his 2008 book, *Fortifying China: The Struggle to Build a Modern Defense Economy*, Tai Ming Cheung elaborates on this idea: "while the United States is well-ahead, China appears to be ready, able, and willing to make major inroads in narrowing this gap. The next two decades may well mark China's coming of age as a top-tier military technological power" (Cheung, 2008, p. 262).

The 2000s laid the groundwork for China in terms of defense manufacturing, with initiatives to expand the People's Liberation Army Navy, make upgrades to existing fighter aircraft like the J-10 and J-11, develop new missile technology like the Dong Feng-21D anti-ship ballistic missile, and modernize its nuclear arsenal. Table 2 shows the development times for selected systems of importance to the People's Liberation Army (PLA) during this time. The information in the table displays China's commitment to the development of new systems, as well as highlights some of the same extended timelines that the United States also experiences with high-profile, complex weapon systems like ships and aircraft. Some of these systems that have joined the PLA force in recent years spent 10–20 years in development, testing, and fielding (Weinbaum et al., 2022a).

Table 2. Development Times of Selected Systems of Importance to the PLA. Source: Weinbaum et al. (2022a).

Metric	J-20 Fighter (F-22 equivalent)	*Luyang*-Class 052C/D Guided Missile Destroyer (*Arleigh Burke*–class equivalent)	J-15 Fighter (F/A-18 equivalent)	Y-20 Transport (C-17 equivalent)
Preliminary research to Milestone A	9 years (1998–2007)	052C: 4–5 years (1997/8–2001)	2–3 years (2005–2007/8)	4 years (2003–2007)
Technology and engineering development to Milestone B	9–10 years (2007–2016/7); maiden flight 2011	052C: 7 years: initial 2 years (2001–2003) followed by another 5 years (2005–2010)	9–10 years (2007/8–2016); maiden flight 2009	9 years (2007–2016); maiden flight 2012
Field deployment	Service entry with the PLA Air Force was achieved in February 2018	052C: 2005 052D: 2014	Production aircraft seen in late 2013; 2020 production resumed	First aircraft accepted by PLA Air Force in 2016
Foreign inputs	Indigenous platforms, foreign engines. In 2021, PLA Air Force indicated it is now fitted with indigenous WS10C engines.	Indigenous platform and armaments but heavily influenced by Russian design and armaments (surface-to-air missiles)	Reverse-engineered version of Russian Su-33	Design and technology inputs from Ukraine and Russia, especially from IL-76
Number in service	18	052C: 6 052D: 17	22	13
Total acquisition period	18–19 years	052C: 11–12 years	11–13 years	13 years

As the United States entered the 2010s, the proportion of the U.S. federal discretionary spending allocated to the DoD began to level off. Figure 2 shows the DoD's percentage of all discretionary budget allocation from 1986–2016. There is a decrease from 2006–2011, and then a gradual leveling off (Wong et al., 2022). The uptick after 2016 can be explained by shifting priorities in the United States to focus more on near-peer or peer-level threats (Wong et al., 2022). During this time, the U.S. defense acquisition priorities centered on modernizing and expanding capabilities across multiple domains to address evolving global threats and technological advancements. Key focuses included the deployment of the F-35, enhancement and investment in cyber capabilities, and strengthening missile defense systems against emerging hypersonic threats. The establishment of the U.S. Space Force highlighted the strategic importance of space, and investments in unmanned and autonomous technologies aimed to increase operational flexibility and reduce risks to human operators. Naval expansion was also a priority, featuring advanced shipbuilding programs like the Ford-class carriers and Virginia-class submarines. At the same time, the DoD sought to improve acquisition efficiency through initiatives like Better Buying Power, which aimed to streamline procurement processes and ensure the military's technological edge in a changing security landscape (Kendall, 2017).

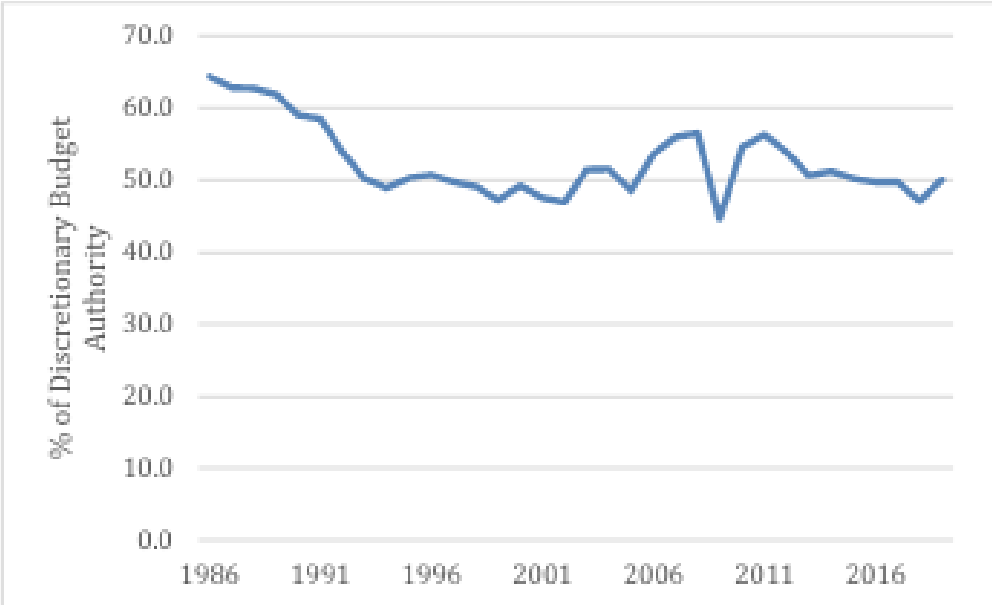

Figure 2. DoD’s Percentage of All Discretionary Budget Authorities. Source: Wong et al. (2022).

During the 2010s, under the leadership of President Xi Jinping, who assumed power in 2012, China aggressively expanded and modernized its military capabilities, focusing on indigenous innovation and self-sufficiency. Key areas of focus included the development and deployment of the J-20 stealth fighter and the commissioning of China’s first aircraft carrier, the Liaoning. During this decade, China placed a heavy emphasis on Military-Civil Fusion (MCF), and a push for the integration of the DIB and the civilian sector. Xi Jinping went as far as to elevate this initiative from sectoral to strategic importance in 2015. In 2017, he created the Commission for Integrated Civilian-Military Development and named himself as chair to highlight its importance (Weinbaum et al., 2022a). Xi also worked to initiate wide-spread anti-corruption efforts within the DIB, which reportedly sought to remove business-owners the CCP deemed threatening due to their individual success and party independence. Weinbaum et al. point out, “the result might be that the anti-corruption activities are the corruption” (Weinbaum et al., 2022a, p. 30). The cost of tight control is stifled innovation, and that is the contradiction that Xi and the CCP face with their perceived desire for order and absolute power.

As the global landscape of military technology evolves into the second half of this decade, the question of whether China is outpacing the United States in defense acquisition becomes increasingly pertinent. Central to this question is the analysis of the efficiency of the technology produced by each country's acquisition system as well as the acquisition system itself. The United States maintains a robust and technologically advanced defense production capability supported by a complex network of contractors and a highly developed technological base. The U.S. defense acquisition process, however, is plagued by bureaucratic inefficiencies and high costs, which can delay the deployment of new systems and stifle innovation. Despite these challenges, the United States continues to lead in cutting-edge technology and maintains strong production capabilities across a wide range of military technologies.

China has rapidly expanded its defense production capacity, focusing on self-sufficiency and indigenous production. This drive is supported by state-led initiatives such as the Made in China 2025 plan, which aims to comprehensively upgrade China's manufacturing capabilities (Cheung, 2018a). PRC defense acquisitions today are characterized by streamlined decision-making processes, facilitated by the integration of MCF strategies. China faces obstacles like technological innovation limitations relative to more established global powers, dependency on foreign technology for critical components, and a declining population. The efficiency of China's acquisition processes, combined with aggressive investment in R&D and training of the workforce, poses the question of whether its increasing pace of modernization will allow it to close the gap or even surpass the United States in certain areas of defense technology.

B. DEFENSE ACQUISITION PROCESSES

This thesis focuses on comparing the efficiency of the U.S. acquisition system and the Chinese acquisition system to determine whether China is outpacing the United States in defense acquisition. For the purpose of this study, as defined in a Congressional Research Service (CRS) report titled, *Defense Acquisitions: How DoD Acquires Weapon Systems*,

> Acquisition is a broad term that applies to more than just the purchase of an item or service; the acquisition process encompasses the design, engineering, construction, testing, deployment, sustainment, and disposal of weapons or related items purchased from a contractor. (Peters, 2014, p. 1)

The purpose of this section is to describe the requirements system, resource allocation system, and defense acquisition system (DAS) for both the U.S. and China. This foundation is necessary for the comparison and scoring of the systems' acquisition efficiency factors in Chapter IV of this thesis.

1. The U.S. Defense Acquisition Process

The DoD process for buying a weapon system, often referred to as "Big A" acquisitions consists of the Joint Capabilities Integration and Development System (JCIDS), the Planning, Programming, Budgeting and Execution System (PPBE), and the DAS. JCIDS is the requirements process, and was created in 2003 to adapt the United States from a threat-based requirements system to a capabilities-based requirements system in an attempt to streamline the requirements system and make it more joint (Peters, 2014). JCIDS pulls from the hierarchy of strategies starting with the National Security Strategy, the National Defense Strategy, the National Military Strategy, and the Joint Operating Concept to identify what the military service branches need to accomplish the country's strategic and military objectives. The Joint Requirements Oversight Council (JROC), chaired by the Vice Chairman of the Joint Chiefs of Staff, manages JCIDS (Neenan, 2024; Peters, 2014). One of the most important parts of the JCIDS process is deciding whether a requirement needs a materiel solution, like a stealth fighter or a new hypersonic missile. This process is called a Capabilities Based Assessment (CBA). If the CBA recommends a materiel solution, the process moves to an Initial Capabilities Document (ICD), which determines if the requirement solution requires new materiel or if it can be developed from existing technology (Neenan, 2024; Peters, 2014). Once the JROC approves the ICD, the program officially enters the DAS and starts the process of "little 'a'" acquisition (Peters, 2014). The JCIDS process plays a vital role in implementing the nation's strategic directives and serves as the initial step toward the realization of new capabilities. Therefore, a comprehensive and thorough understanding of the relevant guidance and strategies is essential to initiating a successful acquisition.

The PPBE system is the budgeting authority for all DoD acquisitions. PPBE is governed by the same guidelines as JCIDS, pulling from the country's highest strategic documents to align acquisition program funds to strategic priorities. PPBE is broken down into four stages, listed below. Also listed are their general purposes and due-outs (McGarry, 2022):

1. Planning: Review of annual national defense and security strategies to ensure alignment, Defense Planning Guidance (DPG) drafted
2. Programming: Director of the Office of Cost Assessment and Program Evaluation (CAPE) reviews service branch Program Objective Memorandums (POM) which detail funding and resourcing for defense programs over a period of five years.
3. Budgeting: DoD Comptroller reviews Budget Estimate Submissions from each branch of service, updates allocations in the Future Years Defense Program (FYDP), DoD portion of President's budget request.
4. Execution: Budget execution, programs are run with allocations made in the previous year.

Ultimately, the PPBE system is set up so every dollar spent on defense acquisition is strategically aligned, efficiently allocated, and directly supports the nation's overarching security objectives.

The DAS, also known as little 'a' acquisitions, is the DoD's process for acquiring weapons and other systems (Peters, 2014). The DAS is primarily governed by two documents, DoD Directive 5000.01: The defense acquisition system and DoD Instruction (DoDI) 5200.02: Operation of the Adaptive Acquisition Framework (AAF). DoDI 5200.02 was updated in 2020 to reflect a more flexible approach to weapons acquisition. The shift to the AAF was an effort to streamline procurement. Instead of trying to force all acquisitions down the same pathway, AAF provides alternative pathways. For example, systems required urgently, as well as software systems that require much more frequent updates would go through the Urgent Capability Acquisition pathway or Software Acquisition Pathway (SWP), respectively. The primary focus of this thesis is the Major Capability Acquisition (MCA) pathway, which supports the majority of large and complex U.S. weapon system acquisitions (Pilling, 2020). Figure 3 displays the five phases of the MCA pathway, which are:

1. Materiel Solutions Analysis
2. Technology Maturation and Risk Reduction
3. Engineering and Manufacturing Development
4. Production and Deployment
5. Operations and Sustainment

Figure 3. MCA Pathway. Source: Pilling (2020).

The process begins by identifying a capability need (Materiel Development Decision) and analyzing potential solutions (Materiel Solution Analysis). It then progresses through maturing technology and reducing risks (Milestone A to Technology Maturation), finalizing designs and developing prototypes (Milestone B to Engineering and Manufacturing Development), and producing and deploying the system (Milestone C to Production and Deployment). Finally, the system achieves operational readiness (Initial Operational Capability [IOC] and Final Operational Capability) and enters long-term support and maintenance (Operations and Sustainment) (DoD, 2020).

2. The Chinese Defense Acquisition Process

In China, strategic guidance comes from both China's defense white papers, released every two to four years, and the CCP's Five-Year Plans (FYP). The most recent white paper was released in 2019, and China is currently executing its 14th FYP, running from 2021 to 2025 (Cheung, 2022a). President Xi and the CCP have also introduced other plans and policies in the past 10 years that likely influence requirements generation, such as the Made in China 2025 plan, introduced in 2015, and the 2035 Vision, which was rolled out with the FYP in 2021 (Cheung, 2022a). The Equipment Development Department (EDD), previously the General Armaments Department, develops the Weapons Equipment Development Strategy (WEDS), "which lays out the basic assumptions about geostrategic trends, technological developments, and future conflicts that underpin the PLA's weapon development" (Curriden, 2023, p. 3). The WEDS is then broken down into "ten-, five-, and one-year Weapon Equipment Construction Plans, which translate its general principles into concrete weapon programs and requirements" (Curriden, 2023, pp. 3–4).

The resource allocation and budgeting process in China is opaque, and it is difficult to come up with accurate numbers for its defense budget in an open-source environment. In 2024, however, RAND conducted a comprehensive study to look at the PPBE processes in Russia and China and compare the two countries' practices with those of the United States'. The remainder of this section pulls information directly from the report (McKernan et al., 2024). The CCP, as with every other aspect of Chinese society, plays a central role in the development of the Chinese defense budget by generating the strategic guidelines and military priorities. The RAND study draws out the intent of the guidance: "By design, this central guidance tends to be vague, setting the tone with broad targets. This approach permits considerable flexibility and experimentation on the part of subordinate ministries and subnational governments" (McKernan et al., 2024, p. 24). The Central Military Commission (CMC) is China's highest military organization and plays a critical role in the budgeting process with its Strategic Planning Department and its Logistics Support Department. The National People's Congress (NPC), China's legislative body, is responsible for approving the defense budget every year. The State Council is China's highest administrative body. Within the State Council is the Ministry of Finance (MOF) National Defense Department, which handles military budgeting-related matters (McKernan et al., 2024). China's annual military budget cycle begins in May with the PLA finance departments across China's theater commands taking subordinate-unit requests for budget contributions. Between August and October, these unit-level requests are reviewed by each respective theater command. There is an All Military Logistics Conference in November where the overall PLA budget is reviewed and analyzed, and this is led by the Logistics Support Department, previously the General Logistics Department (McKernan et al., 2024). From December to February, the CMC presents the budget to the MOF, and by March, the MOF submits the budget to the NPC. In March, the NPC approves and announces the next year's budget, taking into consideration "the previous year's budget, performance evaluation results of relevant expenditures, and forecasts of revenue and expenditures for the current year" (McKernan et al., 2024, p. 26). After the March NPC, the defense budget enters execution (McKernan et al., 2024). In terms of budgeting and execution, the CMC implemented a performance management system in 2014 designed to assess the effectiveness of the budgeting system. As of 2020, "units are required to examine their performance indicators from the previous year when drafting their new budgets for the next year" (McKernan et al., 2024, p. 28). Despite its opacity, China's defense budgeting process shows a structured approach that aligns resources with military goals.

China's RDA process mirrors the U.S. process in several ways. The first is that it consists of five major phases as highlighted by Curriden (2023):

1. Feasibility study
2. Product design
3. Engineering and development
4. Experiment and design finalization
5. Batch production

The feasibility study helps to define requirements and estimate costs for the proposed system. Next is the product design phase which focuses on designing and testing prototypes of the system. The engineering and development phase finalizes the system's design. During experiment and design finalization, systems undergo rigorous testing and evaluation by PLA units. If successful, the process concludes with batch production, though this does not always lead to large-scale manufacturing (Curriden, 2023). Curriden (2023) notes, "Chinese acquisition programs generally seem to take between ten and 15 years, with some exceptions. This is broadly in line with the timescale of major U.S. acquisition programs" (p. 4). Curriden (2023) also highlights an area of inefficiency within the Chinese system: "In some cases, the PLA has been known to rush the early research and design phases, but this has generally led to lengthy technology, engineering, and demonstration processes and low initial production rates, as seen with the J-15 and Type 052 destroyer" (p. 5). Cheung (2018b) discusses three key factors driving China's rapid military modernization. First is the simultaneous execution of development, testing, and initial low-rate production. Second is accelerated research and engineering phases, though often offset by prolonged delays in early production. Third is the combination of active high-level leadership involvement with trial production runs, which allow for upgrades and improvements in subsequent units. These factors, among others, are at the heart of China's recent military success, and are discussed in greater detail in the literature review.

C. SUMMARY

In summary, since World War II, U.S. defense acquisition has evolved in response to shifting global threats, with Cold War efforts centered on countering Soviet influence through technological advancements. After the Cold War, however, defense budgets declined, which led to industry consolidation and bureaucratic inefficiencies that persist today. In contrast, China's system initially depended on Soviet technology transfers, but the Sino-Soviet split forced it to seek self-sufficiency. Deng Xiaoping's Open Door Policy in 1978 marked a turning point, prioritizing economic reforms and dual-use technologies. By the 1990s, China began absorbing foreign defense technologies through direct acquisition and reverse engineering, which set the stage for rapid modernization. Under Xi Jinping, the MCF initiative further integrated commercial and defense sectors. While the United States maintains an edge in advanced defense technology, its acquisition process is plagued by high costs and delays. China's acquisition system appears more streamlined due to its authoritarian governance system, but still faces challenges in innovation and critical technology development. The trajectory of these two systems raises an important question: will China's growing efficiency allow it to surpass the United States in defense acquisition?

III. LITERATURE REVIEW

Understanding the defense acquisition processes of global powers is essential for evaluating their military modernization and strategic competitiveness. This literature review examines research on the United States and China as techno-security states. Next, it examines literature on the Chinese DIB and Chinese defense acquisitions, discussing existing research on how China develops and procures weapon systems. Next, the literature review discusses strengths and weaknesses of previous NPS theses that have compared two countries' acquisition systems. This portion has a specific focus on Lorge's (2018) work which analyzes acquisition efficiency in the U.S. and China's shipbuilding sectors. Finally, this literature review discusses existing research on measures of efficiency within the U.S. acquisition system.

The purpose of this section is to provide foundational context for the research, clearly define key terms, and highlight the relevance of acquisition system efficiency in contemporary defense competition. By exploring existing research, this review identifies gaps and lays the groundwork for comparison of acquisition efficiency between the United States and China.

A. FOUNDATIONS OF THE TECHNO-SECURITY STATE

Tai Ming Cheung is a Chinese and East Asian defense and national security affairs analyst and director of the UC Institute on Global Conflict and Cooperation at the University of California, San Diego. He specializes in defense economics, science, technology, innovation and industry, and his work is integral to this thesis. This literature review includes several of Cheung's books and articles, as they are foundational pieces to the academic ecosystem that exists on these topics. The review begins with the introduction of the techno-security state concept, which Cheung uses as the basis of his most recent book, *Innovate to Dominate: The Rise of the Chinese Techno-Security State*. The techno-security state framework is essential to understanding and comparing the efficiency of the United States' and China's acquisition systems. Examining countries through Cheung's techno-security lens helps to explain the motivations behind their defense acquisition and their resource allocation decisions. This examination also provides logical explanations for why certain countries face challenges with efficiency in defense procurement or in achieving high-caliber weapon system effectiveness.

Cheung (2022a) explains China's "comprehensive strategic rise" through the lens of the techno-security state, which he defines as:

> An innovation-centered, security-maximizing regime that prioritizes the building of technological, security, and defense capabilities to meet expansive national security requirements based on heightened threat perceptions and the powerful influence of domestic coalition. (Cheung, 2022a, pp. 2–3)

There are five notable considerations that affect the makeup of a techno-security state. These considerations reveal key differences between the United States and China, and explain decision-making and motivations behind their defense acquisition processes. The following paragraphs discuss the five considerations using insights from *Innovate to Dominate*, and from an article written by Cheung and his co-author, Thomas Mahnken, titled "The Decisive Decade: U.S.-China Competition in Defense Innovation and Defense Industrial Policy in and beyond the 2020s." Figure 4 is the authors' visual depiction of the differences between the two countries' techno-security systems. The figure highlights differences in governance systems and interactions between sectors of defense industry. The topic of defense industry is addressed in depth later in this literature review.

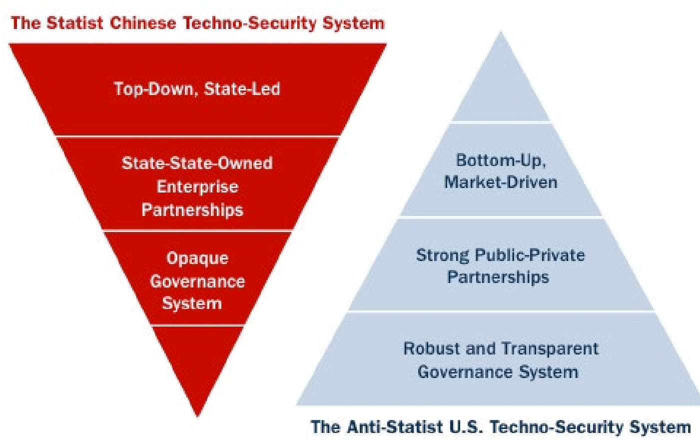

Figure 4. The Differing Natures of the U.S. and Chinese Techno-Security Systems. Source: Cheung & Mahnken (2023).

The statist vs. non-statist nature of a country is the first of the five techno-security state considerations. China is a statist country, one in which the leadership takes a top-down, tightly-controlled approach. The U.S. anti-statist regime takes a much more decentralized governmental approach in which the market is the driver for technological and economic development (Cheung, 2022a). Cheung and Mahnken compare the United States' and China's governance regimes in terms of the techno-security state: "Overall, the United States has a far superior model, and the governance regime is potentially the critical Achilles heel of the Chinese model" (Cheung & Mahnken, 2023, p. 61). The authors also discuss how China's top-down approach has significantly aided their rapid catch-up strategy, but that the United States has a more effective system for "routinized technological development" (Cheung & Mahnken, 2023, p. 61). China is well-postured for rapid modernization because its authoritarian government has the ability to directly funnel resources to strategic projects with virtually no intermediary. The U.S. processes, on the other hand, face bureaucratic stagnation and drawn-out approval timelines which slow down production and delivery of critical technology. There is tension between speed and sustainability in defense acquisition systems. It appears that the Chinese system tends to favor rapid output at lower costs, while the U.S. system prioritizes sustained innovation and adaptability.

The second consideration is the offensive or defensive nature of a techno-security state, and this is largely based on "how states perceive threats to their national security" (Cheung, 2022a, p. 3). Defensive-minded techno-security states are more internally-focused and build their security and resource allocation on internal requirements, rather than external threats. Offensive-minded techno-security states are much more threat-focused, perceiving external threats to the country as the key drivers of technological advancement (Cheung, 2022a). Countries tend to fall somewhere on the spectrum between offensive and defensive techno-security systems (Cheung, 2022a). Cheung and Mahnken assess that in terms of external threat perceptions and threat environment, "China was the first mover in the U.S.-China techno-security strategic competition, which allowed it to significantly narrow the gap with the United States" (Cheung & Mahnken, 2023, p. 61). The offensive nature of China's techno-security strategy fuels its accelerated investments in cutting-edge military technologies, a factor the United States must account for in aligning its acquisition priorities.

The third consideration is the level of integration that the state can achieve between the technological, economic, and national security sectors—how effectively are these three sectors communicating, idea-sharing, and coordinating to achieve national and strategic objectives? This idea is measured by the state of a country's dual-use economy and the strength of its industrial base—China calls this military-civil fusion (MCF) and in the United States, this is typically considered public and private partnerships (Cheung, 2022a; Cheung & Mahnken, 2023). In this area, Cheung and Mahnken assess that despite the increasingly outdated policies that exist for dual-use integration, the United States maintains an advantage over China whose "approach is still in its infancy and will suffer from a structural statist bias in its development" (Cheung & Mahnken, 2023, p. 33). Effective sector integration directly impacts a nation's ability to streamline defense acquisition processes. This underscores the United States' advantage in leveraging established partnerships and innovation ecosystems.

The fourth consideration is the state's pursuit of indigenous innovation and self-sufficiency. Cheung differentiates this category between catch-up countries, like China, and advanced states, like the United States. Catch-up countries are more reliant on foreign technology and know-how to fuel technological modernization, while advanced countries are more inclined and equipped to rely on internal mechanisms for innovative technological production (Cheung, 2022a). Cheung and Mahnken (2023) refer to these two approaches as techno-nationalist vs. global engagement. They assess that the United States leads the way by balancing production of innovative systems domestically, while also maintaining relationships abroad through exports. China still lags behind the United States in this area, but has set goals and made significant headway in the last two decades to become increasingly self-sufficient. President Xi acknowledged that China had not yet reached its goal in this area at a joint session focused on scientific and technological innovation in 2016: "We still have to depend on others for core technologies in key fields, our scientific and technological foundation is still weak, and our innovation capability, especially in original innovation, is not strong" (Xi, 2017, p. 293). The ability to develop critical technologies in-house is a key determinant of acquisition efficiency, and the United States must address China's expanding capability to independently innovate. Cheung and Mahnken highlight the importance of this discussion to the overall competition between the United States and China: "The international system will be a pivotal arena for long-term techno-security competition between the United States and

China and will likely play an outsized influence in shaping the outcome of this competition" (Cheung & Mahnken, 2023, p. 33).

The fifth consideration is the military and commercial revolution that the world experiences today (Cheung, 2022a). Cheung discusses the implications of the intertwined nature of economics, technological advancement, and national security concerns, and the opportunities and challenges that those implications pose for the United States, China, and other techno-security states. Understanding this revolution's implications enables both nations to align their acquisition processes with emerging global trends. This ensures competitiveness in the evolving techno-security landscape.

In summary, these five considerations are critical to understanding the inter-workings of a techno-security state. Different countries have varying approaches to the same end goal, which is integration of economics, technology, and national security to assert dominance and outpace competitors in all three areas on the world stage. A broad understanding of the techno-security state concept and the key differences between the U.S. techno-security system and that of China is critical to understanding differences between the two countries' acquisition systems.

1. The U.S. Techno-Security System

During the Cold War, the United States developed the Offset Strategy to keep pace with the Soviet Union's production capacity, specifically in defense-related systems. Instead of trying to out-produce the Soviet Union, the United States instead focused its efforts on certain critical technological sectors. As Cheung and Mahnken discuss, "this eventually gave the U.S. a decisive technological edge by emphasizing U.S. strengths over Soviet weaknesses" (Cheung & Mahnken, 2023, p. 6). Cheung and Mahnken identify four features of the U.S. techno-security state during the 1970s and 1980s that contributed to its strengths. First was the "pluralistic and decentralized nature" of the system, which allowed for cooperation between different entities—both military and civilian (Cheung & Mahnken, 2023, p. 6). Second was the national laboratories such as Los Alamos, Lawrence Livermore, and Sandia, that played a major role in driving technological advancement and innovation (Cheung & Mahnken, 2023). Third was the U.S. government's financial support for scientific research. Fourth was strong relationships between the federal and private sectors within the DIB that increased cooperation between the two entities and encouraged technological advancement (Cheung & Mahnken, 2023). According to Cheung and Mahnken, these four factors "have not aged well" (Cheung & Mahnken, 2023, p. 7). The public-private sector relationships are strained, risk aversion is commonplace in defense acquisition, and the United States' role in global research and development is diminishing. To address these issues, initiatives such as the National Security Innovation Capital fund, and Office of Strategic Capital have been established to support early-stage dual-use technology development and strengthen public-private collaboration (Cheung & Mahnken, 2023).

The most relevant component of the United States' success as a modern techno-security state and "advanced innovation power," is the idea of the national security state (NSS) as a "technological enterprise" (Cheung, 2022a, p. 267). Cheung uses Linda Weiss' book, *America Inc.?: Innovation and Enterprise in the National Security State*, as a foundation to describe this component of success. Weiss (2014) explains that the NSS developed gradually after World War II in response to ongoing geopolitical threats. Its establishment significantly expanded the executive branch's capacity to drive transformative changes in American politics. Over time, the NSS has adapted to address both international threats and domestic supply chain vulnerabilities, which helps safeguard America's technological dominance. Rather than imposing strict, top-down controls or relying solely on bottom-up innovation, it has fostered a system of managed interdependence across the economy (Weiss, 2014). Within the context of the NSS, Cheung (2022a) identifies three more focused measures of the U.S. techno-security state's success. First, its institutional design balances national security and private sector goals through an incentive-based system rather than one that is penalty-based (Cheung, 2022a). Second is the concept of hybridization, where public-private institutions merge in ways that obscure state involvement, exemplified by organizations like In-Q-TEL and national laboratories (Cheung, 2022a; Weiss, 2014). Third, the decentralized, "bottom-up" nature of the NSS fosters innovation despite concerns about inefficiency. Cheung (2022a) argues this model has proven effective, raising the question of whether China's centralized approach can compete in the race for global techno-security dominance.

2. The Chinese Techno-Security System

The Chinese techno-security system has had a different trajectory than the U.S. system. This section introduces a policy brief written by Cheung, published in 2022 by the University of California Institute on Global Conflict, titled "Inside China's Techno-Security State." In his brief, Cheung identifies five major lines of effort through which China is pursuing a stronger techno-security state. Those lines of effort include, "develop a national security state, innovation-driven development, military strengthening, military-civilian fusion, and economic securitization" (Cheung, 2022b, p. 1). These strategies are very much in line with Cheung's analysis in *Innovate to Dominate* of the breakdown of a successful techno-security system. Cheung and Mahnken discuss "rising threat perceptions, centralized, top-down coordination, and techno-nationalist dependence" as key factors contributing to the evolution of China's techno-security system (Cheung & Mahnken, 2023, p. 11). Both articles stress that one of the main motivations for the rapid rise of China's techno-security state is the external threat posed by the United States.

The United States, as an external threat, fuels China's rapid military buildup and establishment of China as an NSS, which is also the first line of effort for China's techno-security state. Cheung (2022a) highlights six main improvements to the NSS since Xi took power in 2012 (Cheung, 2022a):

1. The concentration of leadership decision-making
2. Strict party oversight
3. Expansion of security responsibilities to include anti-corruption and ideological alignment
4. Increased political influence of security institutions
5. A shift to proactively addressing threats
6. Sustained growth in funding for military and domestic security operations

Cheung (2022a) emphasizes the increasing interdependence between technology and the NSS in the 21st century. He also notes that U.S.-China competition will further solidify China's national security apparatus as a central force within its government.

The second line of effort for China's techno-security state is innovation-driven development. Xi's Innovation-Driven Development Strategy (IDDS) is a tool for China to achieve its dream of national rejuvenation by the middle of the 21st century. Cheung describes the IDDS as a "whole-of-nation effort in the pursuit of technological innovation," designed to allow the government to make strategic choices with critical resource allocation (Cheung, 2022b, p. 5). Figure 5 illustrates China's National Defense Innovation System, depicting actors, contextual factors, and the output, which is new military technology. Xi has consistently pursued innovation, recognizing it as a key driver in China's success as a techno-security state. Cheung describes areas being enhanced to improve China's innovation as "strategic planning, policy formulation, supervision and evaluation, the implementation of major and strategic tasks, and supporting fundamental research" (Cheung, 2022b, p. 5).

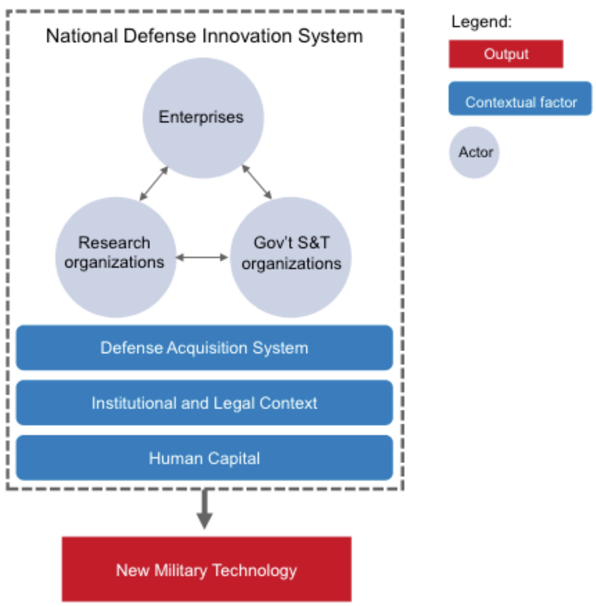

Figure 5. China's National Defense Innovation System. Source: Weinbaum et al. (2022a).

China has a complicated historical relationship with the concept of innovation, as highlighted in the previous chapter. Its leaders recognize the need for original innovation, yet it is still very much reliant on foreign technology for key components, like aircraft engines and microprocessors. Cheung (2022a) introduces the idea of the cult of gold-plated innovation. This is the level of innovation on which the United States operates, and to which China aspires, "in which the pursuit of next-generation technological capabilities trumps all other considerations including affordability, suitability to end-users needs, and development schedules" (Cheung, 2022a, p. 49). Applying this model to defense acquisition, one must consider that although the U.S. acquisition system is able to produce "state-of-the-art" systems that are largely unrivaled in terms of performance, these systems inevitably cost more and can take longer to field. The United States and other world leaders in innovation and technology are increasingly aware of the need for faster, lower cost acquisition of weapon systems. Cheung points out that these slower processes, combined with China's "'good enough'" model of acquisition allowed China to "narrow the gap" in innovation capability over the last two decades (Cheung, 2022a, p. 49). Cheung poses a thought-provoking dilemma that is one of the central themes of this thesis: "The tight ideological climate that has accompanied Xi's rule has seriously hampered efforts to instigate normative changes. Xi has insisted that the country's scientific, academic, and research workforce must be both creative and absolutely loyal to the Communist Party" (Cheung, 2022a, p. 49). It is one thing to acknowledge the need for innovation, but it is something else entirely to provide the freedom for independent thought, and it remains to be seen whether China's military institutions have the structure, aptitude, and willingness to change.

The third line of effort in China's building of its techno-security state is its robust plan to strengthen its military. Cheung outlines a three-phase plan for China's military modernization. The first phase aimed to mechanize the PLA by 2020 while advancing informatization and strategic capabilities. The second phase, set to conclude by 2035, seeks to complete military modernization and bring China's defense industry on par with leading global powers. The final phase envisions China surpassing the United States in military strength by 2050 (Cheung, 2022b). This timeframe holds significance because 2049 will mark the centennial of the founding of the PRC, which was established in 1949 under the CCP. President Xi made military strength a priority when he came to power in 2012, highlighted by significant military reform and re-crafting of military strategy (Cheung, 2022a). The Military Strategic Guidelines (MSG) are China's equivalent of the U.S. National Military Strategy. Although the MSG and the WEDS are both classified, it is likely that both were significantly updated around 2014, two years after Xi came to power. Cheung illustrates this conjecture by quoting Xi's keynote speech at the All-Army Work Conference in December 2014: "in the 'face of the new situation and new tasks, the strategic guidance for armament building must adapt to the times'" (Cheung, 2022a, p. 159). Cheung then assesses that the 2019 White Paper marks significant changes in how

China approaches warfare, “war is evolving in form toward informationized warfare, and intelligentized warfare is on the horizon” (Cheung, 2022a, p. 160).

The strengthening of the military to build a powerful techno-security state is also largely affected by the health of the DIB. China has made significant headway in this area since the beginning of the 21st century (Cheung, 2022a). The defense industry concept is discussed in depth in the following section of this literature review, so this section focuses on how the strength of the DIB directly affects military modernization and facilitates technological innovation within the PLA. Cheung mentions that the “center of gravity” of the DIB’s ability to grow its success is the SOE structure (Cheung, 2022a, p. 170). The CCP has very close ties to the defense industry SOEs which leads to increased funding, workforce investment, and prioritized resource allocation.

The fourth line of effort for China’s building of a successful techno-security state is the bolstering of and investment in MCF. Xi elevated MCF to a national-level strategy in 2015, and this marked the beginning of a gradual, yet determined effort to improve in this area. The “Opinions on the Integrated Development of Economic Construction and Defense Construction,” issued in 2016 alongside the IDDS, was the first tangible step toward achieving the MCF goal (Cheung, 2022a, p. 89). The goal was to be on par with the United States at an MCF rate of about 80 percent, referred to as “deep integration,” by 2020 (Cheung, 2022a, p. 92). Figure 6 shows the stages of China’s MCF development by intensity rate. China’s Central Military-Civil Fusion Development Center published the Military-Civil Fusion Development Strategy in 2018 which “represents a crucial link in Xi’s efforts to coordinate between national security, economic development, and technological innovation” (Cheung, 2022a, p. 94). China’s prioritization of MCF since 2015 has made it a key driver of its defense acquisition system and techno-security state.

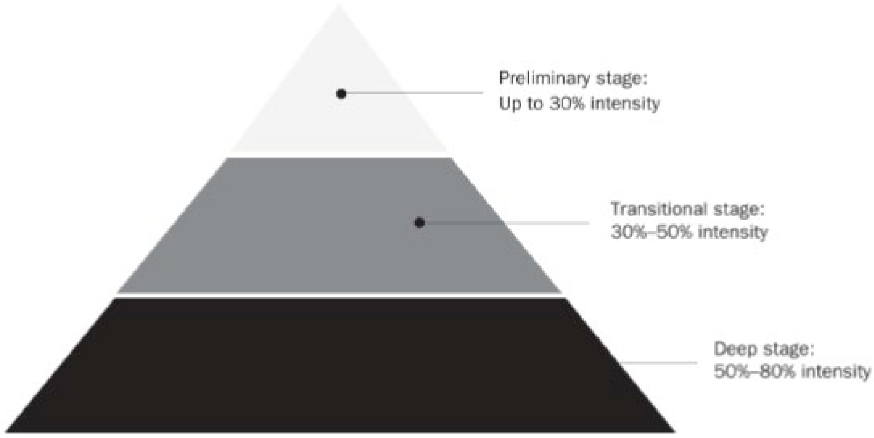

Figure 6. China's MCF Development Stages by Intensity Rate. Source: Cheung (2022a).

The final line of effort for the Chinese techno-security state is economic securitization. This concept is an example of how China's techno-security system is moving toward self-sufficiency in the economic realm, using asset securitization. Cheung explains that in the late 2010s, Chinese leaders became concerned about external countries' ability to affect the Chinese economy through sanctions and tariffs (Cheung, 2022b). In 2020, they came up with a plan for a "'dual-circulation'" economy, the idea of which is "to safeguard and promote the building up of a securitized and self-reliant domestic economic base, especially sectors deemed to be of critical and strategic importance, against the escalating risks posed by de-globalization and decoupling with the West" (Cheung, 2022b, p. 9). Figure 7 shows a rising asset securitization rate from 2012–2020 in the Chinese DIB. This rising trend not only shows China's increased prioritization of self-reliance, but also that it is effectively moving closer toward that goal. Each of these five lines of effort is an integral contributor to a successful techno-security state and as a byproduct, an efficient acquisition system.

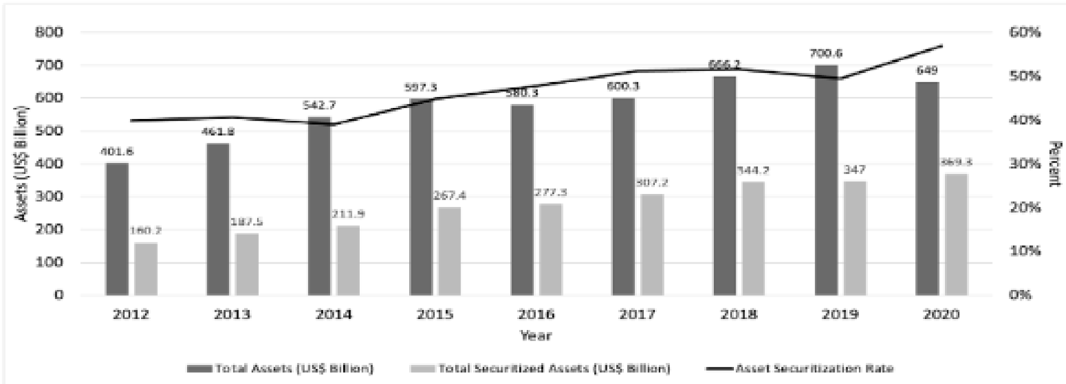

Figure 7. Asset Securitization Trends in the Chinese Defense Industry, 2012–2020. Source: Cheung & Mahnken (2023).

3. The Techno-Security State and Competition

The United States and China, as discussed at length in the previous two sections, have different systems and varying means of achieving similar end goals. All techno-security systems can be broken down into five categories: whether a country has more statist or anti-statist tendencies, where the state falls on the offensive to defensive spectrum, the country's level of integration of the technological, economic, and national security sectors, its pursuit of indigenous innovation, and its ability to capitalize on the military and commercial revolutions of the information age. The United States takes an anti-statist approach that is decentralized and market-based, China is statist and authoritarian in its governance regime, attempting to find the balance between top-down leadership and an effective shift toward an increasingly market-driven economy. Both countries' techno-security systems have different strengths and weaknesses, but what is most striking is the fact that despite their differences, the United States and China are both world leaders in emerging technologies, economic strength, and military might, demonstrating success on both ends of the spectrum.

B. CHINESE DEFENSE INDUSTRIAL BASE

This section of the literature review examines a 2022 RAND report titled *Assessing Systemic Strengths and Vulnerabilities of China's Defense Industrial Base with a Repeatable Methodology for Other Countries* (Weinbaum et al., 2022a). This report, created to meet a congressional requirement, uses strengths and weaknesses analysis to assess China's DIB "across six topics: economics; governance and regulations; research development and innovation; workforce labor and skills; manufacturing; and raw materials" (Weinbaum et al., 2022a, p. iv). The study introduces a novel methodology intended to "be applied to any country to assess the systemic strengths and vulnerabilities of that country's DIB" (Weinbaum et al., 2022a, p. iii). Weinbaum et al. assess the state of China's DIB using both quantitative and qualitative data pulled from primary and secondary source documents. This section of the literature review is supplemented with information from Cheung's *Innovate to Dominate* and a 2005 RAND report titled *A New Direction for China's Defense Industry* (Cheung, 2022a; Medeiros et al., 2021). The first portion of this section will focus on the core components of China's DIB and how it came to be. The second portion will focus on insights from Weinbaum et al. (2022a).

Virtually all literature discussing Chinese military modernization and the growing success of China's DIB since the turn-of-the-century starts by discussing the steady rise of Chinese defense spending year on year since the early 2000s. Figure 8 illustrates China and U.S. gross domestic product (GDP) and defense budgets from 2008–2021. This data shows that "the share of GDP spent on DIB procurement, along with other costs associated with military buildup, has remained under 2 percent of GDP from 2003 to 2020 in the official defense budget" (Weinbaum et al., 2022a, p. 11). The report acknowledges some defense expenditures that are not accounted for in the official defense budget, like "paramilitary and security services, direct outlays by the Central Military Commission (e.g., on military R&D), space activities, recruitment bonuses," that could raise defense spending to over two percent (Weinbaum et al., 2022a, p. 11). China now faces a critical decision due to the success of its DIB: whether to allocate resources toward modernization or focus on maintaining force readiness and sustainment (Weinbaum et al., 2022a).

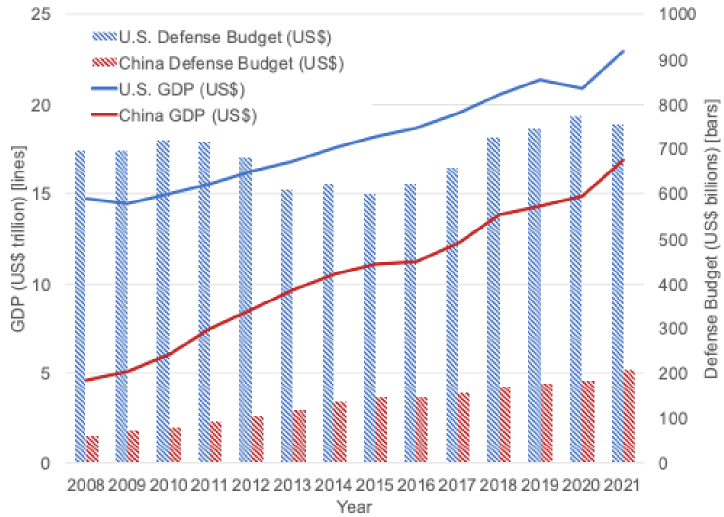

Figure 8. China and U.S. GDP and Defense Budgets 2008–2021. Source: Weinbaum et al. (2022a).

Another important part of understanding the rise of China's DIB is analyzing the 1998 turn-of-the-century DIB reform initiated by then-leader of the CCP, Jiang Zemin, and carried out by his successor, Hu Jintao. Prior to the late 1990s, SOEs suffered significantly after market-driven reforms and were forced to adopt a concept called "defense conversion" (Medeiros et al., 2005, p. 5). This concept was created to encourage defense firms to operate in the civilian sector as well, but this proved difficult in practice (Medeiros et al., 2005). The established structures of these companies, with leadership and employees accustomed to the planned economy, limited their ability to adapt and innovate in the new economic environment.

The turn-of-the-century reforms were designed to increase efficiency as well as weapon system effectiveness. This new era marked the beginning of China's gradual pursuit of not just quantity, but quality as well. Medeiros et al. (2005) attribute allocation of government funds toward weapon acquisition, improvements in R&D, consistent access to foreign military equipment, and policy reforms to the technological "catch-up" China has achieved in the last two decades. Weinbaum et al. (2022a) note that from 1980–2019, "China's economy grew 9.4 percent annually in real value terms, by far the most rapid growth of any sizable economy and the second-fastest growth overall," and explains that the DIB has significantly benefitted from this growth (Weinbaum et al., 2022a, p. 10). Cheung attributes the success of China's DIB to the "enterprise-driven development model" instituted by the 1998 reforms (Cheung, 2022a, p. 168). He says, "Industry-wide profits and revenues have been surging annually, a broad and deep array of advanced weapons and equipment is coming off the production lines, and the research, development, and engineering pipeline is bulging" (Cheung, 2022a, p. 168). Figure 9 shows revenues and profits of the Chinese defense industry from 2009–2021. The following section of the literature review will synthesize the strengths and weaknesses of China's DIB that relate specifically to acquisition efficiency using information pulled from Weinbaum et al. (2022a), and supplemented by data from Cheung (2022a) and Cheung and Mahnken (2023).

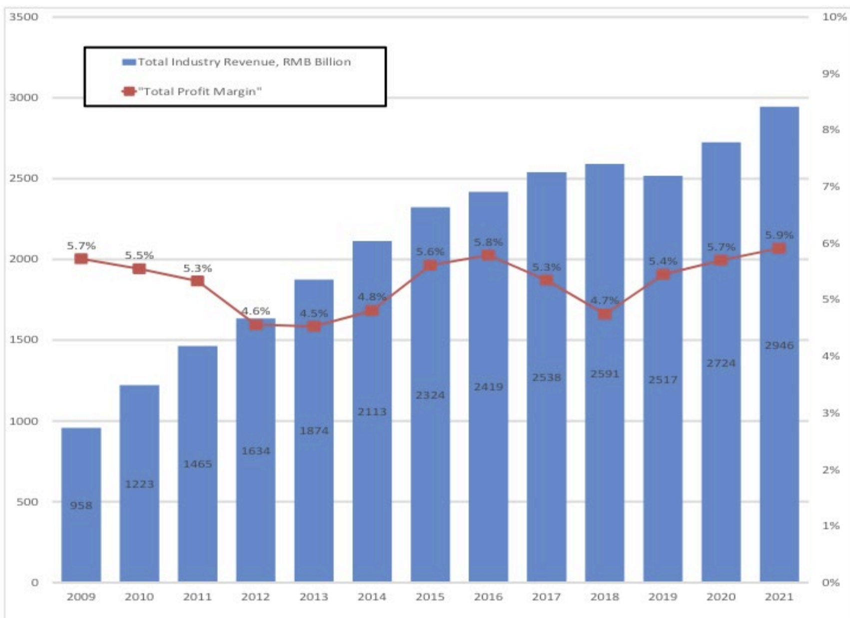

Figure 9. Revenues and Profits of the Chinese Defense Industry, 2009–2021. Source: Cheung & Mahnken (2023).

In their report, Weinbaum et al. (2022a) focus on comparing results and outputs of a country's DIB to its stated goals. The concept of comparing a country to its own stated goals is considered fundamental to this thesis and highlights the importance of a robust understanding of the country in question's domestic, national, and strategic priorities. Through the application of their methodology and framework, Weinbaum et al. came to several conclusions about the Chinese DIB.

The first conclusion has to do with the vastness of China's DIB. This is considered a strength, seeing as its magnitude makes it difficult for potential adversaries to gain a robust understanding of the inner-workings of the DIB. The size, however, is also viewed as a weakness because it can be difficult to manage—especially with the tight control the CCP attempts to retain over its projects. Weinbaum et al. conclude, "the sheer size of China's DIB makes it opaque to outsiders and unwieldy for the Chinese government" (Weinbaum et al., 2022a, p. iv). Figure 10 displays results showing that seven of the 15 largest defense-related firms in the world are Chinese SOEs.

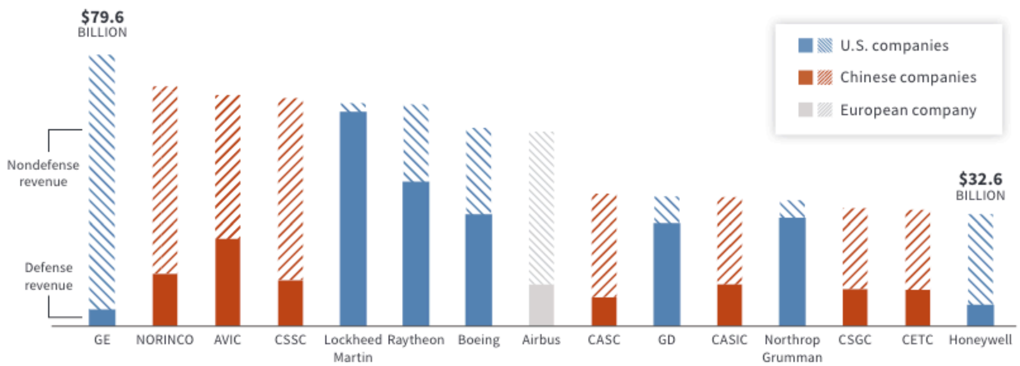

Figure 10. World's Largest Defense-Related Firms. Source: Weinbaum et al. (2022a).

The vastness of the DIB also makes it more difficult for the government to limit corruption left over from the command economy. Weinbaum et al. introduce the concept of "*guanxi,*" which are the "networks of social relationships used to facilitate management, business deals, and party directives" within the DIB (Weinbaum et al., 2022a, p. 57). Deals are made and contracts negotiated based on *guanxi*, but the opacity of the relationships makes it more difficult to assess "why certain firms receive favor in the DIB, including beneficial contracts" (Weinbaum et al., 2022a, p. 57). Cheung and Mahnken discuss how corruption "has thrived with the defense industry's uncertain transition from centralized state planning to a more indirect management model" (Cheung & Mahnken, 2023, p. 26). Specific incidents of corruption in China's DIB are discussed in more detail in Chapter IV of this thesis.

The second conclusion from Weinbaum et al. (2022a) is a continuation of the discussion that governmental centralization can be seen as both a strength and a vulnerability. A strong authoritarian central government allows for direct allocation of funds to certain critical and strategic programs, and whole-of-government efforts aligned on strategic priorities. The problem that arises out of centralization, however, is that "topics outside the priority list risk anemic treatment without the leadership's spotlight. This challenge is a risk for China should the government bet on the wrong technology" (Weinbaum et al., 2022a, p. 58). Another challenge the DIB faces with the centralized system is monopoly and a lack of competition among firms (Cheung, 2022a). During the reform era at the beginning of the 21st century, China split major defense sector SOEs in two in an attempt to generate more competition (Cheung, 2022a). In reality, this just led the two companies to adopt different specialties within their sectors and did little to impact competitive bidding (Cheung, 2022a). In more recent efforts to encourage market-based competition, individual SOEs have implemented "S&T industrial technology innovation centers," of which there are 14 identified as of the early 2020s (Cheung, 2022a, pp. 172–173). This challenge plays a significant role in weapons acquisition because without competition, which drives incentives, firms are neither motivated to be innovative, nor do they feel pressure to deliver systems on time and at cost.

Thirdly, Weinbaum et al. conclude that separation and lack of communication between DIB entities as well as a considerable reliance on foreign inputs are weaknesses of the Chinese DIB. This idea is also apparent when Cheung (2022a) describes compartmentalization within the acquisition process:

> Responsibilities for R&D, testing, procurement, production, and maintenance are in the hands of different units, and underinstitutionalization has meant that linkages among these entities tend to be ad hoc in nature with major gaps in oversight, reporting, and information sharing. (Cheung, 2022a, p. 175)

Cheung and Mahnken describe this compartmentalization as "a major obstacle to developing innovative advanced weapons capabilities because it requires consensus-based decision-making through extensive negotiations, bargaining, and exchanges" (Cheung & Mahnken, 2023, p. 23). China's DIB is reliant on other countries for critical technology and know-how (Weinbaum et al., 2022a). The amount of internal resources China dedicates to acquiring these external resources shows that Chinese leadership recognizes them as areas of weakness (Weinbaum et al., 2022a).

The final conclusion from Weinbaum et al. (2022a) that is within the scope of this thesis is that China's workforce will endure a significant upheaval over the next decade. This upheaval is driven by unaddressed decreasing fertility rates and a declining population (Weinbaum et al., 2022a). Potential effects of a declining population on the DIB are its inability to retain recent graduates, low funding and high drop-out rates for vocational schools, a general lack of academic rigor and critical thinking training at universities due to low incentivization for professors, and a growing workforce gender gap (Weinbaum et al., 2022a). The declining population only exacerbates these problems, forcing China to institute sweeping changes, including talent management programs intended to face these issues head-on. These talent management programs are focused on integration and cooperation between defense industry and research institutions in an attempt to funnel people with expertise in science, technology, engineering and math (STEM) fields into the DIB. Weinbaum et al. (2022a) note, "China's talent programs are providing China with access to cutting-edge scientific innovations, but it remains unclear whether these programs will have a meaningful effect on the DIB's advancements" (p. 45). China's 14th FYP prioritizes policy to ameliorate labor shortages, demonstrating that Chinese leadership views this issue as a significant weakness (Weinbaum et al., 2022a).

China's DIB has experienced considerable growth and modernization since the late 1990s, driven by economic reforms, consistent government investment, and strategic prioritization. This success, however, has revealed several underlying vulnerabilities. The sheer size of the DIB, while a strength in terms of scale and complexity, creates challenges in oversight, efficiency, and innovation due to bureaucratic fragmentation and compartmentalization. These issues, combined with a lack of competition among SOEs, negatively affect the efficiency of the acquisition system by reducing incentives for innovation and slowing delivery timelines. The reliance on foreign inputs continues to impede China's pursuit of technological self-sufficiency. Looking ahead, China must address workforce challenges stemming from an aging population, low retention rates, and gaps in STEM talent, which threaten long-term sustainability. These structural weaknesses present a dilemma for Chinese leadership as they seek to balance force readiness, sustainment, and continued modernization in an increasingly competitive environment, while managing an acquisition system that remains burdened by inefficiencies. The following section discusses the Chinese acquisition system in greater detail, as well as how different researchers have undertaken analysis of the Chinese acquisition system.

C. CHINESE DEFENSE ACQUISITIONS

This section discusses the strengths and weaknesses of China's defense acquisition system and looks at a few different ways that researchers have studied and provided assessments on the current state of China's acquisition processes. Some of these studies also provide assessments on why China appears to be outpacing the United States in some areas of defense acquisition. This section uses three main sources. The first is an article, written by Tai Ming Cheung in 2018, called "Strengths and Weaknesses of China's Defense Industry and Acquisition System and Implications for the United States" (Cheung, 2018b). Cheung (2018b) introduces the nature, pace, and costs of the Chinese defense acquisition system. He then discusses the acquisition process itself in terms of opportunities and constraints, and concludes with long-term implications for the United States. The second source is a RAND testimony presented before the U.S.-China Economic and Security Review Commission in April 2023 called *The Chinese Acquisition Process* (Curriden, 2023). Curriden (2023) examines the key differences between the Chinese and U.S. processes, and then discusses the major strengths and weaknesses of China's processes. The third source is a RAND report prepared for the U.S. Army called *Defense Acquisition in Russia and China* (Ashby et al., 2021). Ashby et al. (2021) explores how China approaches defense acquisitions according to doctrine and compare that to how it approaches defense acquisitions in practice. The authors then discuss potential barriers to China's success in defense acquisitions as well as ways in which China's acquisition system excels.

This section of the literature review uses supplementary information from *Innovate to Dominate*, as well as a chapter written by Cheung in the book *Chairman Xi Remakes the PLA: Assessing Chinese Military Reforms*, called "Keeping up with the Jundui: Reforming the Chinese Defense Acquisition, Technology, and Industrial System" (Cheung, 2019; Cheung, 2022a). The purpose of this section is to provide more insight into how the Chinese acquisition system functions, as well as to comment on different ways that researchers attempt to capture the opportunities and vulnerabilities of the system. It is also important to acknowledge that this thesis is limited to open-source collection and literature, so there is a significant amount of uncertainty about China's defense acquisition performance, cost and schedule, system counts, maintainability and reliability, and overall system performance. As Curriden (2023) points out, this reality "necessitates a focus on large platforms, such as aircraft, warships, armored vehicles, and ballistic missiles, which are easier to track in open sources" (p. 2). The methodology of this thesis uses the same concept in choosing larger, more well-known systems to evaluate the efficiency of both the United States' and China's overall acquisition systems because the data is more readily available.

A key concept of the Chinese acquisition process that all three authors mention is the effect of the defense acquisition reforms in the late 1990s. Ashby et al. (2021) discuss how the reforms "have reshuffled the roles and responsibilities within the Chinese bureaucracy, representing an effort to centralize and standardize China's weapon system procurement strategy in the upper echelons of government" (p. 16). All three sources also identify key players in the Chinese RDA process, citing the State Administration for Science, Technology, and Industry for National Defense (SASTIND) which liaises with industry, the CMC EDD which manages weapon system life cycles for "centralized unified management," and the PLA service branches which are the entities responsible for resourcing PLA units (Ashby et al., 2021; Cheung, 2019; Curriden, 2023, p. 3). While the EDD oversees larger joint design projects and big picture regulations, each service has its own equipment development division which is responsible for overseeing its military representative offices and weapons testing and evaluation (Curriden, 2023). Figure 11 shows the doctrinal layout of the Chinese armament and innovation system from an organizational perspective.

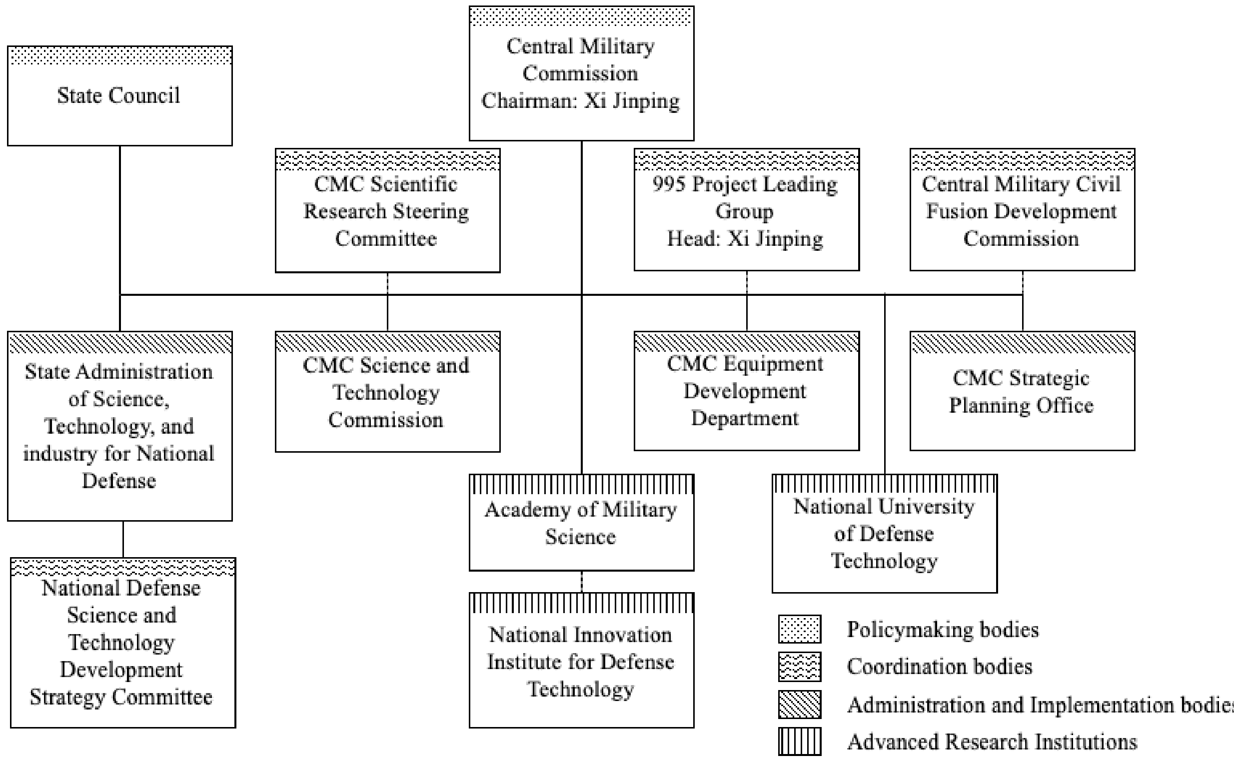

Figure 11. Top-Level Organizational Layout of the Chinese Military and Defense Science, Technology, and Industrial Armament and Innovation System Since the Late 2010s. Source: Cheung (2022a).

Ashby et al. (2021) compare China's acquisition doctrine with its acquisition practices. Doctrinally, the system is set up for unified management with the EDD as an arm of the CMC, so that Xi can have direct oversight and management of defense acquisition priorities. This has directly contributed to the diminishing power of the EDD in the acquisition process. The Chinese emphasis on iteration is also noteworthy, since it essentially starts the acquisition process over again right after a system reaches batch production, "to develop an incrementally improved version of the same system" (Ashby et al., 2021, p. 18). This is especially apparent in China's People's Liberation Army Navy Air Force and People's Liberation Army Air Force, but has folded into the overall Chinese acquisition ethos. In theory, China's system has dedicated testing throughout the acquisition process, designed to generate feedback from its customer. For example, "in the experiment and design finalization phase, specialized testing centers and PLA units conduct increasingly difficult tests on development and batch production systems" (Ashby et al., 2021, p. 18). China also has military representative officers (MRO) whose responsibility is to represent the military and oversee system development at research institutes and factories. The MRO system faces significant challenges, and will be discussed in detail in Chapter IV of this thesis (Curriden, 2023).

A majority of the reviewed literature on Chinese acquisitions highlight that the process has largely proven long and arduous, especially for more complex weapon systems. Ashby et al. (2021) discuss the fact that despite absorption, reverse engineering, and intellectual property theft, the Chinese still face long timelines for major capabilities. Cheung (2018b) discusses some of the potential reasons for these delays. He identifies key features of China's attempts to accelerate their acquisition processes that end up causing delays later. The first is development, testing and low-rate initial production compressed into fewer steps. This can lead to design oversight problems and improper risk calculation that may affect the ability of the service to field the system (Cheung, 2018b). The second is a fast-tracked R&D process, in many cases due to reverse engineering, foreign know-how, or information gained through espionage. The problem that China's acquisition process typically faces, is that "a number of Chinese weapon development programs have been rushed through the initial research and development phases, but then spend extended periods of time undergoing prototyping or demonstration testing" (Cheung, 2018b, p. 9). The third feature that China's high-level leaders, including Xi himself, have a vested interest in—and retain tight control over—the acquisition process. Although this is beneficial for allocation of resources, it can also be a weakness due to "political interference and more reporting requirements" (Cheung, 2018b, p. 10). The final feature is iteration after trial batch production runs. Cheung highlights the J-20 stealth fighter, Type 052 Luyang III-class destroyer, J-15 carrier-based fighter aircraft, and Y-20 transport aircraft as programs that China attempted to accelerate, but that they faced "lengthy periods for technology, engineering, and demonstration to low-rate initial production" (Cheung, 2018b, p. 10).

The existing literature provides a comprehensive examination of China's defense acquisition system, highlighting both its strengths, such as centralized leadership, long-term planning, and integration of defense innovation, and its persistent weaknesses, including bureaucratic fragmentation, monopolistic tendencies, and inefficient acquisition management. Cheung (2019; 2022a), Ashby et al. (2021), and Curriden (2023) reveal that while China's reforms have enhanced its ability to modernize rapidly, significant inefficiencies remain, particularly in oversight, testing timelines, and system delivery.

These analyses stop short of attempting to quantitatively and/or qualitatively measure strengths and weaknesses of the Chinese acquisition system. This study builds on the foundations established in existing literature by focusing explicitly on efficiency factors to determine whether China's acquisition processes are truly outpacing those of the United States'.

D. COMPARISONS OF ACQUISITION SYSTEMS BETWEEN COUNTRIES

A significant number of researchers examine and compare different countries' acquisition systems, and notably, many of these studies also discuss efficiency in some manner. In the literature reviewed for this section, methodologies vary among studies. This section discusses similarities and differences between three different studies and identifies gaps in the literature this research attempts to address. The three studies are NPS theses. One compares Germany and the U.S. acquisition systems, the second compares the acquisition systems of the United States and the Philippines, focusing on rapid acquisitions, and the last compares naval acquisition efficiency between the United States and China. The methodology and framework that was developed and applied in the U.S.-China naval acquisition efficiency study is applied in this study to compare the overall acquisition system efficiency of the United States and China.

1. Purpose Comparison

The German and Philippine studies have a similar purpose, which is to identify key similarities and differences with the United States in order to address gaps and recommend best practices for their respective countries' acquisition systems. Of note, in both the German and Philippine studies, at least one of the authors is from that country (Bautista & Zheng, 2024; Gottwald et al., 2024). This highlights the intent of the author to draw on key measures of efficiency to improve their own country's acquisition processes. The purpose of the U.S.-China comparative study is different in that the Lorge (2018) attempts to create a replicable framework to compare two countries' acquisition systems and apply that framework to effectively assess countries' acquisition efficiency. Lorge's framework is used for the data analysis of this thesis.

2. Methodology and Analysis Comparison

While all three studies seek to analyze and compare acquisition efficiency, each study adopts a slightly different methodology. The German study conducted by Gottwald et al. (2024), is focused on assessing efficiency and key areas for improvement in both the U.S. and German acquisition system. Gottwald al. employ a "comprehensive research methodology," including document analysis, comparative analysis, and theoretical analysis to understand "efficiency, agility, and responsiveness improvements" as well as "systemic challenges" in both the U.S. and German systems (Gottwald et al., 2024, pp. 2–4). In the Philippine study, Bautista & Zheng (2024) analyze the success of the United States' rapid acquisition framework and assesses whether that framework could be applied to the Philippines acquisition system in order to improve efficiency. Similar to the German study, Bautista & Zheng (2024) apply a comprehensive study approach for their research in which they identify strengths and weaknesses of the two systems and conduct extensive qualitative analysis to identify common patterns and themes. Gottwald al. and Bautista & Zheng include case study analysis to assess potential adoption of U.S. acquisition practices in their own countries. The German study looks at multiple case studies of U.S. Middle Tier Acquisition (MTA) programs, whereas the Philippine study specifically examines the rapid acquisition of the Mine-Resistant Ambush Protected vehicle in the mid-2000s (Bautista & Zheng, 2024; Gottwald et al., 2024). The purpose of these analyses is to assess whether the German and Philippine acquisition systems would be able to support similar endeavors, and what it would take to implement these changes.

Lorge (2018) takes a different approach. In his study, he conducts an extensive literature review to identify ten key factors that affect the efficiency of any country's acquisition system. The ten identified factors are "cost, schedule, performance, the acquisition workforce, contracting, the resource allocation system, innovation, the industrial base, the requirements system, and O&S costs" (Lorge, 2018, p. 85). He analyzes the first three factors, cost, schedule, and performance, using quantitative data.

Lorge analyzes the last seven factors using qualitative data. He then creates a framework with a scoring methodology to compare acquisition efficiency between countries.

For example, to analyze cost data, Lorge (2018) first examines total shipbuilding budget over a period of four years and compares that number to the number of ships added to the country's inventory that year to calculate cost per ship. The country with the lower cost per ship number scores points for having superior overall cost performance in shipbuilding. Lorge then compares five different classes of ship from both countries. The country with the lowest costs in the majority of programs scores points. Lorge's point system for cost is displayed in Table 3. Schedule and performance have similar scoring systems.

Table 3. Lorge Cost Factor Point System. Source: Lorge (2018).

Acquisition Efficiency Factor	**United States**	**China**
Cost: Comparable systems of this country have the lowest cost to produce.	Cost performance on programs in the country is: **4 Points:** Superior overall and in the majority of programs. **2 Points:** Superior overall or in the majority of programs. **0 Points:** Neither superior overall nor in the majority of programs.	Cost performance on programs in the country is: **4 Points:** Superior overall and in the majority of programs. **2 Points:** Superior overall or in the majority of programs. **0 Points:** Neither superior overall nor in the majority of programs.

In the next chapter, Lorge's (2018) framework is applied to compare the overall defense acquisition efficiency between the United States and China. The primary goal of the application of the framework is to attempt to answer the primary research question, which is to what extent China is outpacing the United States in defense acquisition. The secondary goal is to identify areas of weakness in the U.S. defense acquisition system. The tertiary goal is to test the ability of the framework to assess and compare the overall acquisition efficiency of the United States and China, not just acquisition efficiency in one sector such as shipbuilding.

3. Recommendations Comparison

Gottwald et al. (2024) conclude with recommendations and areas of improvement for both the United States and Germany. The authors determine if acquisition practices that work for one country would help improve efficiency for the other. This level of nuanced analysis and tailored recommendations demonstrate a robust understanding of each system's strengths and weaknesses. Bautista and Zheng (2024) are in favor of the Philippines adopting a rapid acquisition pathway, as well as general policy reform to improve efficiency and speed within the Philippine acquisition system. Lorge (2018) concludes, through the use of his framework and scoring system, the United States is more efficient overall than China in the acquisition of naval vessels, but that China "is still able to produce naval vessels faster and at a lower cost" (p. 87). Lorge (2018) also recognizes that China is closing the gap in acquisition efficiency at a rapid pace through reform and direct funding to prioritized projects. He recommends accelerated acquisitions, improved contracting methods, increased capacity for shipbuilding, an additional corvette-class vessel that can be produced in quantity at a low cost, and employing absorption, which he identifies as a core driver behind China's acquisition "catch-up" success (Lorge, 2018).

E. MEASURING ACQUISITION EFFICIENCY IN THE DOD

This section of the literature review focuses on the most prominent factors that the U.S. uses to measure acquisition efficiency. Three main sources are included in this section. The first is a volume compiled by Frank Kendall called "Getting Defense Acquisition Right" (Kendall, 2017). Kendall served as the Under Secretary of Defense for Acquisition, Technology, and Logistics from 2012–2017 (Kendall, 2017). This volume is a compilation of lessons learned that Kendall put together at the end of his tenure as parting words of experience and best practices for the acquisition workforce. Kendall was a significant driver of the Better Buying Power initiative to improve defense acquisition efficiency in the 2010s (Kendall, 2017). The second source is a RAND report published in 2022 titled *Improving Defense Acquisition: Insights from Three Decades of RAND Research* (Wong et al., 2022). This study compiled information from 44 RAND reports written about defense acquisition from 1986–2021, and created a methodology to qualitatively study the available data (Wong et al., 2022). The third source is the Government Accountability Office (GAO) 2024 Weapon Systems Annual Assessment. The GAO selected 108 of the DoD's costliest weapon systems to provide specific guidance and recommendations for future improvement in cost reduction, schedule adherence, and weapon system performance (GAO, 2024). These three sources generally agree that those three factors—cost, schedule and performance—are the three primary factors of measuring efficiency in DoD acquisitions. The following subsection includes an assessment of these three factors as well as other notable or repeating efficiency factors addressed.

1. Cost, Schedule and Performance

Cost, schedule, and performance are three of the key metrics for measuring program success in the DoD. These three factors are interrelated and require careful balance to maintain relative equilibrium within the program. It is important to understand that managing cost, schedule, and performance for major defense acquisition programs (MDAP) is virtually impossible, but Program Managers are tasked to ensure the programs stay as close to baseline as possible (DoD, 2020). Evaluating cost growth between a program's baseline and its actual costs, as well as estimating life-cycle costs, is critical to maintaining efficiency in an acquisition (GAO, 2024; Kendall, 2017). Schedule adherence is measured using cycle time, the time that is required for a program to move from its early development stages to IOC, as well as how many incremental schedule delays the program has faced relative to planned milestones (GAO, 2024; Kendall, 2017). Acquisition performance is measured using key performance parameters and capability requirements, as well as operational relevance, to determine program efficiency and success (GAO, 2024; Kendall, 2017; Wong et al., 2022).

2. Risk Management

Risk management, although not part of the iron triangle, plays a major role in efficiency measurement in DoD acquisition. Risk management tools like Earned Value Management and Technology Readiness Levels exist to measure deviation from baseline schedule and cost to manage program risk (GAO, 2024; Wong et al., 2022). If done effectively, risk management is also tailored to specific programs based on their unique characteristics (DoD, 2020). The Weapon Systems Annual Assessment suggests programs that incorporate iterative development cycles, like prototyping, feedback loops, and phased testing, tend to manage risks more efficiently due to their ability to "identify a minimally viable product that can deliver essential capabilities to users with speed" (GAO, 2024, p. 161).

3. Innovation and Adaptability

Measuring innovation is difficult due to its relatively intangible nature, but it is critical to capture as it plays a key role in acquisition efficiency. Adaptable processes allow the DoD to leverage emerging technologies while managing risks. The DoD evaluates the level and proficiency of programs in the competitive prototyping field, which encourages competition during early prototyping stages and promotes innovation (Kendall, 2017; Wong et al., 2022). Wong et al. (2022) discuss another method to measure DoD acquisition efficiency, which is to look at Modular Open System Approaches (MOSAs). MOSAs enable faster upgrades, cost savings, and system flexibility (Wong et al., 2022). GAO monitors a program's ability to integrate commercial practices in order to leverage commercial technology and liaise with the private sector (GAO, 2024). Wong et al. (2022) also mention the importance of DIB engagement in order for the DoD to exploit its innovation potential.

4. Workforce Capacity and Outcome

Wong et al. (2022) discuss the importance of a skilled workforce to efficient DoD acquisition practices. The authors discuss, in particular, system engineers and PMs as essential for effectively executing acquisition programs (Wong et al., 2022). According to Wong et al., "The acquisition workforce must be properly sized, trained, and incentivized to make the smart decisions that flexible acquisition approaches and partnering productively with industry entail" (Wong et al., 2022, p. 44). Kendall (2017) writes extensively about the power of people in the acquisition workforce. He discusses the importance of professionalism amongst acquisition professionals—that they have a deep understanding of their trade, embrace complexity, strive always for improvement, and make decisions in an ethical manner (Kendall, 2017). Wong et al. (2022) and GAO (2024) identify streamlined oversight as another important measurement of efficiency.

Simplification of program reviews and reduction of bureaucratic hurdles improve decision-making efficiency while maintaining accountability (GAO, 2024; Wong et al., 2022).

F. SUMMARY

This literature review examines existing research on defense acquisition efficiency in the United States and China and highlights their distinct techno-security models and acquisition systems. It explores the concept of the techno-security state, introduced by Tai Ming Cheung, to contextualize how both nations integrate technological development, economic strategy, and national security priorities. The review assesses China's DIB emphasizing its rapid expansion, state-controlled structure, and ongoing challenges with innovation, workforce retention, and reliance on foreign technology. It also examines China's defense acquisition system by outlining its strengths in centralized decision-making and rapid production, but also addressing inefficiencies related to bureaucratic fragmentation, monopolistic state-owned enterprises, and delays in fielding advanced systems. Comparisons of acquisition systems between countries are analyzed, particularly the NPS thesis by Lorge (2018), which provides a framework for evaluating efficiency in U.S.-China naval acquisition. The final section evaluates measuring acquisition efficiency in the DoD, identifying key metrics such as cost, schedule, performance, risk management, innovation, and workforce capacity. This review establishes a foundation for analyzing whether China is outpacing the United States in defense acquisition efficiency and identifying areas where the U.S. system may require reform.

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IV. DATA ANALYSIS

This chapter applies Lorge's (2018) framework to analyze overall defense acquisition efficiency in the United States and China. The framework is kept the same for continuity purposes and to test whether this same method can be effective when applied to the efficiency of countries' overall acquisition systems. The only exceptions are in the analysis of cost, schedule, and performance. In the cost, schedule, and performance categories, this thesis quantitatively evaluates aircraft, ships, and missiles. Countries receive scores based on whether they are superior in two or more programs, superior in one program, or superior in zero programs. Table 4 depicts the acquisition efficiency framework and scoring system. This framework alteration was necessary due to limitations of relevant Chinese data. The U.S. platforms being evaluated for cost, schedule, and performance are the Arleigh Burke–class guided missile destroyer (DDG-51), the F-35 Lightning II, and the Long-Range Hypersonic Weapon (LRHW). The Chinese platforms being evaluated are the Luyang III (Type 052D/DL), the J-20 Mighty Dragon, and the Dong Feng-26 (DF-26) intermediate-range ballistic missile. All quantitative data is normalized for inflation using the Joint Inflation Calculator. This thesis uses the following appropriations indices in the Joint Inflation Calculator (Cost Assessment and Data Enterprise, n.d.):

- Ships: Navy Shipbuilding and Conversion Index
- Aircraft and missiles: Defense-Wide Procurement Index

Table 4. Acquisition Efficiency Framework. Adapted from Lorge (2018).

Acquisition Efficiency Factor	United States	China
Cost: Comparable systems of this country have the lowest cost to produce.	Cost performance is: **4 Points:** Superior in two or more programs **2 Points:** Superior in one program **0 Points:** Superior in 0 programs	Cost performance is: **4 Points:** Superior in two or more programs **2 Points:** Superior in one program **0 Points:** Superior in 0 programs

Acquisition Efficiency Factor	United States	China
Schedule: Comparable systems of this country are produced more quickly.	Schedule performance is: **4 Points:** Superior in two or more programs **2 Points:** Superior in one program **0 Points:** Superior in 0 programs	Schedule performance is: **4 Points:** Superior in two or more programs **2 Points:** Superior in one program **0 Points:** Superior in 0 programs
Performance: Comparable systems of this country have superior capabilities.	The performance of weapon systems in this country is: **4 Points:** Superior in two or more programs **2 Points:** Superior in one program **0 Points:** Superior in 0 programs	The performance of weapon systems in this country is: **4 Points:** Superior in two or more programs **2 Points:** Superior in one program **0 Points:** Superior in 0 programs
AW: This country has a well-trained and well-organized acquisition workforce.	The AW of this country is: **4 Points:** Both well-trained and well-organized **2 Points:** Either well-trained or well-organized **0 Points:** Neither well-trained nor well-organized.	The AW of this country is: **4 Points:** Both well-trained and well-organized **2 Points:** Either well-trained or well-organized **0 Points:** Neither well-trained nor well-organized.
Contracting: This country uses contracting methods that hold contractors accountable and incentivize them to meet objectives.	The contracting methods used by this country: **4 Points:** Both incentivize contractors and hold them accountable **2 Points:** Either incentivize contractors or hold them accountable **0 Points:** Neither incentivize contractors nor hold them accountable	The contracting methods used by this country: **4 Points:** Both incentivize contractors and hold them accountable **2 Points:** Either incentivize contractors or hold them accountable **0 Points:** Neither incentivize contractors nor hold them accountable

Acquisition Efficiency Factor	United States	China
Resource Allocation: This country's resource allocation system ensures programs are affordable and maximizes value for money.	The resource allocation system of this country: **4 Points:** Both ensures affordability and maximizes value **2 Points:** Either takes affordability into account or maximizes value **0 Points:** Neither takes affordability into account nor maximizes value	The resource allocation system of this country: **4 Points:** Both ensures affordability and maximizes value **2 Points:** Either takes affordability into account or maximizes value **0 Points:** Neither takes affordability into account nor maximizes value
Innovation: This country has the R&D capability to produce a full range of modern military equipment.	The country's innovation system is: **4 Points:** Capable of developing a full range of technologies **2 Points:** Capable of developing some technologies **0 Points:** Capable of developing no technologies	The country's innovation system is: **4 Points:** Capable of developing a full range of technologies **2 Points:** Capable of developing some technologies **0 Points:** Capable of developing no technologies
Industrial Base: This country's industrial base has the capacity and capability to meet the government's requirements.	The industrial base of this country: **4 Points:** Has both the capability and capacity to meet objectives **2 Points:** Has either the capability or capacity to meet objectives **0 Points:** Has neither the capability nor the capacity to meet objectives	The industrial base of this country: **4 Points:** Has both the capability and capacity to meet objectives **2 Points:** Has either the capability or capacity to meet objectives **0 Points:** Has neither the capability nor the capacity to meet objectives

Acquisition Efficiency Factor	United States	China
Requirements System: This country's requirements system generates requirements that accurately meet the government's objectives.	The requirements system of this country: **4 Points:** Generates only requirements that meet objectives **2 Points:** Generates some requirements that meet objectives **0 Points:** Generates no requirements that meet objectives	The requirements system of this country: **4 Points:** Generates only requirements that meet objectives **2 Points:** Generates some requirements that meet objectives **0 Points:** Generates no requirements that meet objectives
O&S Costs: This country considers O&S costs when developing a new weapon system.	The country's acquisition system: **4 Points:** Considers all O&S costs when developing systems **2 Points:** Considers some O&S costs when developing systems **0 Points:** Considers no O&S costs when developing systems	The country's acquisition system: **4 Points:** Considers all O&S costs when developing systems **2 Points:** Considers some O&S costs when developing systems **0 Points:** Considers no O&S costs when developing systems
TOTAL POINTS		

A. COST FACTOR

This section provides an examination of unit cost data for a comparable naval ship, fighter aircraft, and missile system for each country, to attempt to cover a wider range of the countries' acquisition systems. Each platform has a different metric for comparison due to the time period evaluated for the schedule factor and the availability of Chinese data.

For the ship cost comparison, unit cost data is from 2019 because the available Chinese ship cost data is from 2019. It is assumed that the Chinese unit cost estimates do not include R&D costs; therefore, the U.S. cost data uses the Average Procurement Unit Cost (APUC), as it only considers procurement-related expenses (AcqNotes, 2021). Within the context of this thesis, APUC is referred to as average unit cost (AUC). The program evaluation period for the aircraft comparison is the first 6 years after the programs reached IOC. The Chinese aircraft program evaluation period is from 2018–2024, and the U.S. aircraft program evaluation period is from 2015–2021. Both countries' aircraft unit cost data is from the last year of their program evaluation periods. The missile unit cost data is the most current and available approximation of both the U.S. and Chinese systems. The unit cost is an estimate for the U.S. missile because it is not yet operationally fielded, and for China because the exact number is not publicly available.

1. United States

The program evaluation period for ship unit costs is 2012–2022, and the metric for comparison is AUC as of 2019. The reported AUC in 2019 is in constant year (CY) 1987 dollars because that is the program's base year. The AUC of the DDG-51 as of 2019 is $731.7 million (CY1987$; DoD, 2019). Normalized for inflation, the AUC of the DDG-51 is $1,711.2 million (CY2025$; Cost Assessment and Data Enterprise, n.d.).

The program evaluation period for aircraft unit costs is the first 6 years since IOC, and the metric of comparison is the AUC as of the last year in the program evaluation period. The F-35 reached IOC in 2015, so the program evaluation period for the F-35 is 2015–2021 (Department of the Navy, 2021). Normalized for inflation, the AUC of the F-35 is $118.7 million (CY2025$; Cost Assessment and Data Enterprise, n.d.).

The approximated AUC of the LRHW, normalized for inflation, is $43.0 million (CY2025$; Cost Assessment and Data Enterprise, n.d.; Feikert, 2025).

2. China

Based on the same 10-year program evaluation period as mentioned previously (2012–2022), the AUC of the Type-052D/DL, normalized for inflation, is $899.6 million (CY2025$; Cost Assessment and Data Enterprise, n.d.; Janes, 2024b).

The J-20 reached IOC in 2018, so the program evaluation period is 2018–2024. Normalized for inflation, the AUC of the J-20 is $112.4 million (CY2025$; Cost Assessment and Data Enterprise, n.d.; Kadidal, n.d.).

The approximated AUC of the DF-26, normalized for inflation, is $20.4 million (CY2025$; Cost Assessment and Data Enterprise, n.d.; Dangwal, 2024).

Tables 5–7 show cost comparisons of U.S. and Chinese ships, aircraft and missiles. Table 8 displays the costs comparisons of all 6 platforms, and shows the superior system, in terms of cost, for each platform.

3. Scoring

Table 5. Ship Cost Comparison. Adapted from Lorge (2018).

	DDG-51	Type 052D/052DL
AUC ($M)	$731.7	$733.9
Base Year	1987	2019
Inflation Factor	2.3	1.2
AUC (CY2025$M)	$1,711.2	$899.6

Table 6. Aircraft Cost Comparison. Adapted from Lorge (2018).

	F-35	J-20
AUC ($M)	$101.1	$110
Base Year	2021	2024
Inflation Factor	1.2	1.0
AUC (CY2025$M)	$118.7	$112.4

Table 7. Missile Cost Comparison. Adapted from Lorge (2018).

	LRHW	DF-26
AUC ($M)	$41.0	$20.0
Base Year	2023	2024
Inflation Factor	1.0	1.0
AUC (CY2025$M)	$43.0	$20.4

Table 8. Platform Cost Comparison. Adapted from Lorge (2018).

Ship (CY2025$M)		**Aircraft** (CY2025$M)		**Missile** (CY2025$M)	
DDG-51	**052D/DL**	**F-35**	**J-20**	**LRHW**	**DF-26**
$1,711.2	$899.6	$118.7	$112.4	$43.0	$20.4

In the cost comparison, China is superior in all three programs and scores four points. The United States is superior in zero programs, and scores zero points.

B. SCHEDULE FACTOR

This section examines schedule data for the same ships, aircraft, and missiles discussed in the previous section. Program evaluation periods differ between platforms due to available Chinese data. For the ship comparison, the program evaluation period is from 2012–2022. In this thesis, the average number of ships launched per year is calculated by dividing the total number of ships launched in the 10-year program evaluation period by 10. For the aircraft comparison, the program evaluation period is the first 6 years after the aircraft entered service. The Chinese aircraft program evaluation period is 2018–2024, and the U.S. aircraft program evaluation period is 2015–2021. Total aircraft in service by the last year of the program evaluation period is divided by six to calculate the average number of aircraft produced per year. For the missile schedule comparison, the program evaluation period is the time from start of development to first successful test flight, as data on average missiles produced per year is not available. Due to data constraints, these numbers are approximations. For the Chinese missile, the program evaluation period is 2010–2017, and for the U.S. missile, the program evaluation period is 2019–2024.

1. United States

The DDG-51 program launched a total of 13 ships from 2012–2022 (DDG 113 through DDG 125; Naval Vessel Register, 2025). Dividing 13 ships by 10 years equals 1.3 ships per year.

The first F-35 reached IOC in 2015. Of note, the first F-35 to reach the fleet after IOC was the F-35B, delivered to the U.S. Marine Corps in July 2015 (Department of the Navy, 2021). From 2015–2021, 753 F-35s entered service (Department of the Navy, 2021). Dividing 753 aircraft by the program evaluation period of 6 years equals 125.5 aircraft per year.

The LRHW is not yet operationally fielded, but it is necessary to use for comparison as it is the closest equivalent U.S. system to the Chinese DF-26. According to Lockheed Martin's website, the LRHW contract was awarded in August 2019, and the first successful test flight of the missile was in June 2024 (Feikert, 2025). The next successful LRHW test was completed in December 2024 and was reportedly the first test in which the missile was fired using the battery operations center and a transporter erector launcher (TEL) (Feikert, 2025). Therefore, the best available estimate for the LRHW schedule factor is approximately 5.5 years.

2. China

The Type 052D/DL is evaluated over the same 10-year time frame (2012–2022). A total of 26 ships were launched in the program evaluation period (Janes, 2024b). Dividing 26 ships by 10 years equals 2.6 ships per year.

The first J-20 reached IOC in 2018. By June 2024—6 years later—China had a total inventory of 195 J-20s (Janes, 2024a). Dividing 195 aircraft by the 6-year program evaluation period equals 32.5 aircraft per year.

The DF-26 program is estimated to have started in 2010, and its first documented successful test flight was in May 2017, approximately 7 years later (Missile Threat, 2024).

Tables 9–11 show schedule comparisons of U.S. and Chinese ships, aircraft and missiles. Table 12 displays the schedule comparisons of all 6 platforms, and shows the superior system in terms of schedule for each platform.

3. Scoring

Table 9. Ship Schedule Comparison. Adapted from Lorge (2018).

	DDG-51	**Type 052D/DL**
Ships Produced in Period	13	26
Evaluation Period (Years)	10	10
Average Ships Per Year	1.3	2.6

Table 10. Aircraft Schedule Comparison. Adapted from Lorge (2018).

	F-35	**J-20**
Aircraft Produced in Period	753	195
Evaluation Period (Years)	6	6
Average Aircraft Per Year	125.5	32.5

Table 11. Missile Schedule Comparison. Adapted from Lorge (2018).

	LRHW	**DF-26**
Development Start	2019	2010
Successful Test Flight	2024	2017
Time (Years)	5.5	7

Table 12. Platform Schedule Comparison. Adapted from Lorge (2018).

Ship Ships Per Year	**Aircraft** Aircraft Per Year	**Missile** Time (Years)

DDG-51	052D/DL	F-35	J-20	LRHW	DF-26
1.3	2.6	125.5	32.5	5.5	7

In the schedule comparison, the United States is superior in two programs and scores four points. China is superior in one program and receives two points.

C. PERFORMANCE FACTOR

This section compares performance data for the same ships, aircraft, and missiles. The platforms are evaluated using a different set of performance criteria due to the different nature, functions, and mission sets of the platforms. The ship criteria are the same as the performance characteristics from Lorge's (2018) framework. The ship characteristics being evaluated are "top speed, crew, displacement, primary weapon, and primary sensor" (Lorge, 2018, p. 73). The aircraft performance characteristics being evaluated are top speed, approximated radar cross section (RCS), engine type, primary sensor, and internal weapons. Of note, for the F-35, all characteristics were selected so that they would be agnostic to the different service variants. In other words, this research focuses on performance characteristics that apply to all variants of the F-35 (Demascio, 2024). The missile performance characteristics being evaluated are top speed, range, propulsion, TELs per battery, and warhead. The selected performance characteristics offer diverse metrics to assess platform performance and capture various aspects of the acquisition system (Lorge, 2018). In the comparison portion, the explanations are limited to clarifying only the aspects of the comparison tables that are not already self-explanatory.

1. United States

Tables 13–15 show performance characteristics of U.S. ships, aircraft and missiles.

Table 13. U.S. Ship Characteristics. Adapted from Lorge (2018).

Program	Top Speed	Crew	Displacement	Primary Weapon	Primary Sensor
DDG-51	30+ KT	323	9,496 LT	96-cell VLS	SPY-1D

Data from: Commander, Naval Surface Forces (n.d.)

Table 14. U.S. Aircraft Characteristics

Program	Top Speed	RCS	Engine Type	Primary Sensor	Internal Weapons

F-35	Mach 1.6	$0.0015 m^2$	F135	AN/APG-81 active electronically scanned array (AESA)	2x AIM-120C/D 2x GBU-31

Data from: Demascio (2024), Lockheed Martin (2020), and Wang (2023)

Table 15. U.S. Missile Characteristics

Program	Top Speed	Range	Propulsion	TELs/ Battery	Warhead
LRHW	Mach 5	2,778 km	two-stage solid-fuel rocket booster	4	conventional

Data from: Feikert (2025)

2. China

Tables 16–18 show performance characteristics of Chinese ships, aircraft and missiles.

Table 16. Chinese Ship Characteristics. Adapted from Lorge (2018).

Program	Top Speed	Crew	Displacement	Primary Weapon	Primary Sensor
052D/DL	30 KT	280	7,380 LT	64-cell VLS	Type 346A

Data from: Naval Technology (2017) and Wertheim (2020)

Table 17. Chinese Aircraft Characteristics

Program	Top Speed	RCS	Engine Type	Primary Sensor	Internal Weapons
J-20	Mach 1.8	$0.01 m^2$	WS-10C	UNK AESA	4x PL-15

Data from: Barry (2022), Rogoway (2019), Schneider (2017), and Wang (2023)

Table 18. Chinese Missile Characteristics

Program	Top Speed	Range	Propulsion	TELs/ Battery	Warhead
DF-26	Mach 18	4,000 km	two-stage solid propellant	12–18	thermonuclear or conventional

Data from: Missile Threat (2024) and OE Data Integration Network (n.d.)

3. Scoring

Tables 19–21 show ship, aircraft and missile performance characteristic comparisons, respectively. Table 22 displays the overall platform performance comparison.

Table 19. Ship Performance Comparison

Program	Top Speed	Crew	Displacement	Primary Weapon	Primary Sensor
DDG-51	30+ KT	323	9,496 LT	96-cell VLS	AN/SPY-1D
052D/DL	30 KT	280	7,380 LT	64-cell VLS	H/LJQ-346A

In this table, the primary sensor comparison requires further explanation. The AN/SPY-1D is a passive electronically scanned array radar. The H/LJQ-346A *Dragon Eye* is an AESA radar (Rahmat, 2024). By its nature, an AESA radar is better-performing and typically has a longer range, better detection capabilities, and is more reliable (Gaitanakis et al., 2020). Therefore, the Dragon Eye likely outperforms the AN/SPY-1D. Of note, DDG-51 Flight III is expected to be equipped with AN/SPY-6(V)1, which is an active electronically scanned array radar. Both upgrades are expected to be complete in FY2027 (Office of the Director, Operational Test & Evaluation, 2023). This will likely even the playing field in terms of radar performance.

Table 20. Aircraft Performance Comparison

Program	Top Speed	RCS	Engine Type	Primary Sensor	Internal Weapons
F-35	Mach 1.6	$0.0015m^2$	F135	AN/APG-81 AESA	2x AIM-120C/D 2x GBU-31
J-20	Mach 1.8	$0.01\ m^2$	WS-10C	UNK AESA	4x PL-15

For the aircraft comparison, engine type, primary sensor, and internal weapons require further explanation. China is known to have inferior aircraft engine technology; this is a widely acknowledged weakness in terms of platform performance (Finkelstein, 2019; Saunders & Wiseman, 2011). The F-35's F135 engine incorporates stealth technology that sets it apart even from older U.S. fighters, and it will be receiving upgrades in the coming years to improve engine cooling and increase time to overhaul (Demascio, 2024). The introduction of the WS-15 engine is likely to improve the overall performance of the J-20 and represents a significant milestone in aircraft engine design for China. China is likely to still lag in aircraft engine performance, however, due to a lack of experience and technological know-how (DoD, 2024a; Johnson, 2023; Saunders & Wiseman, 2011).

The AN/APG-81 is the most advanced AESA radar in the world, with long-range detection capabilities, active and passive modes allowing for advanced stealth, and advanced electronic protection (Northrop Grumman, n.d.). Although the J-20 AESA is likely close in capability, due to the combination of the AN/APG-81's unmatched capability and the lack of open-source reporting on the J-20 AESA, the F-35 wins in the sensor category.

The PL-15 active air-to-air missile has a reported kinematic range of 200 km, a top speed of Mach 5, and an on-board AESA radar. With these characteristics, the PL-15 likely outperforms the U.S. AIM-120C/D, which was reportedly originally designed to counter Russia's RS-AA-10 at the end of the Cold War era (Barry, 2022). The United States is likely developing a new air-to-air missile to counter the PL-15 based on the Chinese missile's advanced capability and technology (Barry, 2022). Another consideration is that the J-20's typical load-out is four air-to-air missiles, whereas the F-35's is two air-to-air missiles and two air-to-ground munitions. If the aircraft were to face each other in air-to-air combat with these load-outs, the J-20 would likely have long-range advantage. This point also highlights the potentially differing mission sets of the two aircraft.

Table 21. Missile Performance Comparison

Program	Top Speed	Range	Propulsion	TELs/ Battery	Warhead
LRHW	Mach 5	2,778 km	two-stage solid-fuel rocket booster	4	conventional
DF-26	Mach 18	4,000 km	two-stage solid propellant	12 – 18	thermonuclear or conventional

Having more TELs per battery is advantageous because it provides added flexibility and launch capacity. The LRHW is the only missile in the U.S. inventory that compares to the DF-26 in terms of capability. Although this is not the most like-for-like comparison in terms of performance, it highlights that China is clearly outperforming the

United States in missile development. China's anti-access area-denial strategy has prioritized missile development. This becomes even more clear with Weinbaum et al.'s (2022a) analysis of terms appearing in military patents from 2016–2019. Weinbaum et al. (2022a) found that 12.4% of the 300 analyzed patents contained the term "missile," reiterating that missile technology is a high priority for Chinese leadership.

Table 22. Platform Performance Comparison

Ship		**Aircraft**		**Missile**	
DDG-51	**052D/DL**	**F-35**	**J-20**	**LRHW**	**DF-26**

For the overall platform performance comparison, the United States is superior in two programs and scores four points, and China is superior in one program and scores two points.

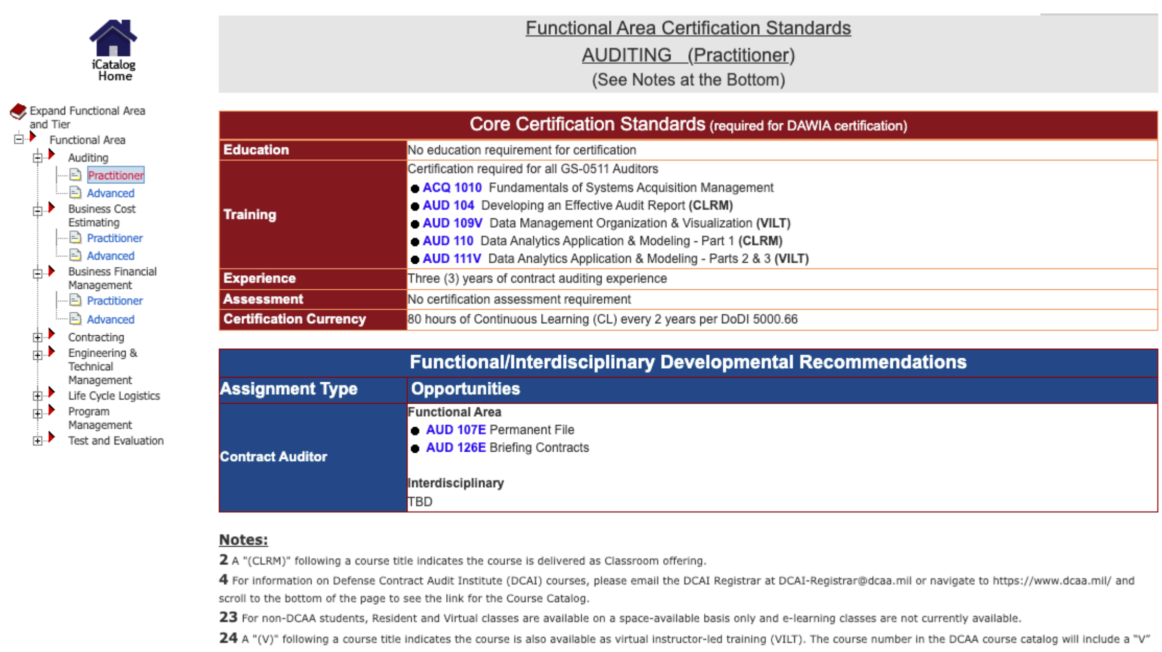
D. ACQUISITION WORKFORCE FACTOR

The AW factor measures two primary attributes. First is the concrete training requirements and certifications for the countries' respective AWs, and how effectively that training translates to job responsibilities. The second is the makeup of the AW in terms of organization, with specific focus on levels of bureaucracy and compartmentalization. A score is assigned to each country based on the AW's perceived levels of training and organization.

1. United States

The U.S. defense AW is comprised of active-duty military personnel, civilians, and contractors (Gates et al., 2022). The defense AW is responsible for the procurement, development, production, and fielding of military equipment and weapon systems to the operational forces. In 2022, the DoD implemented a new framework for the Defense Acquisition Workforce Improvement Act (DAWIA; Gates et al., 2024). The purpose of the original DAWIA was to require tracking and reporting on the AW. After its institution, the military AW remained stable in terms of retention, but the civilian AW shrunk by 28,000 people (Gates et al., 2024). Most notably, the new DAWIA framework consolidated the AW career fields from 14 to seven, streamlined the certification process by increasing the grace period from three to five years, and created more opportunities for career-long learning (Gates et al., 2024). The seven functional areas established in the new framework are “auditing, business financial management and cost estimating, contracting, engineering and technical management, life-cycle logistics, program management, and test and evaluation” (Gates et al., 2024, p. 2). The next paragraph includes a brief description of the new functional areas as well as the training and certification requirements for the AW.

All DAWIA curriculum is retained and managed by the Defense Acquisition University (DAU, n.d.-a). AW training and certification requirements for all seven functional areas are listed on the DAU’s (n.d.-c) website, which offers direct links to courses, tools, and events. The DAU (n.d.-a) also offers certification and development guides for each functional area on its DAWIA Career Field Certifications webpage. The Certification and Development Guides on the DAU’s iCatalog identify core certification standards as well as functional developmental recommendations for all seven functional areas. Figure 12 is an example from the Certification and Development Guides showing the functional area certification standards for the Auditing functional area.



Functional Area Certification Standards
AUDITING (Practitioner)
(See Notes at the Bottom)

Core Certification Standards (required for DAWIA certification)	
Education	No education requirement for certification
Training	Certification required for all GS-0511 Auditors ● ACQ 1010 Fundamentals of Systems Acquisition Management ● AUD 104 Developing an Effective Audit Report **(CLRM)** ● AUD 109V Data Management Organization & Visualization **(VILT)** ● AUD 110 Data Analytics Application & Modeling - Part 1 **(CLRM)** ● AUD 111V Data Analytics Application & Modeling - Parts 2 & 3 **(VILT)**
Experience	Three (3) years of contract auditing experience
Assessment	No certification assessment requirement
Certification Currency	80 hours of Continuous Learning (CL) every 2 years per DoDI 5000.66

Functional/Interdisciplinary Developmental Recommendations	
Assignment Type	Opportunities
Contract Auditor	**Functional Area** ● AUD 107E Permanent File ● AUD 126E Briefing Contracts **Interdisciplinary** TBD

Notes:
2 A "(CLRM)" following a course title indicates the course is delivered as Classroom offering.
4 For information on Defense Contract Audit Institute (DCAI) courses, please email the DCAI Registrar at DCAI-Registrar@dcaa.mil or navigate to https://www.dcaa.mil/ and scroll to the bottom of the page to see the link for the Course Catalog.
23 For non-DCAA students, Resident and Virtual classes are available on a space-available basis only and e-learning classes are not currently available.
24 A "(V)" following a course title indicates the course is also available as virtual instructor-led training (VILT). The course number in the DCAA course catalog will include a "V" (e.g., AUD351V) indicating a VILT class.

Figure 12. Example of Functional Area Certification Standards from DAU’s Development and Certification Guides. Source DAU (n.d.-b).

Although AW training resources are readily available, one of the main challenges that the U.S. AW faces is the fact that new civilian employees or military members rotating in simply do not have the experiential training that is integral to their effectiveness in the AW. Murphy & Bouffard (2017) conducted a survey of over 250 AW personnel to test multiple theories in regards to challenges facing the defense AW. Notably, 64% of respondents believe that it takes 10 years to become fully proficient in acquisitions. Another notable finding is that just 10% of the respondents find formal training to be their main source of education (see Figure 13; Murphy & Bouffard, 2017). Murphy & Bouffard (2017) also evaluated the adequacy of existing training tools. The authors note, "of the respondents, 55% believe existing tools, information, and training are inadequate or only somewhat adequate to conduct tailoring activities" (Murphy & Bouffard, 2017, p. 307). In their analysis, Murphy and Bouffard (2017) also discuss the disconnect between AW leadership and the rest of the workforce. Leadership emphasizes the importance of innovative thinking, yet AW personnel acknowledge that the outdated acquisition system fails to foster a culture of change.

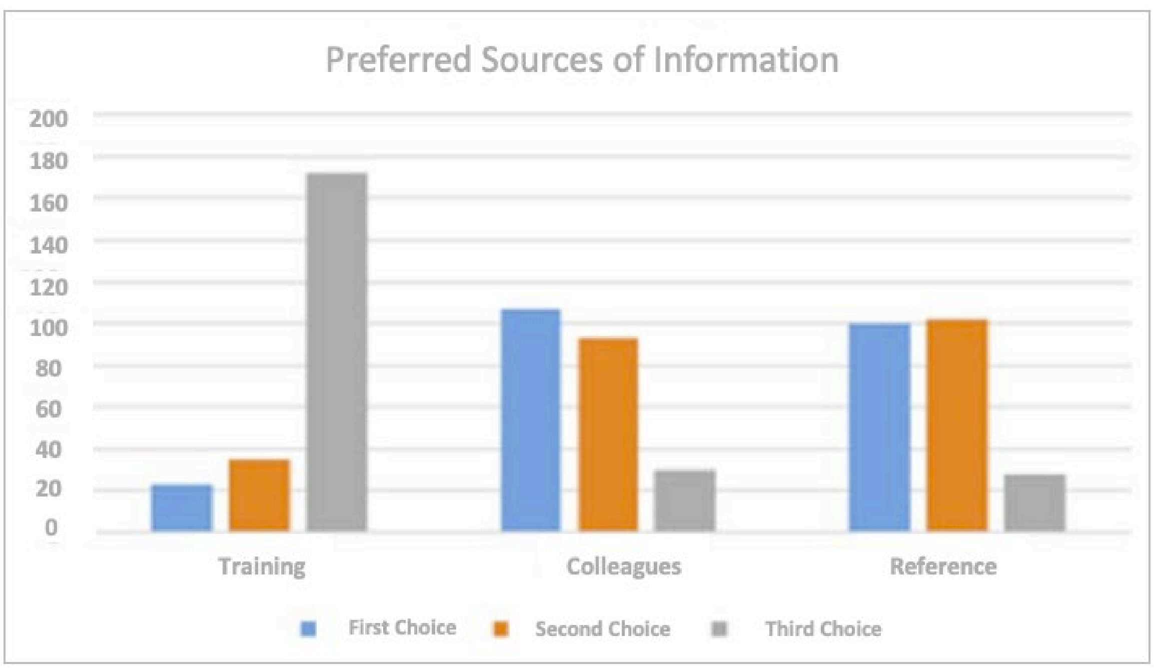


Figure 13. AW Survey Respondents' Primary Education Source. Source: Murphy & Bouffard (2017).

On paper, the U.S. AW receives adequate training to meet job requirements. In practice, however, it appears that a lack of required career experience may hinder AW personnel performance. What is clear is that the new DAWIA framework intends to streamline processes and increase efficiency in regard to AW training and certification. Its goal is to reduce the number of career fields and lengthen initial training timelines. This consolidation likely streamlined the overall organization, which has potential to increase efficiency, promote information-sharing, and decrease bureaucratic hurdles. The United States receives two points in the AW category because it is well-organized and provides access to tailored acquisition training, but the AW itself lacks adequate training (Lorge, 2018).

2. China

China's Military Representative System is the primary entity of AW personnel. In the chapter "Commissars of Weapons Production: The Chinese Military Representative System" in the book *Forging China's Military Might: A New Framework for Innovation*, Susan Puska et al. (2014) describe the system:

> The People's Liberation Army (PLA) is directly responsible for quality control and contract management for military weapons and equipment production and has built a multilayered, redundant, and largely ineffective system staffed by active-duty military officers in military representative offices (MROs). (p. 87)

The top two levels of the MRO system are regional military representative bureaus and offices. These regional entities are charged with overseeing and managing MROs in factories and research institutes in their respective regions, for their respective services. The MROs at factories and research institutes are the lowest level of the bureaucracy and act as the "structural foundation of the system" (Puska et al., 2014, p. 91). These personnel are responsible for liaising with and managing industry to effectively advocate for the requirements of the PLA and CMC. Prior to the restructuring of the General Armaments Department, each service entity had its own MRO officers. With China's extensive military restructuring in 2016, and institution of the EDD, it is not yet clear whether the MRO structure became more joint, or if the structure remains the same (Cheung, 2019). If the structure is similar, Puska et al. (2014) describe that

MRO officers from different services could be collocated at factories, but effectiveness of communication and coordination between them is largely unknown.

Five military universities are tasked with training military representatives, with the primary one being the Academy of Equipment Command and Technology (Puska et al., 2014). There are three levels of training. The first is the most basic, focusing on foundations of weapons and equipment procurement. The second level provides training to existing military representatives for critical leadership billets in factory MROs. The third is more acquisition policy-focused and is geared toward military representatives working at the higher bureau level of the system (Puska et al., 2014). After military representatives receive level one training, they are likely sent directly to their first billet. This relatively low educational baseline—specifically in technical training—can lead to ineffective oversight of systems in production because the military representatives simply do not have the experience to adequately represent the PLA's interests (Ashby et al., 2021; Curriden, 2023). Additionally, the military representatives' salaries are paid by the factories and institutes for which they work, not by the PLA, and the officers stay at these places for long periods of time, if not their whole careers. This can generate allegiance to the industrial base entity, rather than to the PLA, and encourage officers to leave the service and start work for these entities or participate in corrupt activity because of misaligned allegiances (Curriden, 2023).

China's leadership does recognize the importance of AW reform. Most recently, in March 2022, Xi Jinping signed a set of new rules that "aim to improve efficiency in the supervision of military equipment purchase contracts and make sure good quality equipment is delivered to the army" (Woo et al., 2022). Although it is clear that China's leadership is aware of the importance of an efficient AW to be able to effectively modernize its military, sufficient data is not yet available to assess whether the recent reforms have seen significant success. Based on available data, China's MRO system does not adequately train personnel, and its divided bureaucracy leads to compartmentalization and lack of effective communication between different entities. China receives zero points in the AW category.

E. CONTRACTING FACTOR

The contracting factor criteria is based on the efficiency of the countries' defense contracting methods. In the data collection and analysis, the primary focus is whether the contracting methods incentivize defense contractors and whether contractors are held accountable when they do not meet objectives (Lorge, 2018). Other points of discussion in this section are the specific contracting methods used by each country and the number of contracting methods available and explored. The final score is assigned to each country based on level of contractor incentivization and contractor accountability.

1. United States

DoD contracts vary with each procurement and either fall under the Federal Acquisition Regulation (FAR) or do not fall under the FAR for certain statutory reasons; those that do not are known as non-FAR contracts. An example of a non-FAR contract is an Other Transaction (OT) contract. By using OT contracts, which do not fall under the FAR, the DoD is able to reach a wider range of companies that may not have the bandwidth or know-how to operate under the typical regulations (Wong et al., 2022). Wong et al. (2022) also cite research suggesting that OTs offer "greater ability to communicate with offerors and greater freedom to tailor solicitations and agreements" (p. 67). The DoD initiative to stand up the Defense Innovation Unit (DIU), an apparatus designed to bridge the gap between Silicon Valley and the DoD, as well as its employment of Commercial Solutions Openings, which is a system set up to provide *merit-based bids* to companies for pre-existing technology, show the DoD's dedication to employing innovative contracting techniques (Acquisition in the Digital Age [AiDA], n.d.). Other initiatives with this same goal in mind are Small Business Innovation Research and Small Business Technology Transfer. These techniques are intentionally designed to increase competition amongst firms and incentivize smaller businesses with no experience working with the DoD to get involved in defense production. As stated in the National Defense Industrial Strategy,

> The DoD will continue accelerating payments to small businesses and seek ways to incentivize large prime contractors to do the same with small business subcontractors, to include assessment of ways to address slow

> cash flow through existing accounting practices and business systems. (DoD, 2023a, p. 15)

This demonstrates the DoD's commitment to incentivization.

One of the DoD's most common FAR contract types is firm-fixed-price (FFP) (AiDA, n.d.). In FFP contracts, the contractor assumes the risk in that if there are cost overruns, the contractor is penalized and required to pay the difference. On the other hand, if costs are well-managed, the contractor keeps any additional cash as profit (AiDA, n.d.). FFP contracts provide incentives for contractors while also holding them accountable if estimated costs are exceeded. Kendall (2017) mentions that although FFP contracts are right for certain cases, they do not allow for much flexibility if any problems arise in development: "The focus in a fixed-price environment is squarely on the financial aspects of the contract structure and not on flexibly balancing financial and technical outcomes" (p. 105). In an FFP contract, the contractor is much less focused on the outcome of the product because their primary incentive is to keep costs low.

Cost-plus-fixed-fee (CPFF) is the other most common contract type used by the DoD (AiDA, n.d.). CPFF contracts are used when predicting cost is particularly difficult due to novelty or complexity. The government assumes more risk in the case of a CPFF contract in that it agrees to pay for the actual costs of the project, as well as an agreed-upon fee, which is compensation for the contractor's work (AiDA, n.d.). Essentially, due to the higher-risk nature of the project, if there are unexpected cost increases, the government will have to cover those costs and the contractor is still guaranteed the fixed fee. CPFF offers a different kind of incentive for contractors. The government is encouraging contractors to take on the project by accepting the risk of unforeseen cost increases. Although this does not necessarily incentivize contractors to keep costs low, it does encourage innovative behavior in contracted firms. The fact that this type of discussion happens in DoD acquisitions demonstrates that the government and contractors alike are held to a high standard. Although the two groups may not always get it right, the intent is to negotiate the right contract for each particular scenario to facilitate as close to a mutual benefit as possible.

In summary, the DoD both incentivizes contractors and holds them accountable depending on their performance. The government is also aware that some circumstances necessitate taking on more risk. Some contracting types, like FFP, place more risk on the contractor, while others, like CPFF, assign more risk to the government. Notably, the DoD recognizes that each procurement requires careful attention while tailoring contracts. Over the last decade, the DoD has started using non-FAR contracts to generate competition for bids. The DoD has been successful in using OTs and other non-FAR methods to incentivize smaller companies to get involved in defense contracting. The United States receives four points in the contracting category for both incentivizing contractors and holding them accountable.

2. China

China's acquisition system operates an "outdated acquisition pricing regime" left over from the Soviet-style planned economy (Cheung, 2018b, p. 24). China uses a cost-plus model for contracts, a method in which contractors are guaranteed 5% profit no matter the outcome. In the cost-plus model, profits are tied directly to costs because the seller's profit is calculated as a fixed percentage of the total costs incurred. This means that Chinese firms have little to no incentive to keep costs low. In fact, the higher the costs, the higher their profit (Ashby et al., 2021; Cheung, 2018b). Cheung (2018b) highlights three ways in which this contracting method stymies innovation and efficiency. First is the previously discussed incentive for firms to drive up costs. Second is that contractors are not incentivized to look for innovative ways to keep costs low, specifically when it comes to management techniques. Third is the exclusive focus on performance-based rewards that reduces the likelihood that firms will take risks or experiment with incentive models (Cheung, 2018b). Additionally, most contract awards are through a single source. Competitive bidding is only typical for non-combat equipment, and China still uses a compensation principle, which means that contractors that lose out on bids still receive some form of smaller contract (Ashby et al., 2021; Cheung, 2019). China's EDD does not effectively incentivize contractors with its current contracting method.

Other significant considerations that feed into China's poor contracting techniques are the lack of legal backing for contracts and unclear or simplistic contract language. There are few mechanisms to ensure contractors are held legally accountable.

Ashby et al. (2021) describe the inefficient system by stating, “the language of contracts is simplistic and perfunctory, without clear technical or schedule obligations, which is unsurprising given that there is no formal legal authority in the defense industry to adjudicate contract fulfillment” (p. 22). Weinbaum et al. (2022a) add that “the lack of independent judicial, legislative, or media oversight means the PLA and CCP are reliant on the party and military’s powers to directly monitor, regulate, and control DIB cost or time overruns and quality deficiencies” (p. 28). Contractors fail to meet requirements, yet they face very little consequence. Some of this lack of accountability has to do with the fact that defense SOE leadership is highly intertwined with the CCP.

China’s contracting methods are outdated and simplistic. China’s cost-plus model, left over from the command economy, actually incentivizes contractors to drive costs up because the higher the cost, the more profit they receive. The CCP and PLA depend on minimal legal authority to enforce contract compliance, which often proves ineffective. The country does not effectively incentivize its DIB, and when contractors fail to deliver on things like cost or schedule, they are not consistently held accountable. China receives zero points in the contracting category.

F. RESOURCE ALLOCATION FACTOR

The resource allocation data collection focuses on each country’s budgeting processes and methods of resource allocation for weapon system acquisition. The Lorge (2018) framework measures affordability of programs as well as the consideration of value of the product balanced with its level of capability. The data collection for this section was focused on the effectiveness of each country’s PPBE-equivalent system, examining if the countries’ governments consider affordability when making budget requests and whether the respective systems maximize value for money. Additional information is included, such as barriers to resource allocation in both countries and innovative or nuanced resource allocation considerations when working with the defense industry.

1. United States

The DoD's PPBE system is a decision-making tool designed to "link agency strategy setting and plans to a set of programs that will most effectively achieve that strategy within fiscal limitations" (Candreva, 2017, p. 209). PPBE makes a concerted effort to maintain affordability of systems through each of its four phases. In the planning phase, the Defense Planning Guidance is established, and contributors ensure that the DPG aligns with the president's established lines of effort. During programming, services develop POMs, which are the DoD's best efforts to affordably allocate resources over a 5-year period. In the budgeting phase, budget requests are aligned with the overall defense budget. During the execution phase, the DoD pays careful attention to deviations from intended outcomes (McGarry, 2022). The 2022 National Defense Authorization Act established a commission to evaluate the PPBE process, which recommended that it be changed to a three-step process called the Defense Resourcing System. The three steps would be strategy, resource allocation, and execution—essentially combining the planning and budgeting steps of PPBE. The ultimate goal of DRS implementation is a more efficient and aligned system (McGarry, 2024).

Lorge (2018) discusses continuing resolutions as one of the main hindrances to the United States' ability to maximize value for money. In 2025, this remains true. CRs prevent re-programming of funds, funding of new programs, and transition of programs to new phases of the DAS. Between 2003 and 2025, appropriations were delayed 13 out of 23 years, or 78% of the time (P. Candreva, PowerPoint slides, January 22, 2025). When appropriations are delayed or, in other words, resource allocation is late, value of the product is not maximized. It appears that this trend will continue into the foreseeable future, as data shows that late appropriations have been a problem for the last 50 years (see Figure 14). The U.S. resource allocation system effectively looks to make systems more affordable through the PPBE process, but CRs and delayed funding prevent the performance-based budgeting system from effectively maximizing value for money. In the resource allocation category, the United States effectively incorporates affordability into decision-making but does not effectively maximize value for money due to late appropriations. The United States scores two points in the resource allocation category.

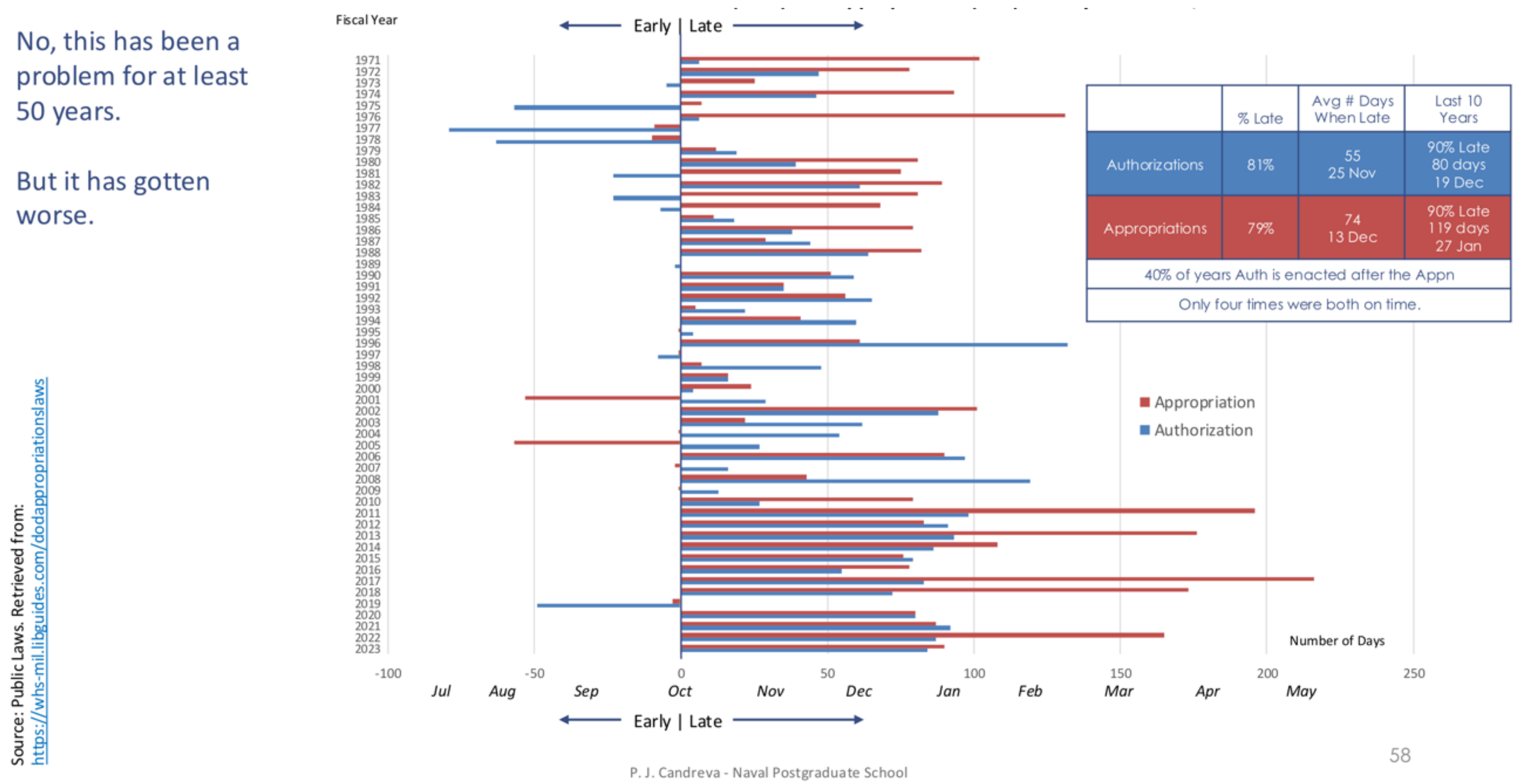


Figure 14. Timeliness of Authorization and Appropriation Acts by Fiscal Year, 1971–2023. Source: P. Candreva, PowerPoint Slides (January 22, 2025)

2. China

At the outset of this section, it is important to highlight the challenges in predicting and evaluating China's budgeting and resource allocation due to limited data. The budget reported by the CCP to the United Nations every 2 years is likely significantly lower than the country's actual expenditures, making accurate assessments difficult (McKernan et al., 2024). What do seem to be relatively well-researched, however, are China's resource allocation processes, budgeting system, and budget reform history. Over the last decade or so, China has sought to professionalize its resource allocation processes through reform. In 2014, China enacted a new budget law that has the characteristics of *incremental budgeting*, or a budgeting approach in which the previous period's budget serves as a base, with incremental adjustments made for the new period based on changes in costs, priorities, or inflation (Candreva, 2017). The 2014 Budget Law requires consideration of the current year's budget when formulating the next year's budget and stresses the importance of performance evaluations to evaluate whether more or less should be spent on systems (McKernan et al., 2024). The 2014 Budget Law also attempts to rid the resource allocation system of extrabudgetary revenue, which was left over from the command economy and rampant in the PLA (Shambaugh, 2003). Starting in the 1980s, the PLA was commercialized, meaning that PLA units were involved in business activities outside of the military to generate revenue (Shambaugh, 2003). This caused significant corruption issues and conflicting allegiances amongst the PLA units. The Chinese government then spent the next 25 years attempting to fix the damage and corruption through reforms, new oversight authorities, and strict auditing procedures.

The latest reforms in 2020 show progress in terms of implementation of modern resource allocation techniques. The reforms require unit-level performance evaluations for training, simulation, equipment, and hospital financial management prior to budget formulation (McKernan et al., 2024). Although the intent of these reforms is positive, the implementation has turned out to be less effective. Performance evaluations have been more evaluative of whether the system's funds are being used properly and less evaluative of the actual system capabilities (McKernan et al., 2024). McKernan et al. (2024) note that "in addition to the CMC system, the MOF evaluates military expenditure performance using such indicators as asset-liability ratio, profit rate, net present value, and net cash profit” (p. 28). There is potentially better oversight in Chinese budgeting procedures with the implementation of significant reforms since President Xi came to power. China’s leadership seems to understand the concept of incorporating affordability into its budgeting practices, but it still faces major challenges in actualizing that goal.

Although the CMC has made some strides to improve its budgeting processes, it faces significant challenges when it comes to affordability and maximizing value for money. The main problems that prevent China from effectively maximizing value for money are corrupt and wasteful management techniques in defense SOEs, unchallenged political authority that can lead to misallocation of funds, communication breakdowns and separations between budget policy-makers and operational forces, and lack of experience preparing budgets in a market-based economy (McKernan et al., 2024). In the resource allocation category, China does not effectively implement affordability or maximize value for money, and therefore receives zero points.

G. INNOVATION FACTOR

The innovation efficiency factor focuses on R&D capability and capacity for each country. Most modern countries with first-class militaries focus on R&D, generating plans to promote original innovation. Lorge (2018) states that the innovation factor assesses whether a “country has the R&D capability to produce a full range of modern military equipment” (p. 103). Investment in R&D and R&D output are different things, and that differentiation is important in this assessment. In this section, scores are assigned based on whether the country is able to produce its own weapon systems without reliance on foreign technology.

1. United States

The United States is renowned for its advanced technological weapon systems. Much of the United States’ success in building state-of-the-art systems stems from R&D investment. During the Cold War, the United States set up dedicated R&D institutions like DARPA to develop cutting-edge technology. While agencies like DARPA still exist, the structure of the acquisition system is no longer optimized for the rapid development and production that is required to maintain a technological edge (McNamara et al., 2024). The root cause of this issue seems to be that DoD suppliers focus on researching and developing solutions to known requirements, which results in programs nearing obsolescence before they even enter production. The result is less lethal systems with outdated technology. Although this method has been generally effective, the alternative would be applying the most current technology on the market to identified operational needs, increasing U.S. lethality (McNamara et al., 2024). This alternate approach introduces more flexibility and room for innovative thought to the process. The problem is the current structure does not allow for this type of flexibility, and even though the DoD invests heavily in research organizations, only a fraction of the systems that come out of them actually go to market. These situations are referred to as "valleys of death" (McNamara et al., 2024, p. B5). Many of these underlying issues stem from the DoD's lack of understanding of commercial sector emerging technology as well as the commercial sector's limited knowledge of how to work with the DoD. Fortunately, U.S. leadership is keenly aware of this problem, and is actively seeking ways to streamline and adapt the outdated processes.

In 2020, the AAF was introduced, providing tailored pathways for acquisitions and reducing bureaucratic hurdles when possible. Figure 15 shows MTA and SWP growth since the inception of the AAF. As of 2023, DIU was elevated to direct reporting status to the Secretary of Defense, which highlights that DIU's work, bridging the gap between the DoD and commercial technology companies, is a top priority for the DoD (DoD, 2024b). Figure 16 shows DIU throughput growth over 7 years. In recent years, the DoD has had success "bridging the valleys of death" with different initiatives like the Rapid Defense Experimentation Review, the Program to Accelerate Procurement and Fielding of Innovative Technologies, the Competitive Advantage Pathfinders, and the Replicator initiative (DoD, 2024b, p. 3). All of these programs are rooted in the foundational understanding that the current system is not conducive to the innovative capabilities the United States needs to outpace its peer competitors, namely China. The DoD is also increasingly adopting and integrating artificial intelligence (AI) into its systems. Task Force Lima, implemented in 2023, was designed to "analyze and integrate generative AI tools across DoD" (DoD, 2024b, p. 5). The success that the DoD has already seen in the last 5 years shows promise that the United States is at least moving in the right direction. It is worth noting that innovative thought is part of what makes the United States unique. Its independent culture breeds innovative thinkers. Despite layers of bureaucracy and outdated processes, the foundation exists for breakthrough technological advancement. The United States is scored as able to indigenously produce a full range of systems and receives four points (Lorge, 2018).

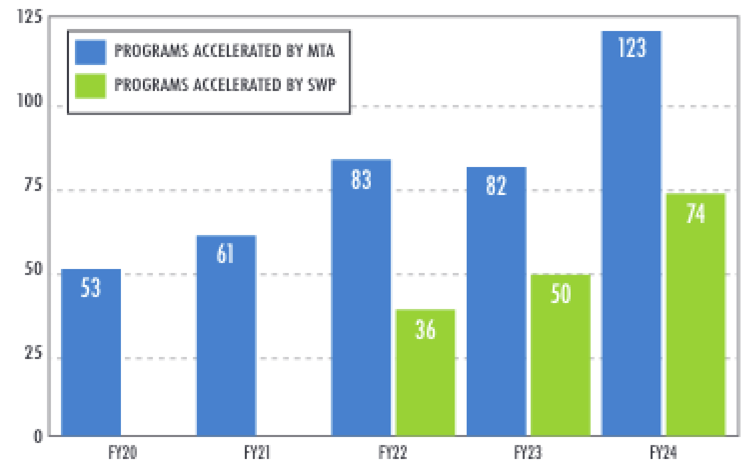


Figure 15. MTA & SWP Growth (FY2020–FY2024). Source: DoD (2024b).

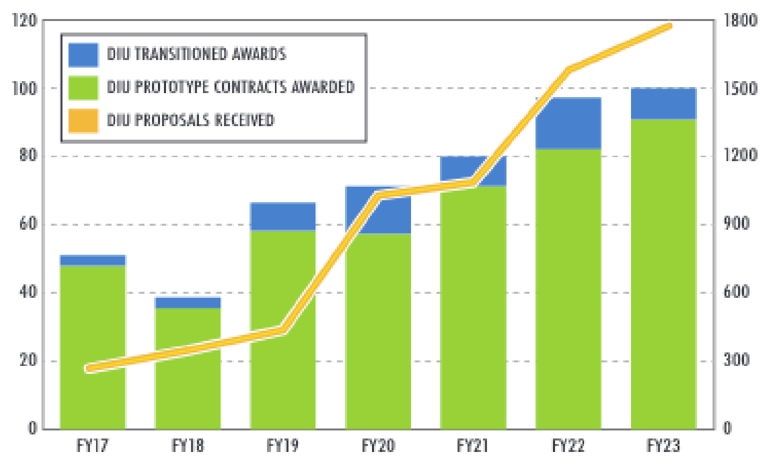


Figure 16. DIU Throughput (FY2017–FY2023). Source: DoD (2024b).

2. China

It is worth noting that China likely does not disclose accurate numbers for its R&D spending. With that in mind, it is still possible to assess whether China is able to produce a full range of technology or whether it is still reliant in some capacity on foreign technology. President Xi has made original innovation a top priority in China. China's

IDDS is broken down into three stages with time-driven innovation goals. The first was becoming an innovative country by 2020, the second is to be on the "leading-edge" of innovation by 2030, and the third is to be a world leader in innovation by 2050 (Cheung et al., 2016, p. 41). The CCP has invested in and set medium- and long-term goals for R&D growth by giving more R&D ownership to SOEs to expedite funding and production and by creating research labs around the country to attempt to facilitate innovation (Cheung, 2018b).

While it is true that a useful indicator of S&T growth in a country is investment in R&D, as mentioned previously, the output or production of so-called innovative technology is an even better metric. For example, China is a world leader in cited research papers and patents, but as Jeroen Groenewegen-Lau (2024) notes in his report *Whole-of-Nation Innovation*, "this is not matched by a corresponding growth in total factor productivity, indicating that much of this research output is not influenced by downstream industrial demand" (p. 5). Groenewegen-Lau (2024) observes that China is narrowing the innovation gap at both the start and end of the acquisition process by making significant investments in R&D and scaling up full-rate production. A substantial gap remains in the intermediate stages, where progress lags behind. The gap between R&D institutions and the DIB is known as the *two-layers problem*. Defense SOEs are not interested in taking risk on R&D; they would rather leave that to the state (Groenewegen-Lau, 2024, p. 5).

One of the main reasons that companies do not want to take risk investing in R&D is because China has weak intellectual property protections (Weinbaum et al., 2022a). R&D typically produces non-excludable goods, meaning new knowledge is generated that can be copied without compensation. Without adequate IP protections, domestic and foreign firms are hesitant to invest because they are afraid that competitors will steal their technology. According to Weinbaum et al. (2022a), empirical evidence shows that "countries that provide strong property rights tend to be more innovative than those that do not" (p. 36). In terms of IP rights, the United States ranks consistently higher than China does. By that logic, the United States is likely to be more innovative.

Xi's goal is to incrementally build China into an innovative powerhouse, and he has seen considerable success and transformation since he came to power in 2012. China still has significant dependencies on foreign countries for key technology and education (Weinbaum et al., 2022a). Figure 17 shows weapon system imports to China by country. Weinbaum et al. (2022a) note that this foreign technology dependency may explain why the Chinese acquisition system is able to rapidly produce new systems, but it also shows that China is vulnerable to foreign supplier policy changes. It is clear that Chinese leadership recognizes this vulnerability and continues to fiercely pursue initiatives that will spark indigenous innovation, but China is not there yet.

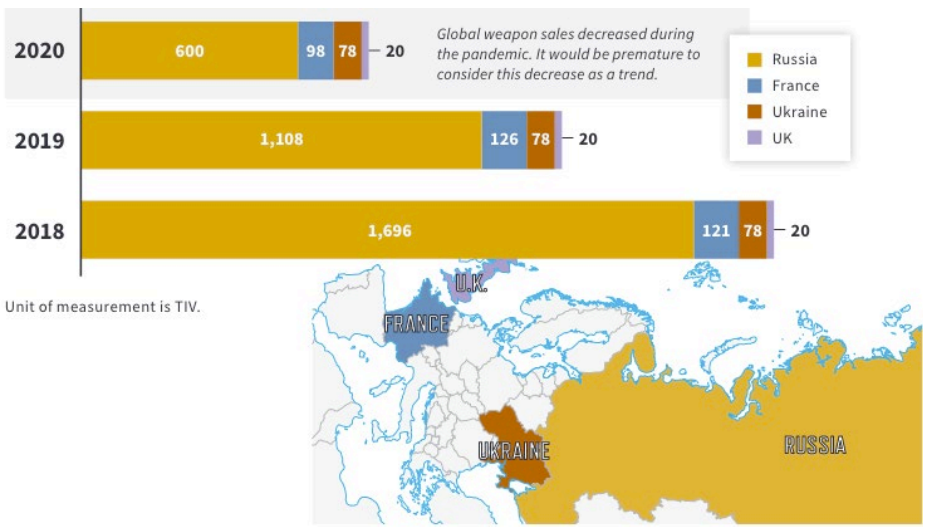


Figure 17. Top Weapon System Imports to China, by Country, in 2020. Source: Weinbaum et al. (2022b).

Chinese culture under authoritarian rule becomes very important in the discussion on innovation. The question is whether the authoritarian, inherently risk-averse Chinese culture is conducive to the spirit of entrepreneurialism. Although the CCP has implemented innovation-promoting policies and plans, like the institution of research labs, S&T competitions, and patent ownership for inventors, "this multi-faceted approach to connecting the innovation chain is piecemeal and slow because the state is simultaneously seeking to centralize control" (Groenewegen-Lau, 2024, p. 5).

China's structure of governance may be inhospitable to the free-thinking, risk-taking behavior that innovation often tends to require. In summary, the CCP is aware of the importance of a strong R&D base and has implemented significant reforms, policies, and plans to attempt to generate whole-of-nation innovation. The results are mixed, however, largely due to the two-layers problem and a lack of expertise in key areas. Although China has made significant strides to achieve indigenous innovation, it is still partially reliant on foreign components and know-how. For these reasons, China scores two points, "capable of developing some technologies" (Lorge, 2018, p. 84).

H. INDUSTRIAL BASE FACTOR

The industrial base factor is an assessment of how well each country's DIB is able to produce quality weapon systems on time while keeping the cost as low as possible. Lorge (2018) discusses the "capability and capacity" of the DIB to "meet objectives" (p. 65). This section also includes a discussion of the size of each country's DIB, historical data on DIB consolidation and/or expansion, the state of competition in the country's DIB, as well as any corruption that exists in each country's DIB.

1. United States

Current U.S. DIB policies, procedures, and manufacturing equipment were founded in the post-Cold War era and require adaptation if the United States intends to maintain its military and technological edge. Notably, since the late 20th century, the DIB has consolidated considerably, leaving the DoD reliant on a handful of prime contractors as of 2024. Table 23 shows the consolidation of prime contractors over 3 decades, and Table 24 displays the U.S. DIB's top five contractors. Consolidation can often lead to a lack of competition, which typically decreases incentivization. Without incentives, contractors do not take as much risk and are less innovative (Office of the Under Secretary of Defense for Acquisition and Sustainment [OUSD(A&S)], 2022). Consolidation can also affect the supply chain, as there are fewer companies producing items. The 2023 National Defense Industrial Strategy was the first of its kind and marked the first time the DoD released a comprehensive strategy dedicated specifically to strengthening the DIB. It highlighted four critical areas of concern for the U.S. DIB:

- Resilient Supply Chains
- Workforce Readiness
- Flexible Acquisition
- Economic Deterrence

Detailed discussion of these four areas is outside the scope of this thesis. What is more important for the purpose of this section is to understand that the DoD has made improving the DIB in these areas a high priority. For each of the four areas identified, there is a section in the National Defense Industrial Strategy that summarizes the criticality of the issue, makes recommendations for action, illustrates outcomes, and identifies risks to achieving those outcomes (DoD, 2023a). U.S. defense leadership understands and is working to bolster and grow the DIB in order to maintain global military dominance.

Table 23. Consolidation of Prime Contractors in Select Industries from 1990–2020. Source: OUSD(A&S; 2022).

Weapons category	Total U.S. contractors 1990	1998	2020	Current U.S.-based prime contractors
Tactical missiles	13	3	3	▶ Boeing ▶ Lockheed Martin ▶ Raytheon Technologies
Fixed-wing aircraft	8	3	3	▶ Boeing ▶ Lockheed Martin ▶ Northrup Grumman
Expendable launch vehicles	6	2	2	▶ Boeing ▶ Lockheed Martin
Satellites	8	5	4	▶ Boeing ▶ Hughes ▶ Lockheed Martin ▶ Northrup Grumman
Surface ships	8	5	2	▶ General Dynamics ▶ Huntington Ingalls
Tactical wheeled vehicles	6	4	3	▶ AM General ▶ General Motors ▶ Oshkosh
Tracked combat vehicles	3	2	1	▶ General Dynamics
Strategic missiles	3	2	2	▶ Boeing ▶ Lockheed Martin
Torpedoes	3	2	2	▶ Lockheed Martin ▶ Raytheon Technologies
Rotary wing aircraft	4	3	3	▶ Bell Textron ▶ Boeing ▶ Lockheed Martin (Sikorsky)

Table 24. U.S. DIB Top Five Contractors. Source: Nicastro (2024).

Company	Location of Corporate HQ	FY2022 DOD Contract Obligations	Total Market Capitalization[a]	Employees
Lockheed Martin (LMT)	Bethesda, MD	$44.5 billion	$136.39 billion	122,000
RTX (RTX)	Arlington, VA	$25.4 billion	$160.03 billion	185,000
General Dynamics (GD)	Reston, VA	$21.5 billion	$83.09 billion	111,600
Boeing Co (BA)	Arlington, VA	$14.2 billion	$98.63 billion	171,000
Northrop Grumman (NOC)	Falls Church, VA	$12.8 billion	$76.04 billion	101,000

The DoD has instituted various policies and programs to attempt to reinvigorate the DIB and garner interest from smaller companies that may be intimidated by doing business with the U.S. government. These efforts are in place to improve the health of the DIB. Venture capital initiatives, small business integration, purchasing and application of commercial off-the-shelf technology, and engagement of the organic industrial base (OIB) are all ways that the DoD is attempting to build up the DIB. Investment in advanced manufacturing automation has also become a priority to address some of the DIB workforce gap challenges arising from younger Americans' increasing disinterest in industry jobs (DoD, 2023a). The U.S. DIB has not had to test its "surge capacity" (DoD, 2023a, p. 15) since the early days of the wars in Iraq and Afghanistan, but Russia's invasion of Ukraine has tested the DIB in its ability to "scale rapidly" (DoD, 2023a, p. 15). The DIB was able to increase production capacity of 155mm artillery rounds by 200% from 2023–2025, which is a positive sign (DoD, 2023a). The U.S. DIB has the capability to produce technologically-sound weapon systems but currently struggles with its capacity due to a limited workforce and lack of competition. For these reasons, the United States scores two points.

2. China

As explored in detail in Chapter III of this thesis, China's DIB is vast and capable of mass production at lower costs (Groenewegen-Lau, 2024). China's authoritarian government allows leadership to direct funding to projects of strategic importance without opposition (McKernan et al., 2024; Weinbaum et al., 2022a). SOE executives typically have significant political status and influence, which allows the government even more access. Similar to the lack of competition in the U.S. DIB, however, China only has one or two SOEs per major defense sector (see Table 24). This lack of competition does not go unrecognized by Chinese leadership. Xi's Made in China 2025 Plan and Internet Plus Plan were created in part to promote competition and build a robust and market-driven DIB (Cheung et al., 2016). Cheung et al. (2016) also point out that, despite the stated goals of these plans, they still exhibit many characteristics of state-controlled planning. Curriden (2023) notes that Xi has made minimal efforts to increase competition and is more focused on further consolidation of power to the state.

Table 25. Chinese DIB SOEs and Manufacturing Activities. Source: Weinbaum et al. (2022a).

DIB Manufacturing Emphasis	Parent SOE	Manufacturing Activity
Land warfare, ground forces	• China North Industries Group Corporation (NORINCO) • China South Industries Group Corporation (CSGC)	Ground combat vehicles, main battle tanks, infantry fighting vehicles and soldier equipment, small arms and light weapons, ordnance
Air warfare, air forces	• Aviation Industry Corporation of China (AVIC)	Fixed-wing combat, transportation, bomber aircraft, rotary-wing aircraft
Naval warfare, sea forces	• China State Shipbuilding Corporation (CSSC) (the China Shipbuilding Industry Corporation [CSIC] was merged into the CSSC in 2019–2020)	Frigates, corvettes, destroyers, and cruisers; submarines (diesel and nuclear-powered); aircraft carriers; dock landing ships
Electronic warfare, electronic equipment	• China Electronics Technology Group Corporation (CETC)	Light unmanned aerial vehicles (UAVs), radars, computing resources, other military electronics
Space warfare, space forces	• China Aerospace Science and Technology Corporation (CASC) • China Aerospace Science and Industry Corporation Limited (CASIC)	Surface-to-air missile systems; intelligence, surveillance, and reconnaissance (ISR) systems; heavy UAVs, ballistic missiles, space launch vehicles
Nuclear warfare, nuclear facilities	• China National Nuclear Corporation (CNNC)	Nuclear reactors, nuclear weapons

SOURCE: Derived from Béraud-Sudreau and Nouwens, 2021.

China’s 14th FYP emphasizes the importance of a strong DIB that embraces more conventional industries. This point is important because it highlights China’s intent to modernize its DIB but also demonstrates that the country is still firmly rooted in its “Communist orthodoxy” (Groenewegen-Lau, 2024, p. 6). As discussed in Chapter III, bureaucratic fragmentation is another residual effect of Communist doctrine. Separation of government and military entities was considered critical to maintaining secrecy in China’s command economy. SOEs were founded on these principles, and as a result, they operate at a level of independence that may not be compatible with the DIB that Xi envisions for China (Cheung, 2019). Future analysis should focus on the interaction between attempted innovation and China’s established Communist practices.

Corruption is arguably the biggest threat to China’s DIB, and by close association, to China’s DAS. With such a large DIB and limited CCP and PLA bandwidth for audit and oversight, corruption can flourish. Since Xi came to power, he has maintained a zero-tolerance policy toward corruption, with anticorruption campaigns leading to purges of top PLA, SOE, and CMC leadership (Cheung, 2018b, 2022a). Although most of the corruption cases are classified, some of the most high-profile incidents have been made public (Cheung, 2022a). Most recently, top leaders of the People's Liberation Army Rocket Force and EDD were replaced. The EDD reportedly posted on its social media "that it was investigating corruption allegations related to procurement bids and the formation of private cliques within the armed forces at high levels that resulted in cronyism and a lack of focus on the core task of building combat readiness" (International Institute for Strategic Studies, 2024, p. 234).

Two of the more promising prospects of China's DIB are its MCF efforts and its access to critical defense minerals. As discussed in Chapter III, China's dual-use economy is one of the main drivers of success for its DIB. Weinbaum et al. (2022a) discuss the importance of MCF in fostering better relationships between enterprises and government S&T organizations. The authors highlight four MCF initiatives China is pursuing to strengthen the DIB:

- MCF zones in place for testing commercial technology with military application
- MCF expositions to inform commercial firms on military requirements and how to conduct business with the PLA
- MCF competitions to encourage entry and stimulate innovation
- MCF catalog detailing PLA "technical standards" (Weinbaum et al., 2022a, p. 36)

The ultimate goal of MCF is to find military purpose for existing technology, which Chinese leadership recognizes could make all the difference in a time of conflict, when rapidity of production can set countries apart (Weinbaum et al., 2022a). Lastly, China has invested strategically in rare earth elements (REEs), specifically REEs that are critical to building defense technology. Over the course of 3 decades, China has gained more control over global distribution of REEs by banning foreign investment in REE mining and instituting REE export controls (Weinbaum et al., 2022a). China also has access, either domestically or through alliances and its belt-and-road initiative, to a significant amount of raw materials that are considered "relevant to defense applications" (Weinbaum et al., 2022a, p. 52). An example of this is China's dominant economic presence and influence in the Democratic Republic of the Congo, which produces 80% of the world's cobalt (Gregory & Milas, 2024). Chinese SOEs and banks control 80% of total cobalt output and own five of the Democratic Republic of Congo's 10 largest cobalt mines. Cobalt plays a vital role in defense applications, such as jet engines and lithium-ion batteries for military electric vehicles (Gregory & Milas, 2024). This has implications for the United States because it reduces the country's access and makes production of these critical technologies costlier. This is just one example of how China's DIB seeks control of critical defense materials.

In summary, with its strategic investments, MCF initiatives, and sheer size and manufacturing capability, China's DIB has the capacity to develop advanced weapon systems. However, it does not yet have the capability due to structural challenges, governance dynamics, and corruption. For these reasons, China scores two points in the DIB category.

I. REQUIREMENTS SYSTEM FACTOR

The requirements system factor analyzes the requirement generation process for each country to determine its ability to generate requirements that meet objectives (Lorge, 2018). In other words, how effectively does the country align its military acquisition processes and outcomes with its national security and strategic objectives?

1. United States

JCIDS is the U.S. requirements system designed to identify gaps in military capabilities to inform resource allocation and acquisition decisions that are aligned with the National Defense Strategy (Neenan, 2024). JCIDS is overseen by the highest-ranking military members in the United States, the Joint Chiefs of Staff, and maintained by the Joint Staff, who are also military members (Neenan, 2024). The JROC is a committee, headed by the Vice Chairman of the Joint Chiefs of Staff, that manages the JCIDS process. The fact that the JCIDS leadership is military and not civilian is significant. This implies that the United States is aware of the importance of having a direct line to the warfighter when generating requirements (Zinn, 2018). As prior operators themselves, members of the Joint Staff and JROC are able to advocate for operational needs while using the broader national security and national defense strategies as guides. There is also a JCIDS manual that provides guidance to the Joint Staff and all other service branches and DoD agencies that interface with the JCIDS process (Neenan, 2024).

The JCIDS process is considered cumbersome at times because of the multiple phases and documentation required. JCIDS does have both a standard process and an urgent process to enable rapid requirement approval when absolutely necessary; these processes are called "'deliberate capability requirements' and 'urgent capability requirements,'" respectively (Neenan, 2024, p. 1). These different pathways allow for some flexibility and speed in the process, but most AW personnel agree that in order to make the process more efficient, JCIDS needs to adapt more to the AW, becoming less cumbersome and more innovative (Neenan, 2024; Zinn, 2018). In summary, although the JCIDS process is potentially outdated and requires a more adaptive framework, it does well in aligning with the nation's strategic objectives and generating requirements that meet objectives (Lorge, 2018). For these reasons, the United States receives four points in this category.

2. China

The CCP generates China's broad military strategy, captured in the FYPs. From the FYPs, the PLA and CMC develop the national security strategy and the MSG, respectively (McKernan et al., 2024). The CMC then uses the MSG to perform an evaluation of military capabilities, which consists of understanding current capabilities, evaluating the difference between desired capabilities and actual capabilities, and "supporting the formulation of national strategic objectives," which contributes to lead planner decision-making (McKernan et al., 2024, p. 25). The CMC then develops military requirements based on this evaluation. Requirements specific to weapon system development come from the WEDS and are developed by the EDD (Curriden, 2023). McKernan et al. (2024) also note that China's most recent white paper, published in 2019, mentioned a transition in the PLA to "demand-oriented planning" and that requirements are also being pulled from the financial departments of individual theater commands (pp. 25–26). Although there is limited data on the structure of China's military requirements system, from the data available, China does seem to effectively produce requirements that are in line with broader strategy. China scores four points in the requirements system category.

J. O&S COSTS FACTOR

The main consideration with the O&S costs metric is whether the country considers the training, maintenance, and upgrades that systems will inevitably require throughout their life cycles. In other words, do the country's AW, industrial base, and military representatives understand the importance of long-term planning in weapons acquisitions? Lorge (2018) also makes clear in his framework that another significant consideration is whether the O&S costs for the system will affect the overall cost.

1. United States

O&S costs are consistently integrated and factored into decision-making in the U.S. DAS. O&S costs are taken especially seriously because in most weapon systems' life cycles, the O&S phase is the costliest, as shown in Figure 18. Every Selected Acquisition Report, which is an annually required document that provides an update on U.S. MDAPs' cost, schedule, and performance, analyzes and discusses O&S costs compared to their baseline estimates (DoD, 2019; Department of the Navy, 2021). O&S costs are also catalogued and tracked through a database platform called Enterprise Visibility and Management of Operating Support Costs (EVAMOSC). This system, owned and operated by the Office of the Secretary of Defense Cost Assessment and Program Evaluation (OSD CAPE), is designed to act as an authoritative O&S cost database for all major weapon systems across the U.S. joint force (EVAMOSC, n.d.). EVAMOSC, created in 2021, has access to things like weapon system data, maintenance and work orders, service requests, purchase orders, and material transactions (Germony, 2023). With large undertakings using EVAMOSC, especially when significant amounts of data were involved, there have been lapses in communication, issues with data normalization, and incomplete datasets (Germony, 2023). Further discussion of improvements to EVAMOSC is outside the scope of this research. The main takeaway is that the U.S. acquisition system is developing a platform to carefully estimate and monitor O&S costs at the joint level. The United States considers all O&S costs, and therefore scores four points in the O&S costs category.

Figure 18. Total Life-Cycle Costs by Phase. Source: Germony (2023).

2. China

Although China's exact mechanisms for tracking and monitoring O&S costs are unknown, the data available suggests that China lags in this area. There are likely three main reasons for this. First is the enormity of the DIB. PLA and CCP personnel tasked with DIB and RDA oversight do not have the modern administrative and managerial tools required to monitor O&S costs (Cheung, 2018b). Second is the separation and lack of coordination that exists between personnel involved in the different phases of a program's life-cycle. Although data is limited on if and how China accounts for and estimates O&S costs, based on the aforementioned research, it is likely that China struggles to collect transparent data to then provide a clear and cohesive picture of O&S trends and changes over time. China receives two points in this category, assuming that its leadership is likely aware of O&S costs and attempting to monitor some O&S costs when developing systems (Lorge, 2018).

K. FINAL SCORING

Table 26 displays the final acquisition efficiency scoring in each category for the United States and China.

Table 26. Final Scoring of Acquisition Efficiency. Adapted from Lorge (2018).

Acquisition Efficiency Factor	United States	China
Cost: Comparable systems of this country have the lowest cost to produce.	Cost performance is: **0 Points:** Superior in 0 programs	Cost performance is: **4 Points:** Superior in two or more programs

Acquisition Efficiency Factor	United States	China
Schedule: Comparable systems of this country are produced more quickly.	Schedule performance is: **4 Points:** Superior in two or more programs	Schedule performance is: **2 Points:** Superior in one program
Performance: Comparable systems of this country have superior capabilities.	The performance of weapon systems in this country is: **4 Points:** Superior in two or more programs	The performance of weapon systems in this country is: **2 Points:** Superior in one program
AW: This country has a well-trained and well-organized acquisition workforce.	The AW of this country is: **2 Points:** Either well-trained or well-organized	The AW of this country is: **0 Points:** Neither well-trained nor well-organized
Contracting: This country uses contracting methods that hold contractors accountable and incentivize them to meet objectives.	The contracting methods used by this country: **4 Points:** Both incentivize contractors and hold them accountable	The contracting methods used by this country: **0 Points:** Neither incentivize contractors nor hold them accountable
Resource Allocation: This country's resource allocation system ensures programs are affordable and maximizes value for money.	The resource allocation system of this country: **2 Points:** Either takes affordability into account or maximizes value	The resource allocation system of this country: **0 Points:** Neither takes affordability into account nor maximizes value
Innovation: This country has the R&D capability to produce a full range of modern military equipment.	The country's innovation system is: **4 Points:** Capable of developing a full range of technologies	The country's innovation system is: **2 Points:** Capable of developing some technologies
Industrial Base: This country's industrial base has the capacity and capability to meet the	The industrial base of this country:	The requirements system of this country:

Acquisition Efficiency Factor	United States	China
government's requirements.	**2 Points:** Has either the capability or capacity to meet objectives	**2 Points:** Has either the capability or capacity to meet objectives
Requirements System: This country's requirements system generates requirements that accurately meet the government's objectives.	The requirements system of this country: **4 Points:** Generates only requirements that meet objectives	The requirements system of this country: **4 Points:** Generates only requirements that meet objectives
O&S Costs: This country considers O&S costs when developing a new weapon system.	The country's acquisition system: **4 Points:** Considers all O&S costs when developing systems	The country's acquisition system: **2 Points:** Considers some O&S costs when developing systems
TOTAL POINTS	**30**	**18**

Based on the raw scores, the United States leads by 12 points. The critical areas of weakness for China's acquisition efficiency are the AW, contracting, and resource allocation categories, in which it received 0 points. The main weakness for the United States is cost, where three of China's major weapon systems were cheaper than all three comparable U.S. programs.

L. HYPOTHETICAL WEIGHTING SCENARIO

As analyzed under these circumstances, the only way that China could close the efficiency gap would be if cost was the only factor that mattered. In future analysis, if efficiency factor scores are more evenly matched, then it may be helpful to assign weights to indicate importance according to the geopolitical context. The following scenario is an example of assigning weights to prioritize efficiency factors according to their importance within a developing geopolitical context.

In the event of indications and warnings that China is preparing to invade Taiwan, the relative importance of the efficiency factors, weighted 1–5, is shown in Table 27.

Table 27. Hypothetical Efficiency Factor Weights and Adjusted Scores

Efficiency Factors	Raw Score		Weight	Adjusted Score	
	U.S.	China		U.S.	China
Cost	0	4	2	0	8
Schedule	4	2	5	20	10
Performance	4	2	4	16	8
Acquisition Workforce	2	0	2	4	0
Contracting	4	0	1	4	0
Resource Allocation	2	0	4	8	0
Innovation	4	2	3	12	6
Industrial Base	2	2	5	10	10
Requirements System	4	4	1	4	4
O&S Costs	4	2	1	4	2
Score	**30**	**18**		**82**	**48**
Difference	**12**			**34**	

With different raw scores, the weights could reveal that a country has either more or less of an advantage than it previously thought. Although not entirely beneficial in this scenario, this method could prove to be illuminating in future comparisons.

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V. CONCLUSION AND RECOMMENDATIONS

This thesis explores defense acquisition efficiency between two of the world's most powerful countries: The United States and China. The two research questions this thesis attempts to answer are as follows:

1. To what extent China outpacing the United States in defense acquisitions?
2. What factors of efficiency can the United States improve upon to maintain a strategic and technological edge?

By applying Lorge's (2018) framework to the collected data, this thesis determines that the United States remains firmly ahead of China in terms of defense acquisition efficiency. The following section will expand on the findings from the framework application, and provide answers to both research questions.

A. SUMMARY OF FINDINGS

The data shows that based on the efficiency factor framework established by Lorge (2018), the United States maintains a 12-point lead in defense acquisition efficiency. Categories in which the United States receives the maximum four points were schedule, performance, contracting, innovation, requirements system, and O&S costs. China only receives four points in the cost category, in which all three of its comparative systems proved less expensive to produce. Although somewhat helpful to acknowledge that the United States scores more points in the framework application, and therefore continues to outpace China in overall defense acquisition efficiency, the real significance lies in the areas in which the United States is deficient, sans comparison. These findings address the second research question. The efficiency factors for which the United States received either zero or two points are listed below with potential recommendations for improvement.

1. Cost

The United States received zero points in the cost category. The DDG-51, F-35, and LRHW are costlier to produce than the comparative Chinese systems based on available data. Regardless of the considerable differences between how the United States and China fund their strategic weapons programs, the cost of U.S. weapons systems should still be a topic of discussion. According to GAO (2024), the primary factors driving 1-year cost changes for 31 MDAPs are displayed in Figure 19.

Figure 19. Factors Driving 1-Year Cost Changes for 31 MDAPs. Source: GAO (2024)

Based on the findings, the main contributors to cost increases in the selected MDAPs are quantity increases, modernization costs, delivery delays, and testing issues. It is worth recognizing that the United States has some of the most superior and highly complex weapon systems in the world, the advanced technology of which contribute to these high costs. The following list, however, consists of tangible recommendations for potential ways to reduce costs based on GAO's factors and the results from Chapter IV of this thesis.

- Improve demand forecasting by using predictive analysis to determine realistic quantity requirements early in the acquisition process. Highly proficient cost estimators are critical.
- Implement and enforce iterative development in modern systems. This would mean continuing to field systems with modular architecture to allow for easier and cost-effective future upgrades.
- Invest in AI-driven maintenance techniques that will lower sustainment and upgrade expenses. AI could also be used in testing environments to identify potential system failures early on.
- Continue to expand public-private partnerships and leverage existing commercial technology to reduce production costs.

2. Acquisition Workforce

The United States received a score of two points in the AW category, primarily for lacking effective workforce training. The U.S. AW faces several challenges despite recent reforms under the new DAWIA framework. The civilian workforce has significantly declined, and personnel struggle to gain proficiency, with many believing it takes up to 10 years to become fully effective (Murphy & Bouffard, 2017). While DAU provides extensive training resources, most AW personnel find the formal training inadequate. Instead they rely on experiential learning. Additionally, there is a disconnect between leadership's push for innovation and the rigid, outdated acquisition system. The following list consists of recommendations to improve inefficiency within the U.S. AW.

- Create mentorship-based apprenticeships where new AW employees work alongside experienced professionals in real-world acquisition environments.
- Use simulations to provide realistic training on procurement and contract management without real-world risks. AI could also be used to automate contract reviews and procurement processes, reducing the burden on AW personnel.
- Encourage bottom-up innovation by rewarding personnel who propose acquisition reforms. This reward system would need to be accompanied by policy reforms that introduce more flexibility into the acquisition system.

3. Resource Allocation

The United States received a score of two points in the resource allocation category due to lack of effective maximization of value for money. The DoD's PPBE system is designed to align strategy with resource allocation, but its CRs and delayed appropriations undermine efficiency and the ability to maximize value for money. The following list consists of recommendations for improving resource allocation efficiency.

- Broaden the use of multi-year procurement and Other Transaction Authorities to allow acquisition programs to continue without disruption from CRs
- Increase the threshold for re-programming funds without congressional approval
- Expand rapid acquisition authorities by extending pathways like MTA to allow high priority projects to receive funding outside the standard budgeting timeline
- Support the shift to Defense Resourcing System, which integrates planning and budgeting to reduce delays and increase flexibility

4. Industrial Base

The United States received a score of two points in the acquisition efficiency category for lacking the capacity to produce technologically-sound weapon systems. This assessment is based on challenges in supply chain resilience, workforce readiness, acquisition flexibility, and economic deterrence. These are factors which are all critical for maintaining military and technological superiority. The following list consists of recommendations for improving efficiency in the U.S. DIB.

- Expand middle tier and small business involvement to diversify the contractor base and allow new entrants to contribute components
- Expand domestic production capacity to incentivize onshoring of critical components
- Launch a defense industry workforce development initiative to attract and retain skilled workers. This could include partnering with community colleges, trade school, and technical institutes to develop certification programs for high-demand manufacturing roles

B. RECOMMENDATIONS FOR FUTURE RESEARCH WITHIN SCOPE

These are recommendations within the scope of the framework that came up throughout the data analysis process. They recommend ways to alter the framework, or use it in different contexts.

- Quantify all efficiency factors: If possible with data available, assigning quantitative metrics to measure all 10 efficiency factors would decrease subjectivity. The goal of this research would be to make changes to the framework itself, not necessarily apply the framework. This research would examine how others have measured similar factors, and apply those methods to assign quantitative metrics to Lorge's (2018) factors.
- Add risk management as a factor: A country's approach to risk management is directly linked to acquisition efficiency, and would be a valuable addition to this analysis. The framework would then have 11 efficiency factors and could still be applied to compare any countries in any sector of defense acquisition.
- Use of classified data: It is possible that more data is available at the Secret or Top-Secret levels, in which case, future research should attempt to apply the same framework to classified defense acquisition efficiency data, and compare results.
- Apply framework to countries in recent conflict: Applying this framework to a recent conflict could be useful to determine whether the efficiency of countries' acquisition systems was linked to their militaries' performances, and even to the outcome of the conflict. These results may also inform the weighting scenario for future use, illuminating which efficiency factors had the most impact on the conflict.

C. RECOMMENDATIONS FOR FUTURE RESEARCH OUTSIDE OF SCOPE

The following are research topics and questions that arose throughout the research process for this thesis. They are not directly related to the framework but would be valuable for future research nonetheless.

- Examine the measures of success the United States currently uses to evaluate the defense acquisition system, like cost, schedule and performance. Does the United States have an effective system in place, based on its national and strategic priorities, to measure success in defense acquisitions?
- Can China achieve its goal of becoming a global innovation leader in defense and technology while maintaining an authoritarian governance model? Does fostering military and technological innovation create a more open and free-thinking society, and if so, is that what Chinese leadership wants?
- How does China's force development and defense acquisition strategy differ from that of the United States in both peacetime and in preparation for high-end conflicts? Is acquisition efficiency prioritized as much in China as it is in the United States?
- A case study analysis of China's advanced missile capabilities could assess the strategic implications and the significance of the United States lacking comparable systems.
- Even if China surpasses the United States in certain military capabilities, does it possess the economic, logistical, and institutional capacity to sustain the military force envisioned by Xi Jinping?

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