

China Strategic Choices Tool



International Cost Estimating and Analysis Association Workshop, May 2019

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CSBA

Center for Strategic and Budgetary Assessments

CSBA Mission, Vision, Values

- **CSBA is the world's premier center for understanding future international competition and conflict. Our mission is to develop innovative defense concepts, promote public debate, and spur action to advance U.S. and allied interests.**
- Our vision is to set the terms of debate for the future of national defense and drive change in concept development and force structure to prepare the U.S. and its allies to compete and win in an era characterized by great power competition and conflict.
- Independence Integrity Expertise
Objectivity Innovation Quality

Our Team



Jack Bianchi,
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Asia-Pacific Strategy and
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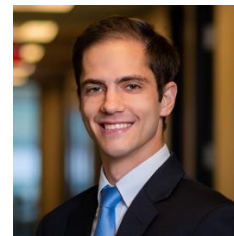
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- **Data:** Other potential data sources we should consider?
- **Methodology:** Strengths and weaknesses of the outlined methodologies? Other methodologies to consider?
- **Chinese Context:** How to adjust Western cost data for China?
- **Workshop:** How to structure upcoming workshop and propose questions for paper authors?

- Project Background & Strategic Choices Tool Overview
- Literature Review
- Potential Cost Estimation Models
- Case Study: Fighter Aircraft
- Discussion

Project Background & Strategic Choices Overview

Project Goals

- Understand at the *strategic level* the feasible range of China's potential future force structures
- Gain policy-relevant insights into competitive dynamics between U.S. and China and analyze potential interactions in series of moves
- Aid U.S. competitive strategy development toward China
- Create an extensible methodology that can be used beyond project end date and applied to other countries/competitions

For this project, the relative effort that a country makes to produce systems is essential; the absolute cost is not.

What is the Strategic Choices Tool?

The **Strategic Choices Tool (SCT)** is
an **interactive** decision making tool in which
users can rapidly consider **alternative future force structures**
within a **real world budget constraint**.

Strategic Choices Tool opening page

- HOME
- ADD/CUT SUMMARY
- SELECTION DETAILS VIEW
- FORCE STRUCTURE
- FORCE STRUCTURE DETAILS

- AIR
- GROUND
- LOGISTICS & BASING
- MISSILE DEFENSE
- MUNITIONS
- NUCLEAR FORCES
- PERSONNEL
- R&D
- READINESS
- SEA
- SOF
- SPACE/CYBER/COMMS
- PERSONNEL DEVIATIONS
- UNLOCKED SELECTION

- REFERENCE FILES
- SEARCH
- ASK FOR HELP
- SIGN OUT

ITEM	MOVE 1 2019 - 2023	MOVE 2 2024 - 2028	Aircraft	Munitions	Ships	Active BCT	Reserve BCT	Active Personnel	Reserve Personnel
Running Total	\$-6.19 B	\$-32.6 B	6,744	0	292	31	27	1,314,000	814,200
			0	401	2	-3	-3	-35,300	-78,700
			6,744	401	294	28	24	1,278,700	735,500

Running Total of Spending

Summary of User Choices

Categories

- Air >
- Ground >
- Logistics & Basing >
- Missile Defense >
- Munitions >
- Nuclear Forces >
- Personnel >
- R&D >
- Readiness >
- Sea >
- SOF >
- Space/Cyber/Com... >

Lock Move 2

Categories of Spending Options

The SCT has a wide range of built-in options

Air

Airlift
-
Bomber
+
Fighter
+
ISR/C2
+
Refueling
+

C-130

↑ OPTION	PLATFORM INFORMATION					PERSONNEL INFORMATION				TOTAL COST	
	PLANNED BUY	BASELINE	MOVE 1	MOVE 2	SELECTION	MOVE 1	MOVE 2	RECOMMENDED	MOVE 1	MOVE 2	
Increase Buy - Air Force C-130 J (A/C)	8	168	\$1.24B	\$0.68B	0 <input checked="" type="checkbox"/>	\$0.01B	\$0.02B	0	\$0B	\$0B	
Reduce Buy - Air Force C-130 J (A/C)	8	168	\$-0.99B	\$-0.55B	<input type="checkbox"/>	\$-0.01B	\$-0.02B	0	\$0B	\$0B	
Retire - Air Force C-130 (R/C)	N/A	238	\$-0.27B	\$-0.68B	0 <input type="checkbox"/>	\$0B	\$0B	0	\$0B	\$0B	

Pop-up Box w/Platform Detail

Medium-size transport aircraft capable of performing a variety of combat delivery (tactical airlift) operations across a broad range of mission environments.

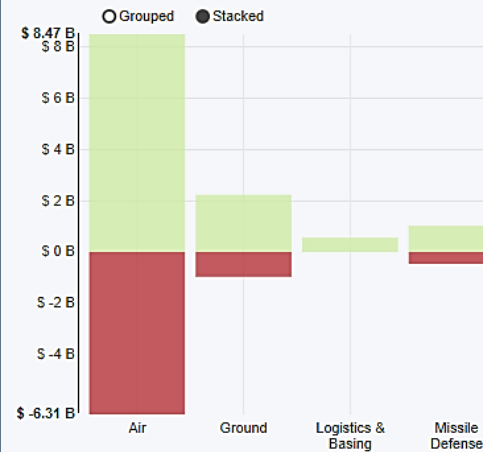
Ok

List of Add/Cut Options

Total Cost (Savings) of Selection by Move

Example SCT outputs

Summary of Adds/Cuts: jcohn



Selection Details: jcohn

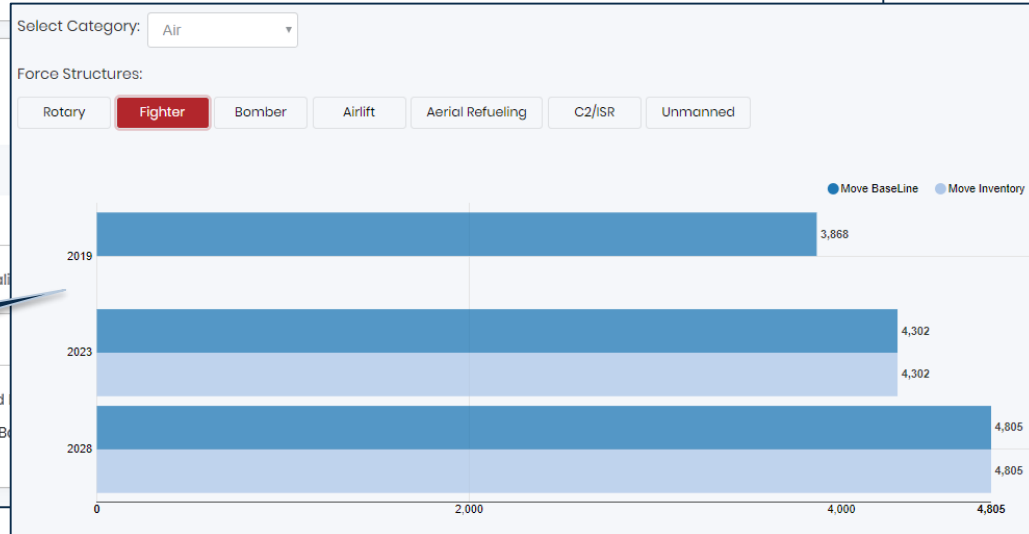
List of Each User Selection

Air

		MOVE1	MOVE2
Subtotals:		\$3.94B	\$-1.76B
Add	Quantity		
Restart Production Line - Air Force C-17	1	\$3.59B	\$0.0B
Accelerate - Army Future Vertical Lift	0	\$3.66B	\$0.81B
Reconstitute - Air Force C-17 (R/C)	3	\$0.12B	\$0.3B
Cut	Quantity		
Cancel - Navy MQ-25 Stingray (A/C)	0	\$-2.72B	\$-1.02B
Retire - Air Force C-5 (A/C)	5	\$-0.3B	\$-0.78B
Retire - Air Force C-5 (R/C)	5	\$-0.3B	\$-0.78B
Retire - Air Force C-17 (A/C)	3	\$-0.11B	\$-0.29B

Ground

Add	
Purchase - Marine Corps Artillery Battalion	
Cut	
Retire - Marine Corps Reserve Armored	
Retire - Marine Corps Reserve Artillery Battalion	



Visual Display of Adds and Cuts by Category

Visual Comparison of Baseline and User Platform #'s

The SCT Is a Strategic Level Tool

- Costs are rough order of magnitude estimates (precision not required)
- Since this is a trading tool, correct relative cost relationships are more important than correct absolute costs
- The SCT is NOT a budget building tool; users make adds/cuts to the existing baseline budget, primarily for major defense acquisition programs

China SCT: Project Stages

- **Phase I: Literature Review**
- **Phase II: Construct a force structure trading tool**
 - Part A: develop cost estimation models of PLA platforms and systems
 - Part B: develop a projected 2030 PLA force structure
 - Part C: estimate the annual PLA equipment budget for 2020-2030
 - Build model internally, then hold workshop with external participation
- **Phase III: Exercises**
 - Conduct three exercises utilizing the China SCT and the existing U.S. SCT to examine competitive dynamics between the U.S. and China
 - Solicit feedback before launching



WE
ARE
HERE

Literature Review

Literature Review: Process

- Reviewed existing literature on PLA budget and Chinese defense procurement over last 30+ years
- Consulted 50+ experts worldwide in Chinese military studies, defense analysis, and cost analysis
- Collected platform characteristic and cost data on U.S. and Chinese platforms and systems

Literature Review: Insights

- Limited Chinese Data Available
 - No official defense budget data, except total defense budget amount
 - Some data on arms exports, but prices may be distorted
- Unique Project
 - Western research efforts in this field are sparse, sporadic, and isolated
 - No organization—at least in public domain—has attempted to develop cost estimates of PLA platforms/systems in all warfighting domains
- Reception Varied by Field
 - PLA experts are particularly skeptical about estimating costs
 - Analysts in defense industry, civilian industrial sectors, and consulting more open minded
- Wealth of U.S. Data Available

Potential Cost Estimation Models

Cost Models: Procurement (1)

Comprehensive Cost Estimation Models

1. ***Single Characteristic Ratio Model**
 - Apply ratio of key characteristics, such as weight or power, to cost of known Western platforms to generate price of similar Chinese platforms
2. **“Walk-down” Approach**
 - Apply cost from U.S. platform to similar Chinese platform, then adjust major subsystem costs based on research on China’s defense S&T industry
3. ***Parametric Model**
 - Both Frequentist and Bayesian versions: develop Cost Estimating Relationships (CERs) for US/Western aircraft and apply to Chinese platforms
4. **Existing Off-the-Shelf Cost Estimation Software**

Limited Cost Estimation Model

1. Calculate per platform cost based off of financial data of subsidiary companies

All methods can include a PPP or other factor to adjust for Chinese labor costs

** Denotes ongoing CSBA effort*

The qualities of ‘good’ estimates of Chinese costs:
internally consistent, scalable, and minimum variance

Cost Models: Procurement (2)

Overall Checks

1. Create cost ratios from complex civilian platforms (e.g. ships, aircraft) or construction processes (e.g. hotels) and apply to defense goods and production:
 - Data can be from U.S. and China, or from U.S. and a developing country with factor costs similar to China (e.g. Brazil)
2. Estimate procurement budget and production for previous five years, then compare these historical estimates to our budget and production forecasts for future five-year period (serves as a top-down check on bottom-up data)
3. Chinese prices:
 - Use existing commercial database of Chinese “prices” for defense goods
 - Check uncorroborated Chinese prices on blogs and press reports
 - Calculate prices from defense export deals

Comprehensive Cost Estimation Models

1. *Single Characteristic Ratio Model:
 - Apply ratio of key characteristics (e.g. tonnage or days at sea) to cost of known U.S. platform to generate price of similar Chinese platform
2. Parametric Model:
 - Develop parametric model from U.S. cost and specification data; apply to China
3. Use existing parametric model cost estimation software

Cost Estimation Model Limited to Particular Platforms

1. Find official sources (e.g. PLA field manuals) with O&M guidance and procedures

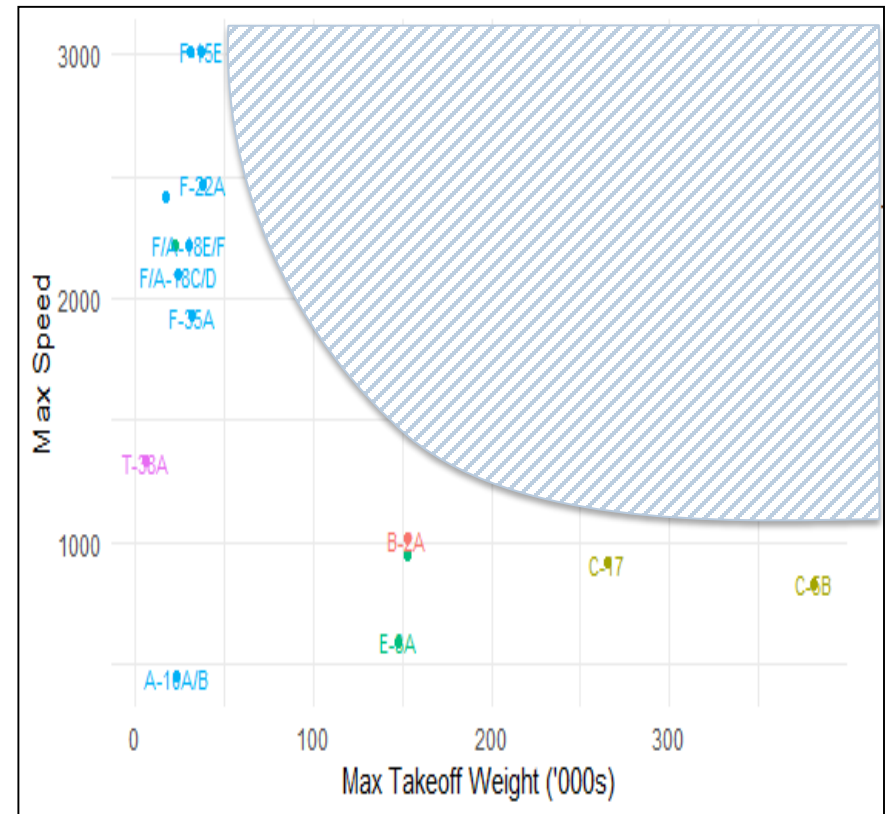
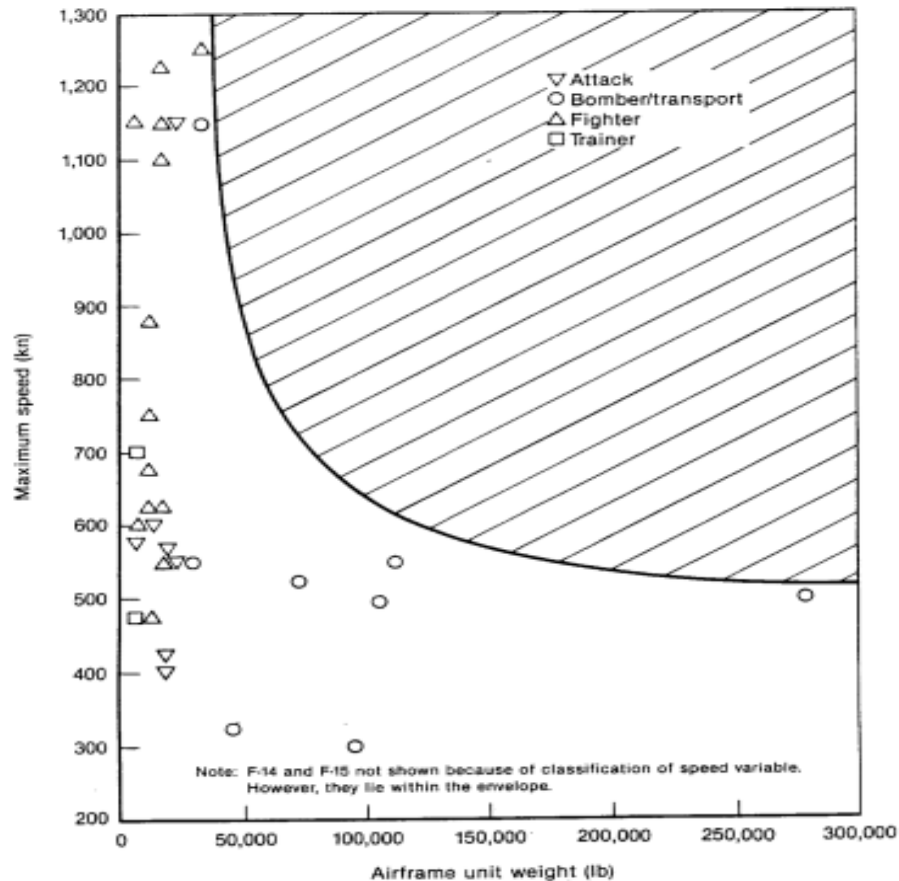
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Cost Model: Personnel

1. ***Single-factor model:** Apply a simple per person cost
2. **Multi-factor model:** Create a detailed model with personnel costs from job postings, articles, and blogs

Case Study: Fighter Aircraft

Fundamentals Still Hold



Example: Aircraft Speed-Weight Relationship
 Comparison of 1987 RAND Study (Left) vs. Modern Data (Right)

Sample Single Characteristic Model

- **F-15A/B/C/D**
 - MTOW: 31,700 lbs
 - APUC: US \$65.6m (2018 dollars)
 - Annual O&M: \$15.1m (2018 dollars)
 - Directly Associated Personnel: 100
- **J-11D Fighter**
 - MTOW: 25,300 lbs
 - APUC: $25300/31700 \times 65.6 = \text{US } \52.4m
 - O&M: $25300/31700 \times 15.1 = \text{US } \12m
 - Personnel: $100 \times 0.021 = \text{US } 2.1\text{m}$
- **Example SCT Option:**

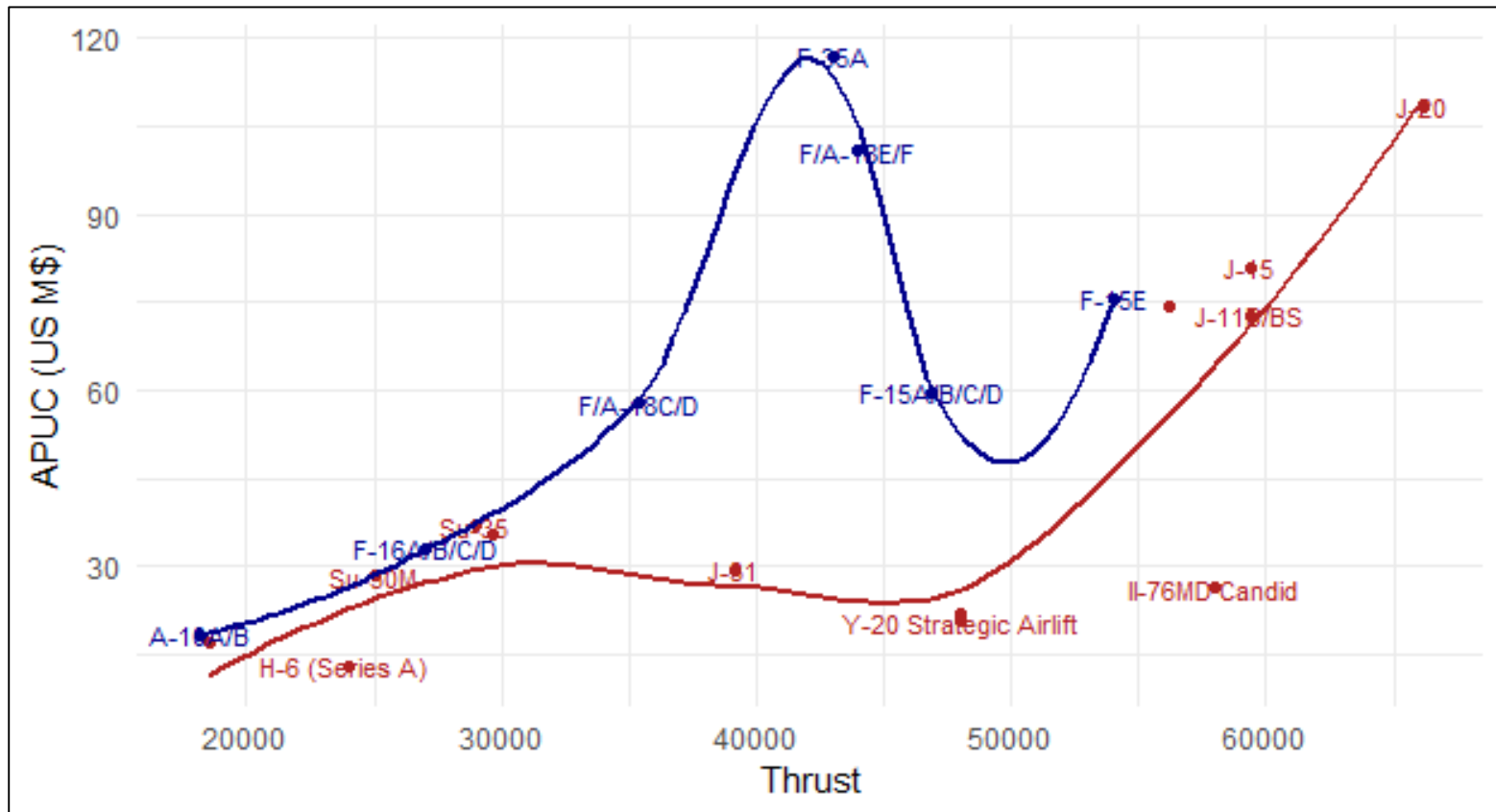


Platform	Planned Buy	User Selection	APUC	O&M Cost	Personnel Cost	Move 1 Cost	Move 2 Cost
J-11D - Increase Buy	42	8	52.4	12.0	2.1	701	564

- Assuming Move 1 planned buy of 42 platforms, max selection # = 42

Model Approach: Supervised Learning CSBA Center for Strategic and Budgetary Assessments

- Sample parametric model developed from U.S. fighter aircraft (Blue) and applied to current/future Chinese aircraft (Red)
- Model generates a cost estimate in U.S. dollars for a hypothetical identical aircraft produced in the U.S.



- This is a **Hard Problem**, but worth the effort!
- No single approach is likely to yield a definitive ‘answer’
 - Many approaches in concert will help discern the feasible regions
 - Chinese themselves likely don’t know the costs of these platforms
- Next steps:
 - With more U.S./Allied data, may attempt Recursive Partitioning, Neural Nets, or other ‘Machine Learning’ approaches
 - Create platform cost and production estimates for all domains
 - Organize workshop and invite experts to author papers on key questions

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Thank you!

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