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Strategic Cost Estimation: Understanding Resource Tradeoffs in China's Defense Modernization Efforts

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Abstract

China's military modernization efforts appear unrelenting, but China's defense-related cost constraints remain underappreciated by Western strategists and defense planners. Understanding Chinese defense budget limitations and resource tradeoffs is necessary for accurately estimating the future force structure of China's People's Liberation Army (PLA) and for aiding U.S. and allied policymakers in developing competitive strategies that exploit Chinese resource scarcity. This paper, which is an overview of ongoing research, addresses methodologies for estimating the PLA's platform- and unit-level defense expenditures and its future force structure. This research has produced three major insights. First, rough order of magnitude cost estimates are feasible and useful for understanding China's potential defense modernization trajectories. Second, U.S.-based cost estimating relationships provide a basis for assessing relative cost tradeoffs among China's defense programs, and Chinese production efficiencies and operating practices can be incorporated into those estimates over time. Finally, multiple mutually reinforcing approaches are required to bound uncertainty about future PLA force structure developments. This research enables the analysis of alternative future PLA modernization trajectories, which will support the development of robust and adaptable U.S. strategies, operational concepts, modernization plans, and basing and posture arrangements. Future publications will build on these initial insights and conclusions.

Introduction¹

The United States defense enterprise is constantly reminded of its resource constraints yet, in much of Western discourse about the People's Liberation Army (PLA), cost constraints are understudied. Sustained and dramatic increases in the PLA defense budget since the mid-1990s have made discussions of resource tradeoffs within the PLA defense budget portfolio seem out of place. But the PLA undoubtedly confronts resource constraints: a large portion of the PLA's force structure is still comprised of legacy platforms and systems, and rising personnel costs are constraining manpower levels. As China's economic growth slows over the coming decade and demands on non-defense government programs increase, resource limitations will likely play an even more prominent role in shaping China's defense spending. Western policy-makers and analysts should consider how resource constraints will limit the PLA's modernization, and how differing PLA

¹ Current and former CSBA staff members, including Toshi Yoshihara, Harrison Schramm, Lukas Autenried, Jacob Cohn, Peter Kouretsos, and Grace Kim, have made significant contributions to this research effort.



modernization strategies could result in different PLA force structures over the medium to long term. The Center for Strategic and Budgetary Assessments (CSBA) is developing a PLA force structure and defense modernization tradeoff tool, called the China Strategic Choices Tool (henceforth “China SCT”). The China SCT builds on CSBA’s existing Strategic Choices Tool, a user-friendly web-based program originally designed to allow analysts to evaluate alternative U.S. military modernization and force structure over a coming 10-year period under a defined budget constraint. Similarly, the China SCT will enable examination of plausible alternative future PLA defense modernization trajectories, which will support the development of robust and adaptable U.S. strategies, operational concepts, modernization plans, and basing and posture arrangements.

Difficulties in Forecasting Future Threats

Due to lengthy research and development timelines and the long average service life of U.S. platforms and systems, U.S. defense policy-makers today are confronted with acquisition decisions that will have consequences for decades to come. Their decisions consequently should be based on an assessment of the security environment over a 10- to 20-year period, but policy-makers are often asked to make decisions given narrow or piecemeal analysis of future threats. Personal experience, bias, or intuition, along with institutional inertia, therefore become the basis for many research and development or investment decisions.

As the United States re-enters a period of great power competition, policy-makers should consider bounding how the militaries of other competitors may evolve. Predicting the future is difficult and single-scenario predictions of future developments, especially more than five years out, will most likely prove incorrect. Similarly, predictions of an adversary’s future force structure that do not account for potential variability are deceiving and can potentially lead to dangerous outcomes when used in analysis and decision-making. Instead, defense policy-makers and planners should consider alternative future force structures that an adversary could realistically field. Preparing for a variety of plausible threat scenarios will focus U.S. decision-makers on developing strategies and plans that are robust and flexible in the face of uncertainty.

China’s Ambitious Military Modernization Goals

China’s rapidly expanding military power will result in increasingly high demands on U.S. defense policymakers and planners to understand and prepare for the future threat environment. Benefiting from sustained real budget increases since the mid-1990s, the PLA has engaged in a decades-long modernization process, which has included the development and procurement of advanced weapons platforms and systems. Compared to the Cold War-era, when the PLA’s conventional forces were largely confined to the Asian continent and focused on preparing for ground warfare, the PLA is increasingly capable of engaging in complex military operations beyond China’s borders in all warfighting domains. The PLA’s modernization will likely continue well into the future given Chinese President Xi Jinping’s two ambitious modernization targets. First, Xi intends for China to complete the “modernization” of its armed forces by 2035 and, second, Xi plans for the PLA to be “fully transformed into world-class forces” by 2050. (Xi Jinping, 2017)

The PLA’s ongoing modernization is seriously concerning to the United States and its allies and partners. China’s rising military power casts doubt on the ability of the United States to defend regional partners and allies, including Taiwan, Japan, the Republic of Korea, and the Philippines, which have been subjected to growing Chinese military threats in recent years. China’s modernizing forces will also strain the ability of the United States,



which faces persistent defense budget constraints and competing global security demands, to maintain the overall stable post-1945 balance of power in the Indo-Pacific. If Washington becomes viewed as a weak or unreliable security partner, regional states could choose to accommodate Chinese power or pursue destabilizing options, such as the development of nuclear weapons. Given these potentially grave consequences, U.S. and allied defense policymakers therefore need to refocus their strategies, plans, and investments to counter the PLA's growing capabilities and to ensure that Beijing does not further erode the existing military balance.

But, despite the PLA's recent advancements and Xi's stated modernization aims, the exact magnitude and character of the future threat posed by the PLA remains uncertain. Modern military equipment is expensive both to procure and to operate and maintain and, as pressure on China's defense budget likely increases over the coming decade, China's political and military leaders will confront difficult strategic-level choices concerning the type of force structure the PLA should field. The military capabilities required for potential conflicts along China's immediate periphery in the near seas, for example, are quite different from those needed to project power globally. As a result, China's leaders will also need to prioritize among their country's expanding security goals, which now range from ensuring the Chinese Communist Party's survival to unifying with Taiwan to protecting Chinese investments and nationals overseas. Given the likelihood of increasing tension between China's security interests and resource constraints over the coming decade, the PLA's modernization trajectory is unclear and, partly as a result, the response required by the United States and its allies and partners is still subject to considerable debate.

Project Goals: Understanding and Preparing for Alternative PLA Force Structures

To provide greater clarity about potential PLA modernization paths and to support U.S. defense policy-maker and planner needs, CSBA is developing a PLA force structure and modernization tradeoff tool, called the China Strategic Choices Tool (SCT). The China SCT project has four main goals. First, the project seeks to advance understanding at the strategic level about the feasible range of China's potential future force structures. Similar to a production possibilities curve in economics, this tradeoff tool will enable users to generate plausible alternative force structures given differing allocations of a defined set of resources.

Second, by using the new China SCT, along with CSBA's existing U.S. Strategic Choices Tool, policy-relevant insights can be generated regarding the competitive dynamics and potential interactions between the United States and China. The U.S. and China tools allow changes in defense spending over a 10-year period, broken into two five-year periods (e.g., 2021–2025 and 2026–2030), which will enable interactive exercises and wargames. Competing U.S. and China teams can assess each other after the first five-year move and then react to their opponent's actions in the second five-year move.

Third, this project aims to further the development of U.S. competitive strategies against China. Through an iterative series of exercises and wargames using the new China tool, either alone or in conjunction with the U.S. tool, insights and conclusions can be developed regarding how the United States can both capitalize on China's cost constraints and defend against China's attempts to take advantage of U.S. constraints.

Finally, the project seeks to create an extensible methodology that can be applied to other countries, such as Russia, that have opaque defense budgets.



China’s Defense Spending Data: A Lack of Detail

China’s reticence to release detailed defense expenditure data has long hindered Western analysis of the PLA’s budget.² The primary official figures available to foreign analysts are the annual PLA topline budget and, for a limited set of years, a breakdown of the PLA budget into three defense-wide categories: equipment, training and operations, and personnel. Western research on China’s defense budget to date primarily focuses on overall spending levels and addresses topics such as: categories of spending included in or excluded from the budget; defense budget making processes; estimates of the difference between official and actual defense spending (Bitzinger & Lin, 1994; Blasko, Freeman, Horowitz, Medeiros, & Mulvenon, 2007; Crane, Cliff, Medeiros, Mulvenon, & Overholt, 2005; Liff & Erickson, 2013; Wang, 1996).

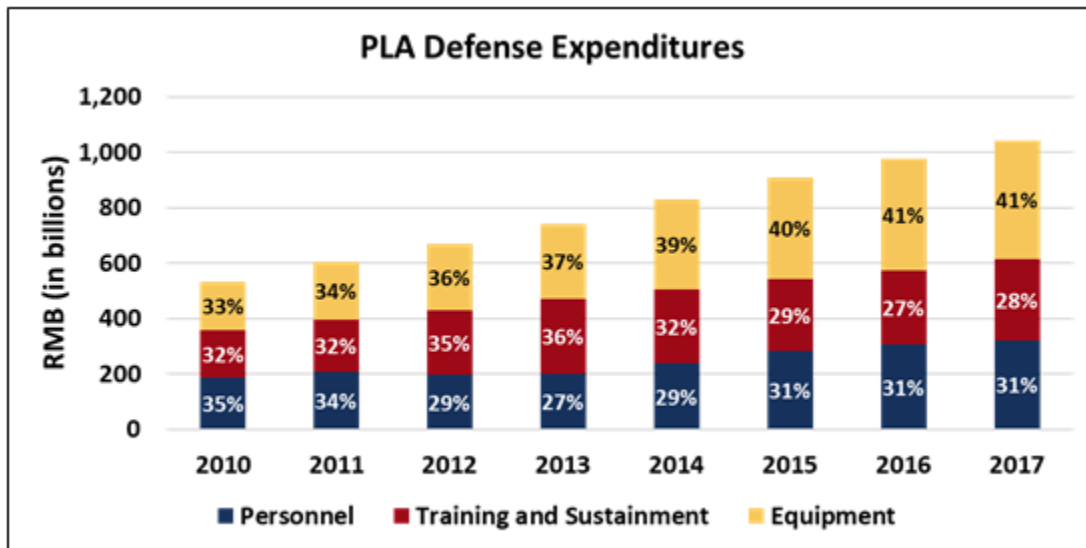


Figure 1. Official PLA Defense Expenditures by Category, 2010–2017. (“China’s National Defense,” 2019).

Estimates of Chinese defense budget estimates at more detailed levels is rare, though a select number of analysts have ventured to push our understanding of China’s defense spending forward through developing approximate, yet reasonable spending estimates at more granular levels based on qualitative information about PLA strategy, modernization programs, technological capabilities, and other factors. Examples of these types of estimates include PLA spending estimates by service (Caffrey, 2018) and platform-level cost estimates (Collins, 2015). Other forward-looking analysis has examined the affordability of certain modernization programs given rough estimates of future defense spending and platform-level procurement costs (Bitzinger, 2003). One analyst even estimated future PLA procurement across multiple domains given historical spending trends, estimated platform costs, and other qualitative information (Cliff, 2015).

² Even Chinese cost estimators bemoan the lack of sufficient defense expenditure data (Zhu et al., 2004).

Yet, at least in the public domain, there has been no comprehensive estimate of future PLA procurement, operations and maintenance, and personnel spending at a platform level that would enable the analysis of alternative future force structures.

Revisiting Cold War-Era Analysis of Adversary Defense Spending

The closest historical analogy to CSBA's current project is estimates of Soviet defense spending performed by the Central Intelligence Agency (CIA) and other organizations within the U.S. government during the Cold War. This effort started in the CIA in the early 1950s and continued until the early 1990s, and the goals of this effort were expansive. U.S. government analysts sought to estimate total Soviet defense spending, calculate defense spending as a percentage of Soviet gross domestic product (GDP), and estimate the Soviet Union's future force structure based on their estimates of Soviet cost constraints. This effort produced two distinct types of budget estimates: 1) an estimate denominated in Soviet rubles, to assess defense costs and spending tradeoffs from a Soviet perspective; and 2) an estimate denominated in U.S. dollars, to communicate what the cost of the Soviet effort would be if the United States attempted to replicate it (Firth & Noren, 1998).

From the outset of this work in the 1950s, due to doubts about the veracity of official Soviet statistics, CIA analysts were committed to a labor-intensive process of developing cost estimates at the platform level.³ In the 1950s, due to the lack of Soviet data, estimates of Soviet defense procurement, operations and maintenance, and military construction were primarily based on U.S. data, usually with some modification for the characteristics of particular pieces of Soviet equipment. By the late 1970s and 1980s, many of the cost estimates had been tailored to Soviet production efficiencies and operating practices (Firth & Noren, 1998; United States of America, Central Intelligence Agency, Office of Strategic Research [CIA], 1979, 1981). Yet, even as the cost estimation methodologies were updated over time, the relative cost relationships between different platforms generally held, indicating that the initial relative cost relationships derived from U.S. data in the 1950s were still useful in understanding Soviet defense resource tradeoffs.

Evaluating China's Future Modernization and Force Structure Using CSBA's Strategic Choices Tool

A central component of this project is CSBA's Strategic Choices Tool (SCT), a web-based program that allows evaluation of tradeoffs in a given country's⁴ defense modernization and force structure spending over a coming 10-year period. CSBA originally developed the Strategic Choices Tool in 2012, in the wake of the passing of the Budget Control Act in Congress, to evaluate alternative approaches to reducing U.S. defense spending. Since that time, the tool has become an integral part of many of CSBA's workshops and wargames. For example, in a given wargame, U.S. teams can be tasked

³ Research and development spending estimates were the main exception. Instead of a bottom-up program-level budget building process, a top-down budget estimation method was used to estimate research and development expenditures (Firth & Noren, 1998).

⁴ In addition to the United States version of the Strategic Choices Tool discussed here, CSBA has now developed versions for multiple allied and partner countries, including the United Kingdom, Australia, Canada, New Zealand, Japan, and Poland, among others.



with accomplishing specific objectives in an operational vignette set 10 years in the future given projected (e.g., 2030) U.S. forces. After completing the vignettes, teams can then use the SCT to realign projected U.S. defense spending and generate a new, alternative future force structure that may be more successful in the vignettes compared to the current projected, or baseline, U.S. force structure. Finally, teams can re-fight the original vignettes using their alternative U.S. force structure and evaluate whether their rebalancing choices actually lead to a more successful operational outcome. Figure 2 shows the user homepage of CSBA'S U.S. Strategic Choices tool. This page shows the categories of spending options in the SCT and displays indicators that track user choices in real time.



Figure 2. The User Home Page of CSBA's U.S. Strategic Choices Tool

The existing U.S. version of the Strategic Choices Tool contains more than one thousand pre-costed options, covering research and development, procurement, operations and maintenance, personnel, and military construction. The cost data in the U.S. tool primarily comes from publicly available U.S. Department of Defense budget documents, and for this strategic-level tool to function properly, only rough order of magnitude cost estimates are required.

The tool is not a budget-building tool, and the tool does not cover the entire defense budget. Rather, the tool contains a projected 10-year (e.g., 2021–2030) baseline force structure. Users can then select add and cut options to readjust that baseline force structure under a defined budget constraint. For the United States, the 10-year baseline force structure is a current projection based on publicly available information from the Future Years Defense Program, budget documents, service-level strategy and planning documents, and other sources.

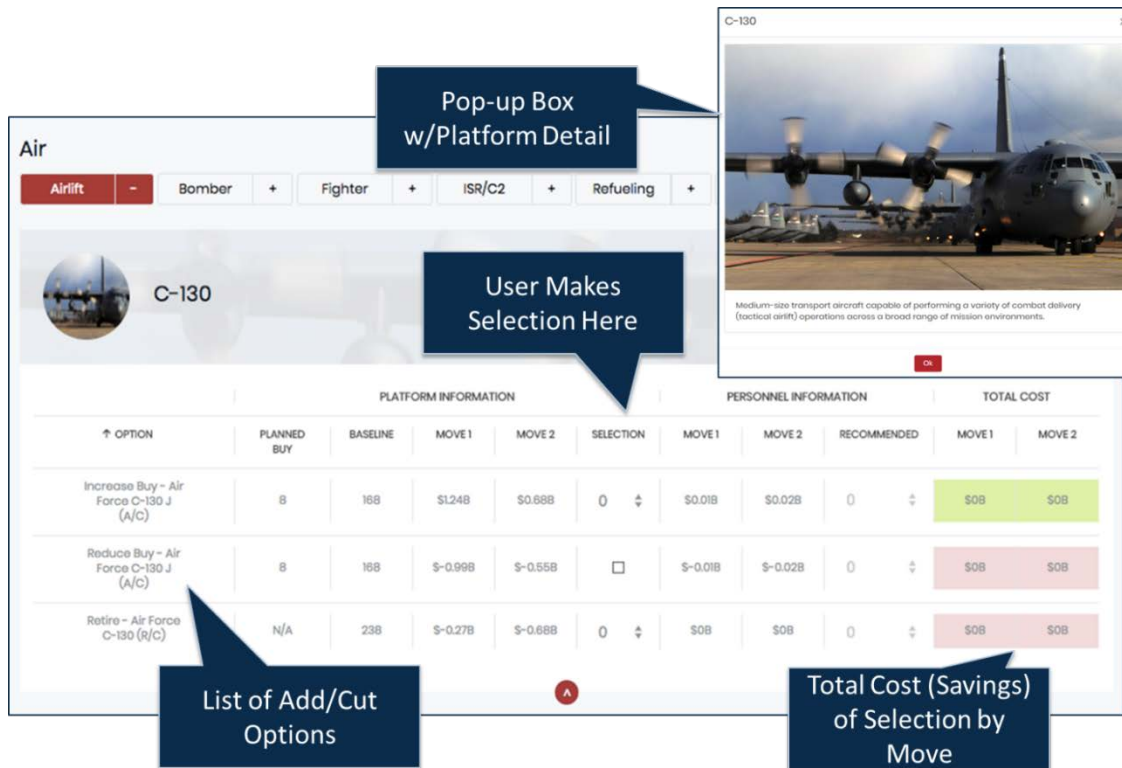


Figure 3. The Strategic Choices Tool Contains Platform-Level Options to Add or Cut Future Spending. In this Example from the U.S. SCT, a User is Presented with Options to Add or Cut C-130-Related Spending.

Since this tool analyzes tradeoffs within a projected baseline defense portfolio, rather than building a budget from the bottom up, accurate relative cost relationships between all of the options are more important than the precise absolute cost of each option.

Importantly, the SCT itself does not evaluate the effectiveness of any given force structure. The tool merely allows reallocation of defense spending over a 10-year period to produce a new force structure. Instead, the force structure generated by running a Strategic Choices Exercise often serves as an input for wargames, exercises, workshops, and other analytical methods that can assess the effectiveness of military capabilities.

Overcoming the Challenges of Estimating PLA Spending at the Platform and Unit Level

To create a China version of the Strategic Choices Tool, rough order of magnitude cost estimates of PLA procurement, operations and maintenance, and personnel costs at the platform and unit level are required, but the challenges to developing such estimates are considerable. First, and most importantly, the basic lack of platform-specific budget data is a tremendous knowledge gap since cost estimates are usually developed based off historical data. Even Chinese cost analysts face this problem. Second, estimating research and development costs is inherently and notoriously difficult due to inherent uncertainties in the research and development phase. Third, the production processes and efficiencies of Chinese defense conglomerates are either obfuscated due to a lack of data, or require substantial Chinese-language research and technical subject matter expertise to attempt to make use of existing open source data. Fourth, learning curve effects and the synchronization of production schedules can impact procurement costs over time (O'Rourke,

personal communication, January 29, 2019). Fifth, PLA operations and maintenance practices could differ considerably from U.S. or Western practices, which are the foundation of most operations and maintenance cost models. Finally, PLA platform quality is difficult to assess in quantitative terms since open source data on the exact capabilities and cost at a sub-component level are lacking (O'Rourke, 2018).

Nevertheless, rough order of magnitude estimates for PLA platforms and systems that are useful for strategic level analysis of PLA resource tradeoffs and modernization trends are still feasible. Despite the lack of PLA-specific cost data, there is an inherent, universal relationship between platform characteristics and cost. To develop rough order of magnitude estimates for many types of platforms, often only a few key variables are sufficient. For example, tonnage and energy density consistently remain the two primary cost drivers in naval shipbuilding, despite the fact that costly information technology systems are increasingly integrated into these platforms (Arena, Blickstein, Younossi, & Grammich, 2006). Similarly, weight and speed, along with a few other variables, are primary cost drivers for military aircraft (Arena, Younossi, Brancato, Blickstein, & Grammich, 2008). Thankfully, for many PLA platforms, these overall platform characteristics are observable or can be estimated with a high degree of confidence.

Moreover, the primary function of the SCT is to allow users to deviate from a baseline force structure estimate for the coming 10-year period by selecting various investments or divestments. Since the tool focuses on evaluating resource tradeoffs among various defense spending options, the SCT only requires approximate relative cost relationships between platform types. Precise absolute costs of PLA platforms would certainly be helpful for fully understanding the magnitude of China's defense modernization effort, but they are of secondary importance.

While Chinese cost data is unavailable, initial relative cost relationships between platform types can be estimated through the use of U.S. platform-level cost data. The U.S. Department of Defense is an abundant source of platform and system cost data and, through collecting and analyzing that data, U.S.-based cost estimating relationships (CERs) can be generated. While mirror imaging should be avoided, U.S.-based CERs can still be a useful first step in assessing PLA tradeoffs between different platform types. Such an approach would be analogous to the CIA's initial estimates of Soviet defense costs in the 1950s, and similarly, PLA cost estimates can be refined over time through additional research on Chinese defense industry production efficiencies, and PLA operating practices. Unlike the Cold War-era CIA cost estimation effort, CSBA's project will focus more narrowly on evaluating potential resource tradeoffs in PLA force structure over a 10-year time period, rather than attempt to create a bottom-up estimate of the entire PLA defense budget or calculate China's true defense burden as a percentage of gross domestic product.

Many of the challenges outlined above become less meaningful when evaluating defense spending over multi-year time periods. The SCT evaluates defense spending over a 10-year time period, broken into two five-year increments. While several variables can lead to significant cost differences between months or individual years, when viewed as a five-year move, these differences become less pronounced.

Toward a China Strategic Choices Tool

Given the feasibility of rough order of magnitude PLA platform and system cost estimates, CSBA's roadmap for the China SCT project contains three lines of effort: 1) cost estimates for procurement, operations and maintenance, and personnel at the platform or unit level; 2) a force structure estimate for the current year (e.g., 2020), five years in the future (e.g., 2025), and 10 years in the future (e.g., 2030); and 3) a PLA defense budget



estimate. These three separate but mutually reinforcing tasks collectively provide the information needed for the China Strategic Choices Tool. The cost estimates for individual platforms and force structure units will support the development of a force structure estimate that is cost-informed, using realistic defense spending growth rates. The force structure estimate in aggregate can then be compared against the PLA defense budget estimate to determine whether the cumulative amount of spending seems reasonable. If the cumulative force structure–related spending is too high or low, revisions to the cost and force structure estimates may be required.

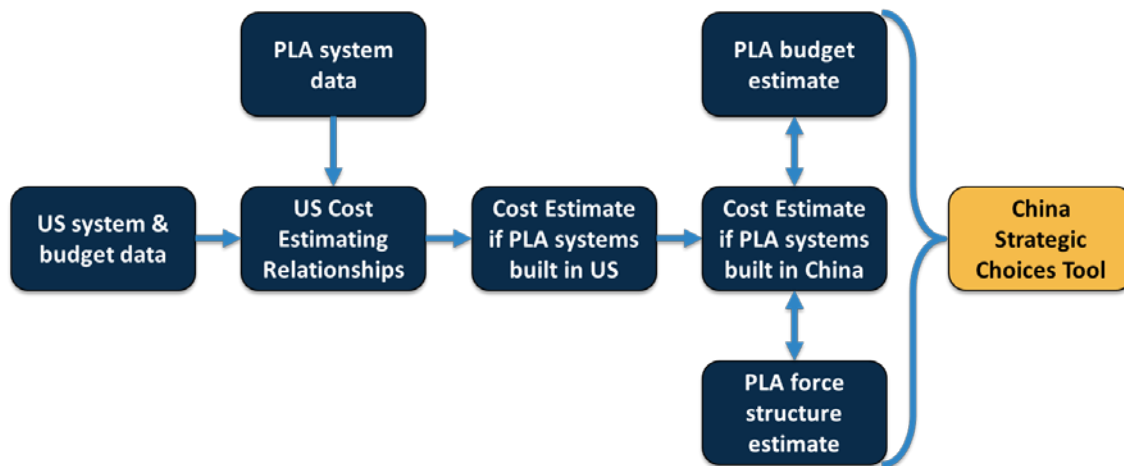


Figure 4. CSBA Project Roadmap for the Development of the China Strategic Choices Tool

Developing Cost Estimates for PLA Platforms, Systems, and Force Structure Units

The tool depends on cost estimates for research and development, procurement, operations and maintenance, and personnel. Research and development will be addressed separately below.

Our development of procurement and operations and maintenance cost estimates follow similar methodologies. First, U.S. platform and system characteristic and budget data are used to create U.S.–based cost estimating relationships (CERs) for procurement and operations and maintenance (Schramm et al., 2019). CSBA has already developed cost estimating relationships for a variety of platforms in the air, sea, and ground domains and for munitions. We then input PLA platform and system characteristic data into these CERs to generate the procurement or operations and maintenance cost of that platform or system, if it were to be built in the United States. Next, we use certain macroeconomic indicators that reflect differences in U.S. and Chinese factor prices and productivity in order to adjust the absolute cost estimates for China’s economic conditions.⁵ Using these macroeconomic

⁵ Candidate macroeconomic factors are still being assessed, in combination with other absolute cost adjustments necessitated by the comparison and validation of CSBA’s aggregated force structure

factors is preferred over purchasing power parity (PPP) exchange rates, which tend to vastly underestimate China's costs to produce complex, technologically advanced equipment. Importantly, these macroeconomic factors are constants. While the resulting adjusted absolute costs are helpful in understanding the magnitude of the PLA's defense spending, the relative cost relationships between platforms are still fully determined by the U.S.-based CERs.

Personnel costs are calculated more simply using official data on PLA personnel spending and the number of PLA personnel. Dividing the personnel budget by the total number of PLA personnel yields a cost per PLA service member. The total annual personnel cost for a platform or force structure unit is determined by multiplying the individual service member cost by the approximate number of personnel per platform or force structure unit, a number that comprises both the personnel directly associated with the platform or unit and the supporting personnel or forces. This approach to personnel costs is the same as that used for the existing U.S. SCT.

Research and development costs at a program level are particularly difficult to estimate, even in the United States, and these estimates are one of the next major steps in CSBA's work. Given the current availability of data, these estimates will primarily follow rough rule-of-thumb relationships regarding the proportion of research and development spending within a program's total life-cycle cost. Moreover, since the SCT is a tradeoff analysis tool rather than a bottom-up budget building tool, the tool fortunately does not require an estimate of all Chinese research and development spending. In fact, no particular number of research and development programs is inherently required. Finally, since the SCT focuses on a 10-year time period, most research and development program options would result in only a limited number of platforms produced within that time frame. Nonetheless, some research and development options will be included in the China SCT so that users can indicate the types of technologies in which they believe the PLA will invest.

Developing a Future Force Structure Estimate

As explained above, the SCT requires a projected, or baseline, force structure estimate for the coming 10-year period, so that users of the SCT can then readjust defense spending over that time period through selecting add and cut options. Since the SCT functions in two five-year increments, force structure estimates are needed for the current year (e.g., 2020), the end of the first five-year increment (e.g., 2025), and the end of the second five-year increment (e.g., 2030).

Future force structure estimates for the PLA, as well as many foreign militaries that provide limited data on force structure plans, confront several methodological challenges. First, analysts often disagree about what comprises the PLA's force structure today, let alone in five or 10 years. In addition to differences in the absolute number of platforms or units, sources vary in the level of granularity provided on the number of each type of platform variant.

Second, when looking toward the future, there is inherent uncertainty about the PLA's future defense plans. This uncertainty results partly from the PLA's lack of

spending totals with projected PLA defense budget estimates (see the section below titled "Cross-Referencing Cost and Force Structure Estimates with a Forecasted PLA Budget Estimate").



transparency, but also from the fact that in the future the PLA could diverge from an earlier plan based on any number of factors, such as changes in the security environment, shifts in military strategy, or technological developments.

Third, defense industrial base constraints limit the possible quantity produced of a particular platform. These constraints usually become less stringent over the medium-to-long term, since prioritization of the production of any particular platform type could result in major changes in defense industrial base capacity. Yet there are certain areas where defense industrial base constraints are difficult to shift even in a five- or 10-year period, such as in submarine production.

Fourth, defense industrial base constraints and domestic production limitations, more broadly, can be overcome through foreign military sales, which China has engaged in over the last several decades, particularly with Russia.

Fifth, annual historical data on the PLA's force structure inventory is usually uneven, complicating calculations of force structure trends. Due to the lack of accurate and timely data on the PLA's procurement or retirement of particular platforms, foreign assessments of the PLA's historical force structure inventory often show year-to-year changes that are too great in magnitude to have occurred in only one year.

Finally, data is unavailable on platform attrition rates, expected service life, service life extension programs, and other factors that would provide clarity on future force structure changes.

CSBA's approach to these challenges follows existing unclassified best practices, and notably, adds cost constraints to changes in force structure. First, CSBA collected historical PLA force structure data for the last 10–20 years for major platform, system, and force structure unit types from multiple sources. This data was used to assess, among other factors, trends in production, retirement, and force composition, which enabled the development of working assumptions about future changes in force structure. Due to significant year-to-year fluctuations in the data, some of the historical numbers were smoothed out to reflect more realistic changes over time and to produce recognizable trends that can be applied to estimate future growth (Cliff, personal communication, August 10, 2018). To develop future force structure projections, these growth rates, trends, and working assumptions were then applied forward, combined with assessments of defense industrial base capacity for new platforms. Qualitative assessments based on PLA strategy and on modernization plans, drivers, and trends were also factored into the estimates. The resulting force structure estimate is now being subjected to a period of validation and iteration through cross-checks with historical data and estimates of PLA defense spending.



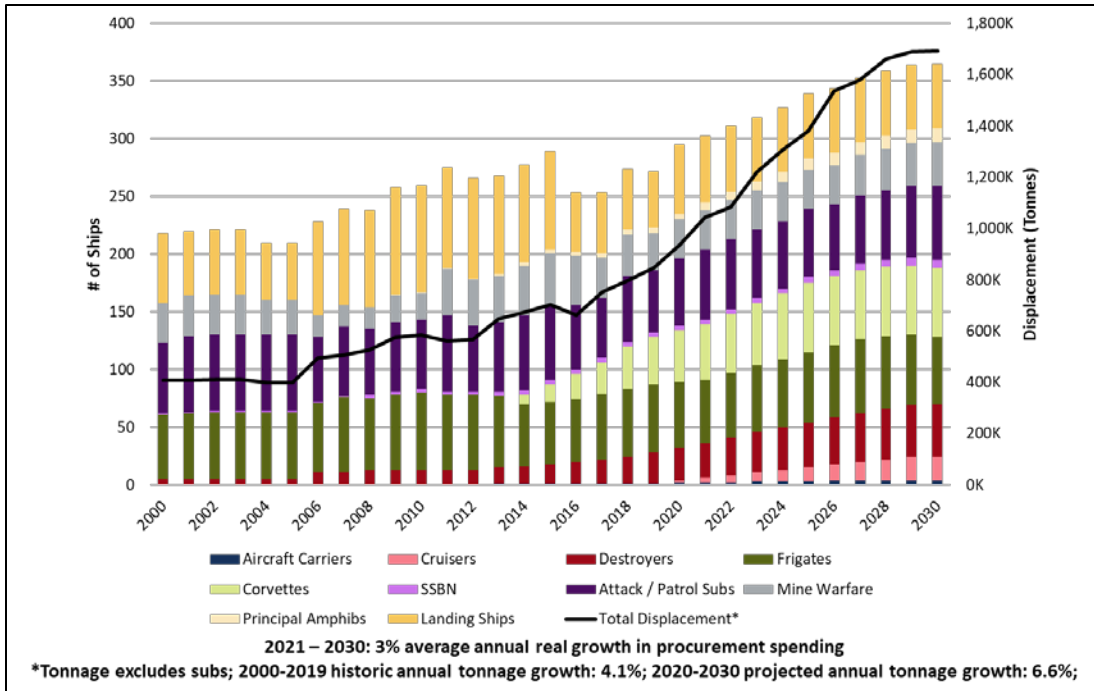


Figure 5. A Preliminary Cost-Informed PLA Navy Force Structure Estimate⁶

Figure 5, depicting PLA Navy force structure from 2000 to 2030, is an example of the above methodology. CSBA used historical trends from 2000 to 2019, qualitative information about the PLA’s modernization and force structure plans, and CSBA’s cost estimates for PLA platforms and systems to generate a baseline projection of PLA Navy force structure from 2020 to 2030.⁷ The projection yielded a reasonable 3% annual growth rate in naval procurement spending and a projected annual tonnage growth rate of 6.6%.

More important than the specific number of any individual platform or unit type in the estimate is the cumulative amount of spending in the future force structure estimate (Cliff, 2015). In the SCT, the future force structure estimate serves as a projected budget baseline, and teams can select various add and cut options in the tool to generate alternative budget-neutral future force structures.

The China SCT’s ability to allow users to rapidly consider realistic alternative PLA force structures is a major benefit for U.S. policy-makers and planners. Instead of relying on a single-point estimate of the PLA’s future force structure, users of the China SCT can evaluate differing PLA force structures. Through the integration of the China SCT with

⁶ The force structure categories in the graph follow a traditional Western military typology. For example, the Type-055 Renhai-class ships are regarded here as “cruisers” even though the PLA defines them as “destroyers.” Historical data is based on several sources (International Institute for Strategic Studies, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020; Jane’s, 2008, 2009, 2010, 2014, 2015, 2016, 2017, 2018, 2019; O’Rourke, 2020).

⁷ Certain small ships, such as coastal combatants and logistics ships, were excluded from the above graph.

workshops and wargames, U.S. analysts will be able to assess how baseline and alternative U.S. force structures might perform against those alternative PLA futures, which will aid U.S. decision-makers in creating a force structure that is more robust and resilient in the face of uncertainty over the PLA's modernization trajectory.

Cross-Referencing Cost and Force Structure Estimates with a Forecasted PLA Budget Estimate

As one of several methods used to validate the cost and force structure estimates above, CSBA will check these estimates against an estimate of the PLA's future defense budget, which is this project's third line of effort. This process is one of the next steps in CSBA's ongoing research. While foreign analysts have historically criticized the PLA's official defense budget as severely undercounting actual spending, many PLA experts today generally agree that, compared with official budget figures from the 1990s or 2000s, the official overall budget in recent years is much closer to reality, at least for the budget categories that are included in the official budget.⁸ With certain modifications and projected to 2030 at specific growth rates, the official defense budget can therefore be used as one method for assessing whether the cumulative spending totals generated from the cost and force structure estimates above are reasonable.

The Way Forward

Development of the China Strategic Choices Tool is ongoing and the tool will be launched later in 2020. Work remains in three key areas:

1. Developing U.S.-based cost estimating relationships for procurement and operations and maintenance costs in remaining platform, system, and unit categories, including space systems, nuclear forces, and Strategic Support Force units;
2. Developing research and development cost estimates; and
3. Adjusting the absolute cost estimates of PLA platforms, systems, and force structure units by applying appropriate macroeconomic indicators—primarily factor prices and productivity—and comparing cumulative force structure spending levels with forecasted PLA budget estimates.

Peer review and feedback is also being sought through an ongoing series of CSBA workshops and exercises, which involve a multidisciplinary group of experts composed of cost analysts, PLA analysts, economists, statisticians, defense industry analysts, and other experts.

After the official launch of the tool this year, the cost and force structure estimates will be subject to continual refinement based on external feedback and additional CSBA effort. Over time, the U.S.-based CERs can be replaced with CERs that are based on Chinese defense industry manufacturing efficiencies and PLA operating practices. In part, these refinements will depend the formation of a multidisciplinary expert community—composed of the types of experts listed above—to study Chinese defense economics.

⁸ Certain budget categories, such as research and development, paramilitary forces, and foreign military equipment acquisitions, are partially or fully excluded from the official budget (Blasko et al., 2007; Crane et al., 2005; Liff & Erickson, 2013).



Conclusions

While this project is in process, CSBA's work has yielded several preliminary conclusions. First, rough order of magnitude cost estimates are feasible and useful for understanding China's potential defense modernization trajectories. Second, U.S.-based cost estimates are a reasonable starting point and Chinese production efficiencies and operating practices can be incorporated into these cost estimates over time. Finally, no single approach is likely to yield a definitive answer to questions on Chinese platform costs and force structure plans. Multiple mutually reinforcing approaches are required in order to bound uncertainty about future developments in PLA force structure.

Once complete, the China Strategic Choices Tool, in combination with the existing U.S. Strategic Choices Tool, will be a valuable set of tools for use in iterative exercises and wargames. These tools will provide U.S. defense policy-makers and planners new insight into U.S.-China competitive dynamics and improve the development of U.S. competitive strategies, operational concepts, investments, posture, and basing in the face of China's growing military power.

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