



Processes of Weapon Systems Innovation

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International Cost Estimating and Analysis Association (ICEAA)

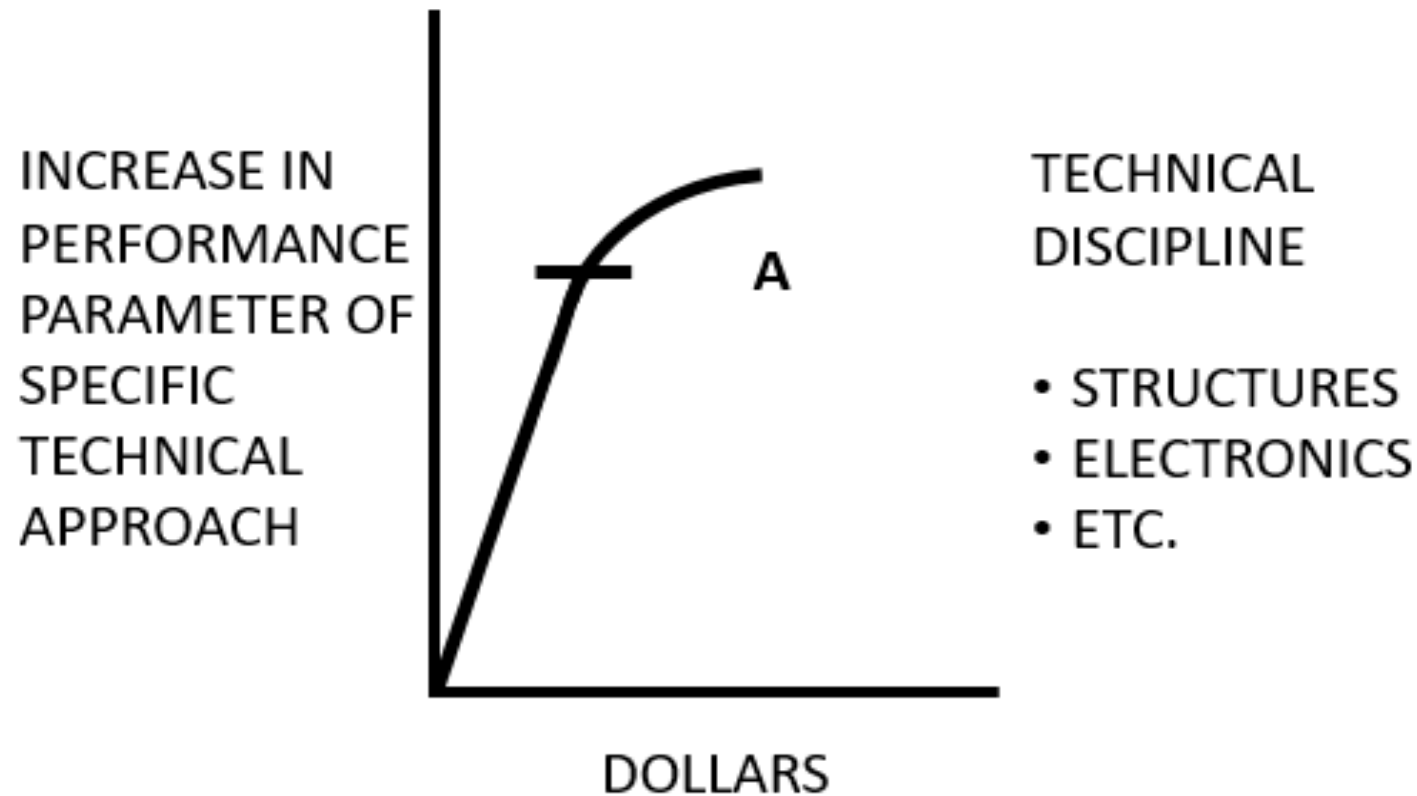
June 2018

Overview

- Background
- Alternative paradigms
 - Systems approach, incrementalism, and evolutionary
- Impact of Acquisition Processes
 - Layering of budget approvals
 - Regulations of contract vehicles
 - Case study: lightweight fighter
- International comparisons
 - Soviet Union
 - France, Sweden, Great Britain
- Cost analysis in the 21st century
 - Impact of AT&L reorganization

Technological Plateau

DIMINISHING RETURNS ON USING EXISTING TECHNOLOGY



Reproduced figure from the 1972 Commission on Government Procurement (COGP) Report, depicting the leveling-off of performance gains as more dollars are expended on a specific technology. The figure suggests the importance of discovering new technologies, the only source of progress in the long-run.

Defense Innovation Process

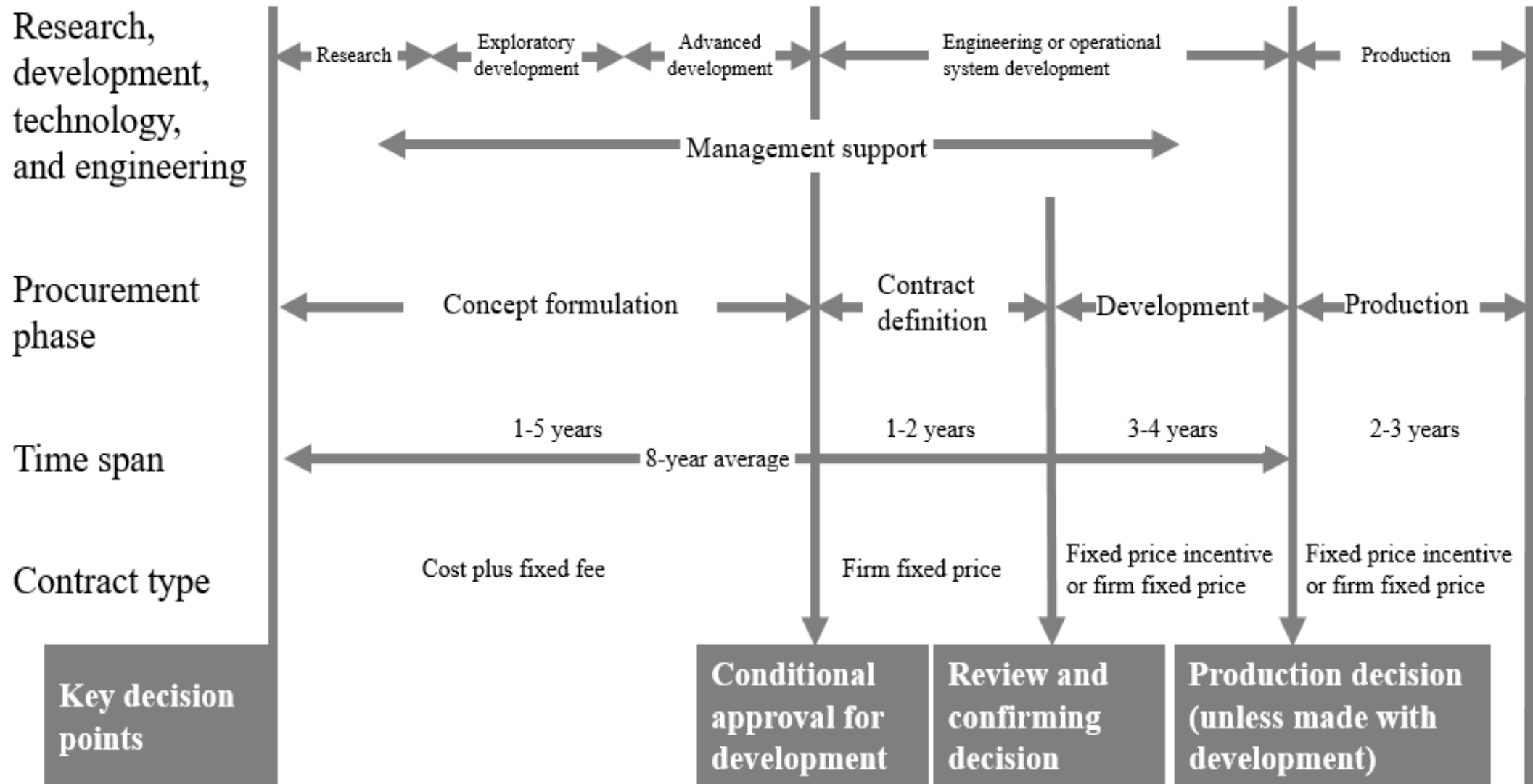
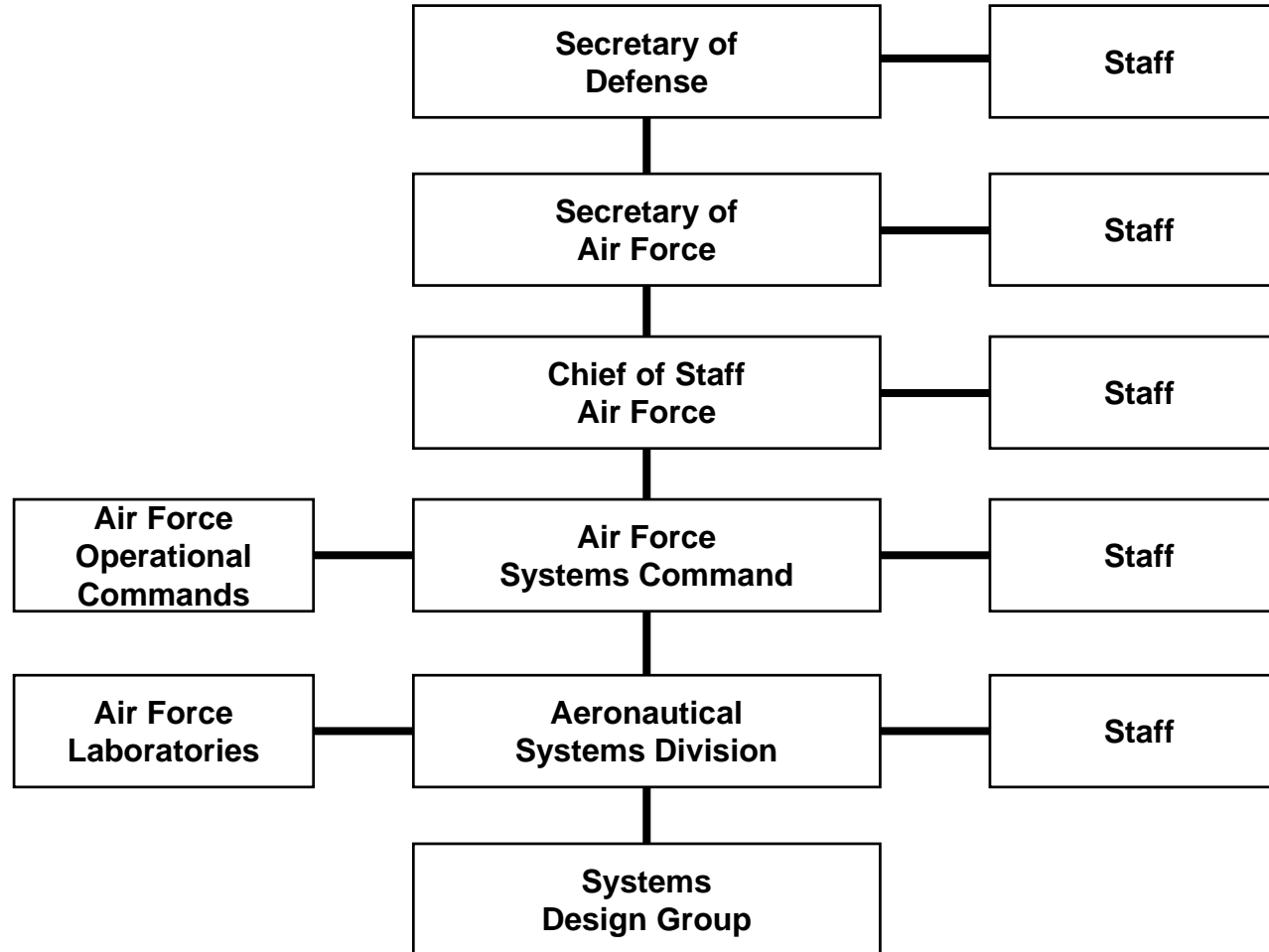


Figure depicting the DODI 3200.6 R&D cycle, dated June 7, 1962. The McNamara innovation process was largely retained by Laird and Packard. Reproduced from Martin Meyerson's 1967 article, "Price of Admission into the Defense Business."

Budget Approval Process: Air Force

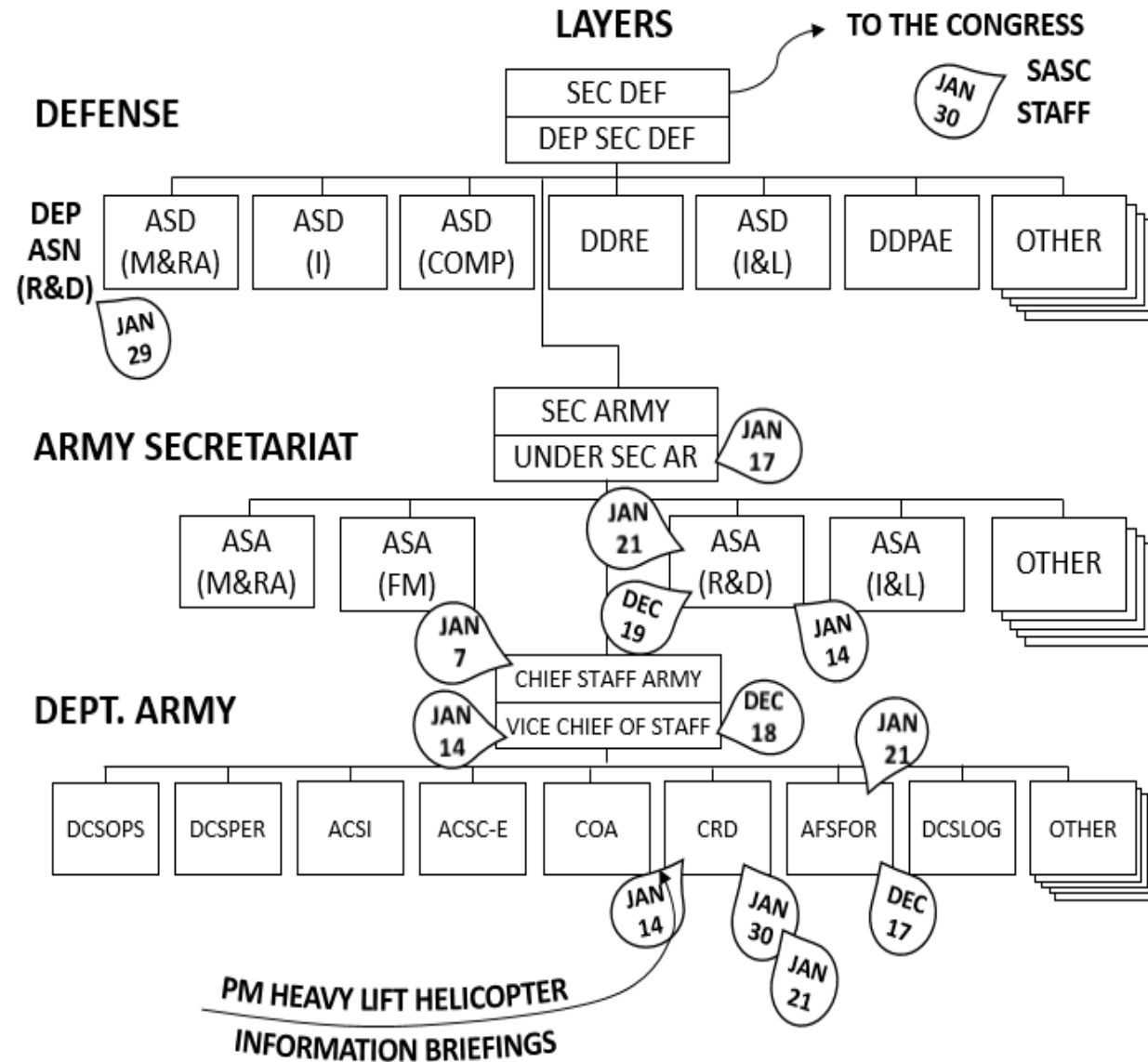
Location of the Systems Design Group (Air Force)



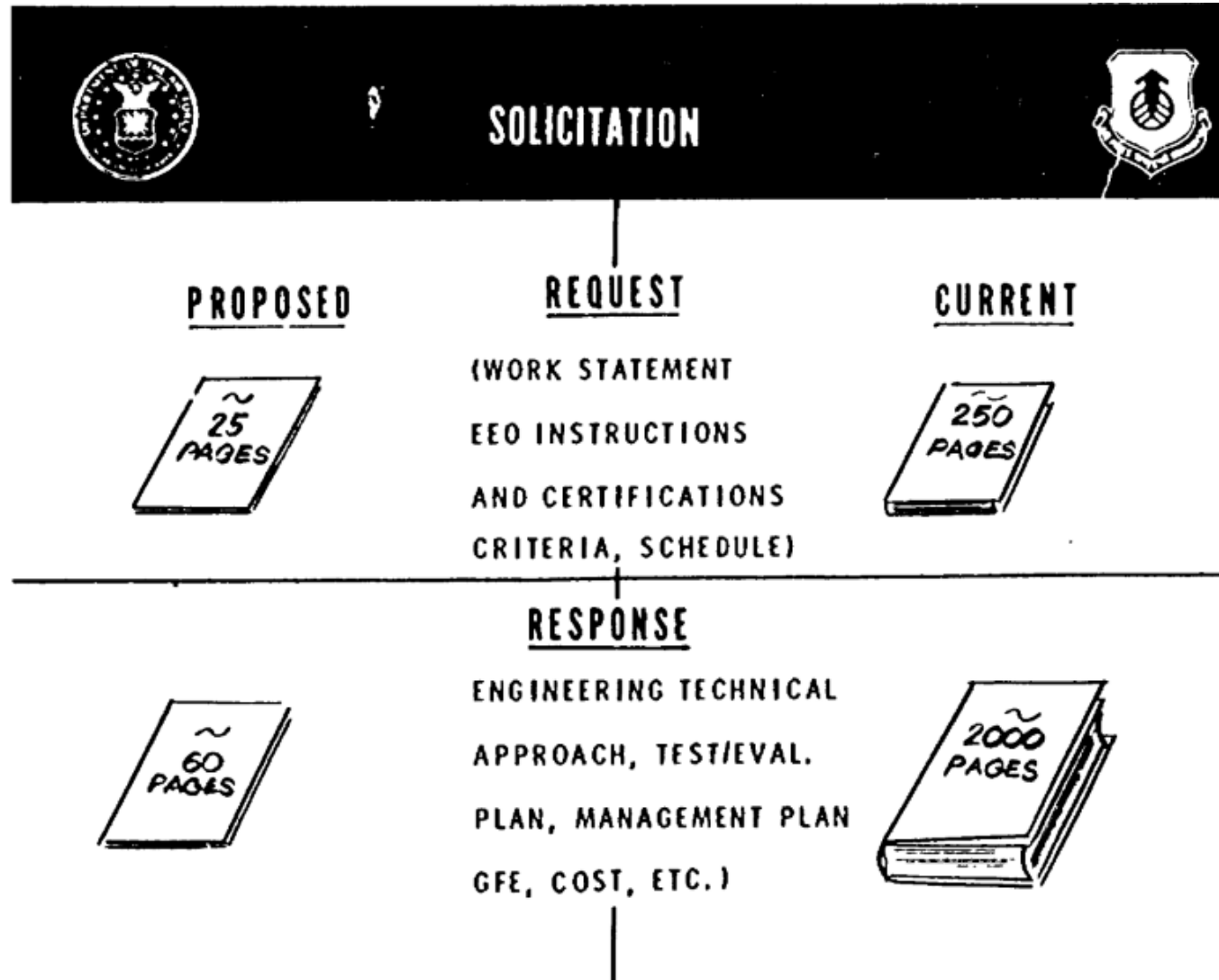
Reproduced figure.

*Source: Commission Studies Program.
Similar illustrations could be made for
the Army and Navy.*

Budget Approval Process: Army



Contract Approval Process

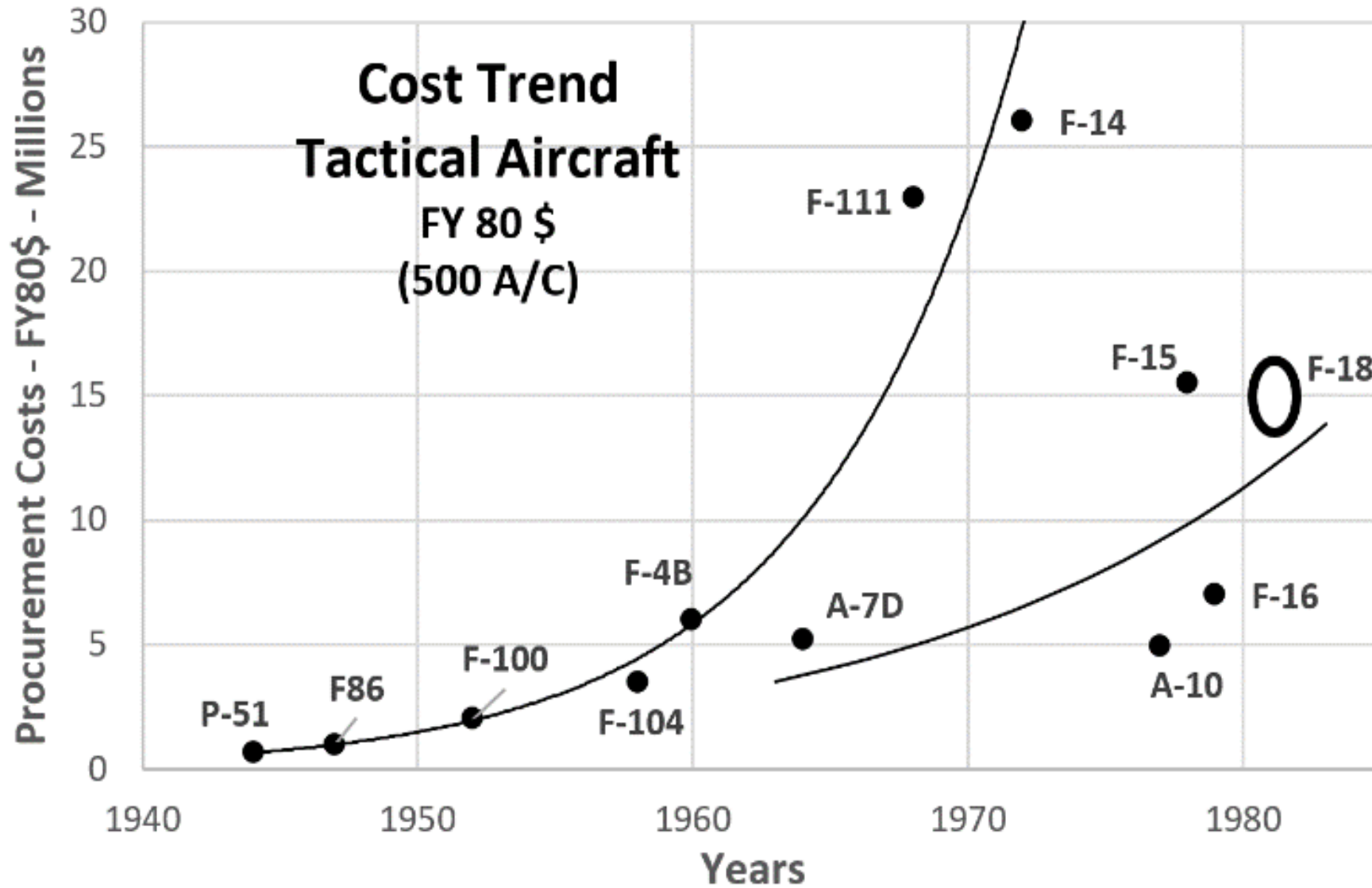


Case Study: Lightweight Fighter



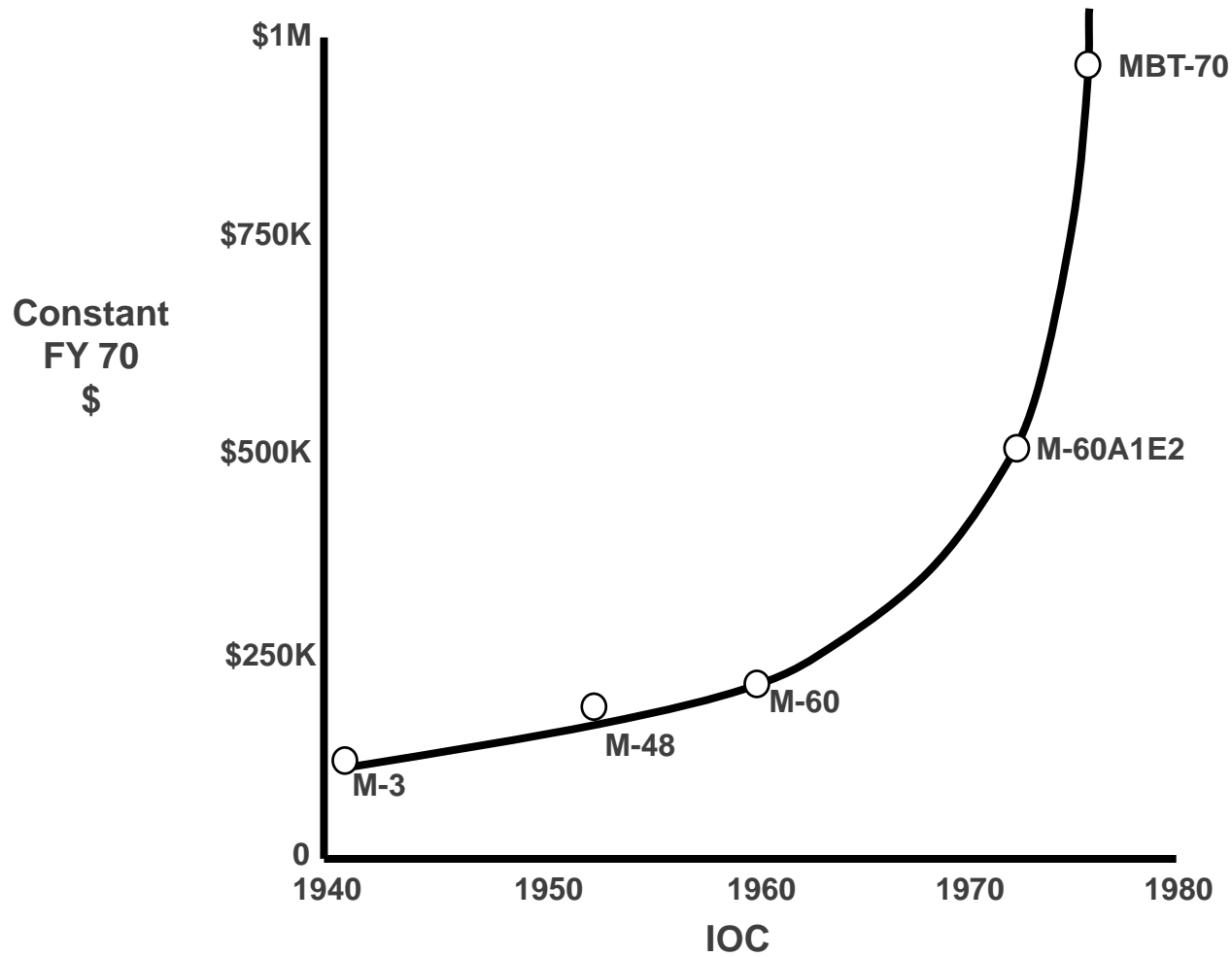
General Dynamics' YF-16 (bottom) and Northrop's YF-17 (top).

Cost Trends - Aircraft



Aircraft cost trend presented by Charles ("Chuck") Myers to the Congress in 1979. The unit costs have the effects of inflation removed relative to 1980, and were further adjusted to a total procurement quantity of 500 aircraft. Note the F-18 has a larger circle to represent uncertainty in its costs, still years out from Initial Operational Capability (IOC). Reproduced figure.

Cost Trends - Tanks



Reproduced Figure. "Weapon Systems Acquisition Process." Hearings before the Committee on Armed Services U.S. Senate, First Session, Dec. 3, 6, 7, 8, and 9, 1971.

Soviet Aircraft Organization (1970)

AVIATION RESEARCH AND DESIGN ORGANIZATIONS OF THE MINISTRY OF AVIATION INDUSTRY

Research Institutes

Central Aerohydrodynamics Institute (TsAGI)
Central Institute of Aviation Motor Building (TsIAM)
All Union Institute of Aviation Materials (VIAM)
Scientific Research Institute for Aviation Technology and Organization
of Production (NIAT)
Scientific Research Institute for Aviation Equipment (NISO)
Flight Research Institute (LII)

Design Bureau Heads and Chief Designers Active Since 1950

Airframe Design Bureaus

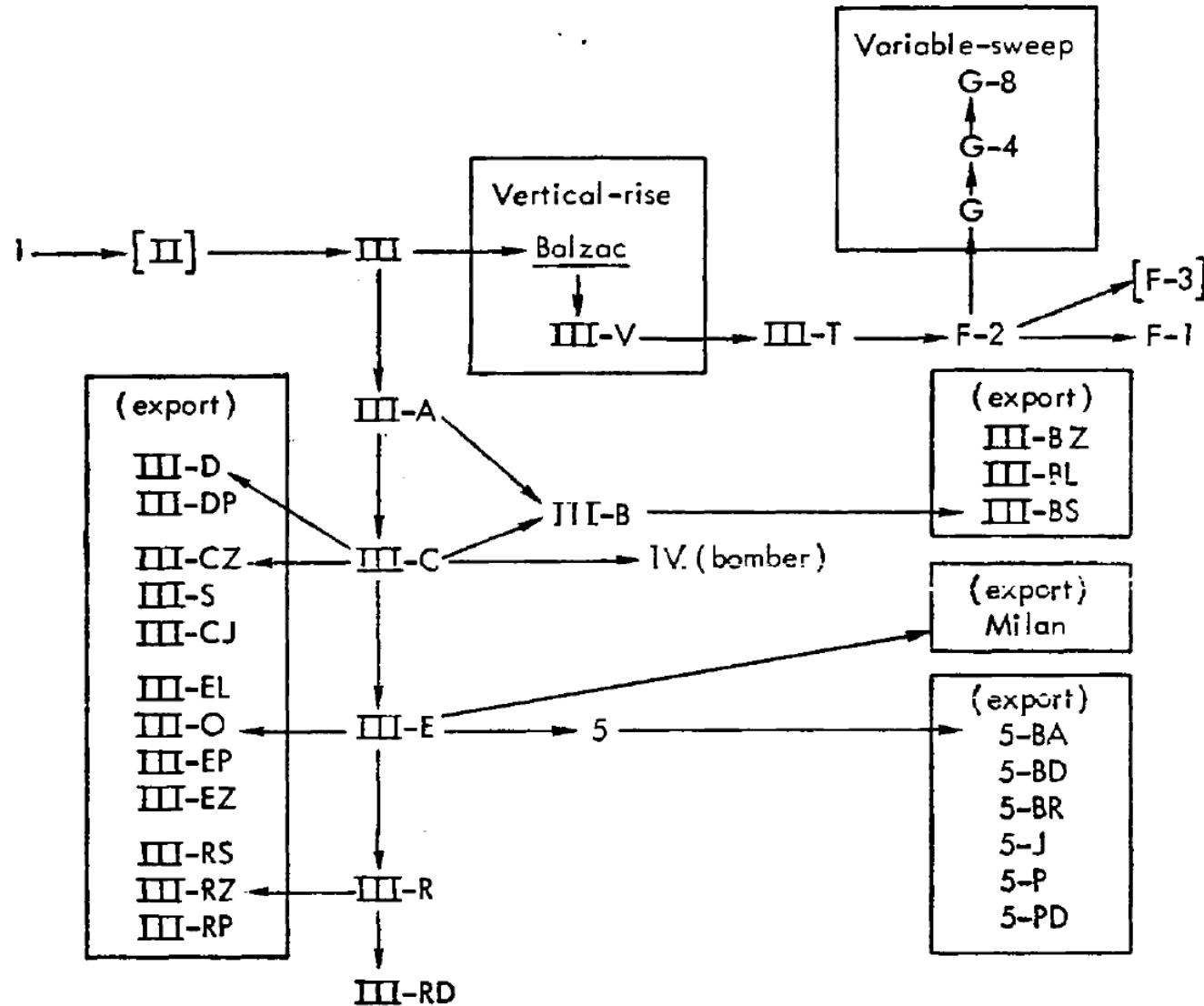
O. K. Antonov
A. A. Arkhangel'skii
G. M. Beriyev
M. I. Gurevich
N. K. Kamov
S. A. Lavochkin (dec. 1960)
A. I. Mikoyan
M. L. Mil (dec. 1970)
V. M. Myashishchev
P. O. Sukhoi
A. N. Tupolev
A. S. Yakovlev

Engine Design Bureaus

M. M. Bondaryuk
Glushenkov
A. G. Ivchenko
S. P. Izotov
V. Ya. Klimov (dec. 1962)
S. A. Kosberg (dec. 1965)
N. D. Kuznetsov
A. M. Lyulka
A. A. Mikulin
A. D. Shvetsov (dec. 1953)
P. A. Solovyev
S. K. Tumanski
I. M. Vedeneev

*"R&D in Soviet Aviation." Arthur J. Alexander,
RAND Corp., R-589-PR, Nov. 1970.*

Diversity of Dassault Aircraft (1954 - 1973)



(24 variants, 41 individual models, based on 19 prototypes, including 2 prototypes not completed)

Bracketed models were not completed as originally laid down, but were subsequently used in test programs of one sort or another

"A Dassault Dossier: Aircraft Acquisition in France." Robert Perry, RAND Corp., R-11148-PR, Sep. 1973.

Cost Analysis in 21st Century

- Current cost reporting and analysis joins R&D and Production, treats sustainment as separate
- 2017 National Defense Authorization Act
 - AT&L split into USD (Research & Engineering) and USD (Acquisition & Sustainment)
 - Cost management framework coordinated by Chief Management Office (CMO)
- Potential future cost data requirements
 - Acquisition & Sustainment largely entail known processes and existing systems specification
 - Consistent data categorization from production through sustainment
 - Statistical analyses and new “big data” techniques can produce actionable insights
 - Research & Engineering a journey into the unknown
 - Past data is largely irrelevant as a guide to future action