



INSTITUTE FOR DEFENSE ANALYSES

**There is Cost Growth and then there is
Cost Growth; Do They Have the Same
Causes? (Conference Presentation)**

David L. McNicol

April 2020

Approved for public release;
distribution is unlimited.

IDA Document NS D-13164

Log: H 20-000142



The Institute for Defense Analyses is a nonprofit corporation that operates three Federally Funded Research and Development Centers. Its mission is to answer the most challenging U.S. security and science policy questions with objective analysis, leveraging extraordinary scientific, technical, and analytic expertise.

About This Publication

The views, opinions, and findings should not be construed as representing the official position of either the Department of Defense or the sponsoring organization.

Acknowledgments

Thank you to Gregory A. Davis for performing technical review of this document.

For More Information

David L. McNicol, Lead Author
dmcnicol@ida.org, (703) 575-4668

David E. Hunter, Director, CARD
dhunter@ida.org, (703) 575-4686

Copyright Notice

© 2020 Institute for Defense Analyses

4850 Mark Center Drive, Alexandria, Virginia 22311-1882 • (703) 845-2000

This material may be reproduced by or for the U.S. Government pursuant to the copyright license under the clause at DFARS 252.227-7013 (Feb. 2014).

INSTITUTE FOR DEFENSE ANALYSES

IDA Document NS D-13164

**There is Cost Growth and then there is *Cost Growth*; Do They Have the Same Causes?
(Conference Presentation)**

David L. McNicol

Executive Summary

Introduction

The working title of this briefing initially was: “There is Cost Growth and there is Cost Growth and the Two are Not the Same.” This title plays off the widespread, tacit assumption that cost growth is a single malady that reflects a common cause or related set of causes. It insinuates, to the contrary, that different magnitudes of cost growth have different causes. At a minimum, the point was that the causes of very high cost growth differ from the causes of low to moderate cost growth.

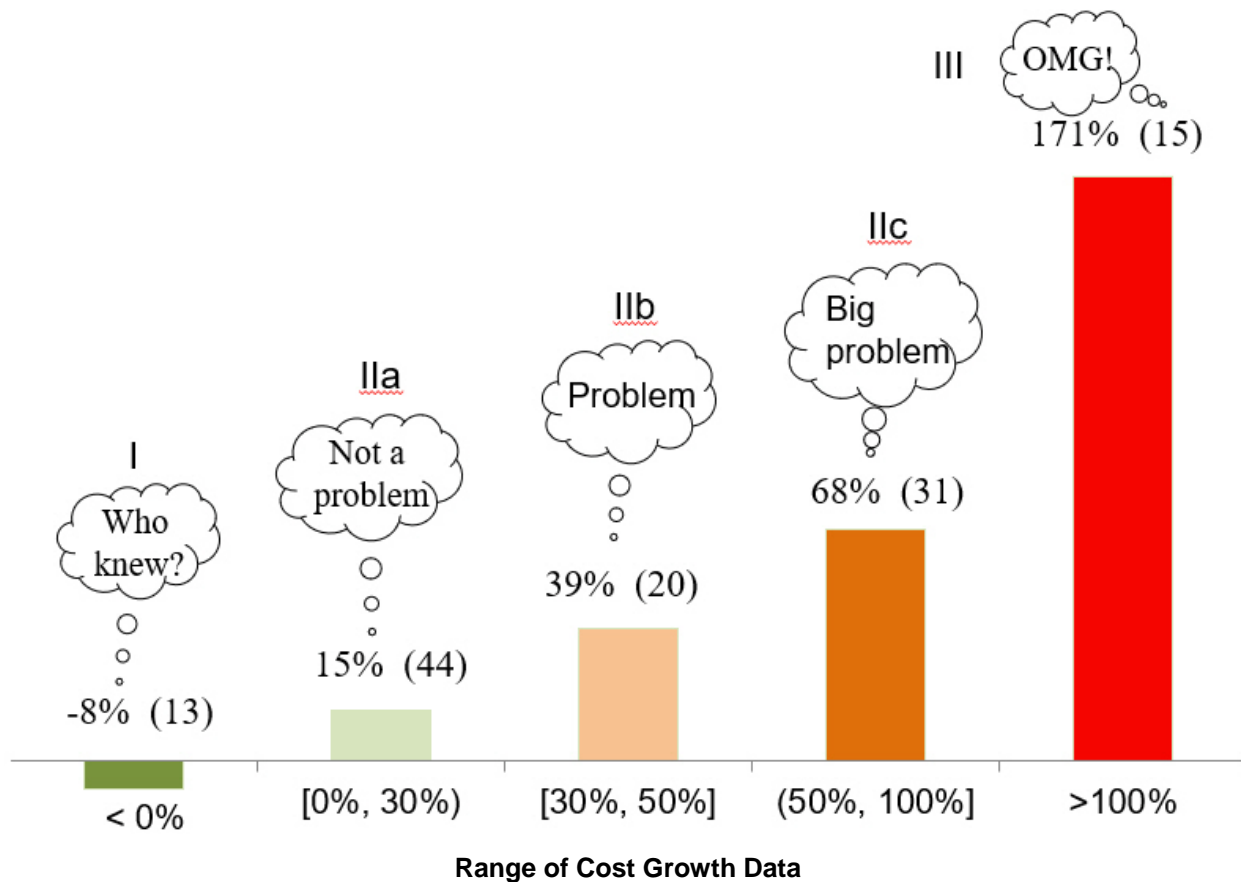
It quickly became clear that this assertion largely was an intuition that could not be adequately supported with the available evidence or, in fact, anything short of a large study. Consequently, the title changed from an assertion to its current form: a question. The briefing finally evolved into a one-question, open-book, self-graded, take home examination on the causes of cost growth. The exam was first administered (by himself) to the author; it is now offered for others to try. The test has no prerequisites and makes no assumptions about how much of the relevant literature the test taker has read. In fact, the exam may work better as a test of the conventional wisdom on cost growth than it does of statistical analyses and case studies of cost growth.

The Exam

The chart on the following page sets the exam question. The cost growth data for 123 Major Defense Acquisition Programs (MDAPs) are grouped into three main categories:

- Category I: MDAPs with negative cost growth—that is, which, when the acquisition was completed, cost less per unit than had been projected at Milestone (MS) B.
- Category II: MDAPs that had cost growth between zero and 100 percent. This category is divided into three sub-categories:
 - a. Cost growth of less than 30 percent.
 - b. Cost growth between 30 percent and 50 percent.
 - c. Cost growth of more than 50 percent but no more than 100 percent.
- Category III: Cost growth of more than 100 percent.

The question is: Do we have a theory of cost growth that can, without contortions or ad hoc assumptions, explain the full range of cost growth that we observe, from the negative to the extremely large?



Note: The data in this figure are for 123 MDAPs that passed Milestone (MS) B during the bust funding climates Fiscal Year (FY) 1965–FY1980 and FY 1987–FY 2002. In these climates, competition among MDAPs for funding was particularly intense. Programs that passed MS B in boom climates are set aside initially. The measure of cost used is Program Acquisition Unit Cost (PAUC) in program base year dollars. Cost growth is the ratio of actual PAUC observed at the end of the acquisition cycle adjusted to the MS B baseline quantity procured divided by MS B PAUC.

2014 Congressional Staff Report¹

In 2014, the Senate Committee on Homeland Security and Governmental Affairs published a staff report on acquisition reform, which presented the views of 31 experts. The staff summary largely attributed cost growth in MDAPs to the culture of acquisition organizations and misaligned incentives. This explanation fails on its face because you cannot explain variation with factors that remain constant.

¹ Permanent Subcommittee on Investigations of the Senate Committee on Homeland Security and Governmental Affairs, *Defense Acquisition Reform: Where Do We go From Here?*, S. Prt. No. 113-28 (2014) (Staff Report).

Lorell et al., RAND 2017²

Lorell et al. differs from other sets of case studies in that it is a comparative examination of both programs with extremely high (six) and very low (four) cost growth. It finds that extremely high cost growth programs each possessed all or most all of five characteristics. These were found to be entirely absent in two of the low cost growth programs, and the remaining two programs possessed, respectively, one and two of the five factors that cause extremely high cost growth. So, to the extent that Lorell et al. is accepted, we know what causes very high cost growth (Category III) and we know that those causes are largely absent in lower cost growth programs (Category I and the lower end of IIa).

Lorell et al. has some technical limitations, i.e., a small sample size and that only Air Force programs, drawn from a fairly narrow time window, are considered. Laying these aside, and recognizing the excellence of the work, its crucial shortcoming is that it does not provide an explanation of the full range of cost growth we see in Category II. There are 95 programs in Category II—the bulk of the sample used here—and even if all of Category IIa is dropped out, the cost growth of the remaining 51 programs ranges from 30 percent to 100 percent. These programs are the dandelions of cost growth—not the most noxious of weeds but the most common.

Conjectures Motivated by Lorell et al.

No published study has tried to explain the differences in the magnitudes of cost growth across Category II programs. In fact, the topic has barely even been noticed.

The most plausible way forward on this problem is to make a guess about the explanation and then, to the extent possible, test it against the data. The three possibilities noted in the briefing all concern Errors of Inception, that is, unrealistic elements in the MS B baseline.

1. One possibility is suggested immediately by what Lorell et al. found—that high cost growth programs each had all or most of a particular set of flaws in the MS B program or process and that low cost growth systems had few or none. The suggestion is that what explains the differences is the number of unrealistic elements in the MS B baseline or flaws in the MS B process.
2. The crucial cause of cost growth variation may be instead the magnitude of the unrealistic elements in the MS B baseline—the doses of the poisons, not the number. For example, the MS B cost and schedule estimates vary widely in the degree to which they proved to be unrealistic.
3. The extent of cost growth may be determined by toxic combinations of unrealistic MS B elements, e.g., immaturity of some critical technologies that appear early on the critical path and an unrealistic EMD schedule.

² Mark Lorell et al., “Program Characteristics That Contribute to Cost Growth,” RR-1761 (Santa Monica, CA: The RAND Corporation, 2017). (Referred to hereafter as Lorell et al.)

Note that the third of these has a particular implication for how acquisition oversight should be framed. The first two point to the importance of review of the particular elements of the program proposed as MS B—the cost estimate, schedule, acquisition strategy, and the systems engineering plan, among other. In contrast, the third points to the importance of the part of the process—the Overarching Integrated Product Team—that looks across elements of the MS B proposal.

The first of the three hypotheses can be tested easily, albeit crudely, and seems not to be true. The other two also could be tested, but doing so would require a great deal of work.

Did We Pass?

The author's grading is as follows:

- A great deal of effort has gone into Category III over the years. We probably understand the causes of extremely high cost growth reasonably well. Grade: 25 points
- Lorell et al. gives us a start on MDAPs with negative cost growth and it is easy to find additional factors involved. Grade: 15 points
- On Category II programs as a whole, we know one possible explanation that seems not to be true; apart from that, we have only conjectures. Grade: 10 points

This gives us a total 50 points out of 100. We do not pass.

On a more serious plane, the literature has progressed to the point that deficiencies in understanding of Categories I and III largely could be remedied by careful and judicious reading and synthesis. The same cannot be said of Category II, which is the largest group and arguably the one most relevant to acquisition policy. There appear to be real substantive gaps in our understanding of Category II cost growth.

Concluding Opinion

The suggestion offered in conclusion rests on two points:

1. Further frontal assaults on the proximate causes of cost growth are unlikely to gain much increased knowledge—they require too much effort and there is no accepted framework within which the results of different studies can be accumulated.
2. Over the past several years a substantial body of evidence has accumulated indicating that the root causes of cost growth are imbalances that persist for several years between funding and factors like force structure, missions, and equipment age profiles that determine the demand for funding. Moreover, it seems likely that highly optimistic MS B baselines often receive tacit acceptance by senior DoD officials.

Taken together, these two points suggest that the analytical community shift its attention to the sorts of issues suggested by a root cause approach:

- In exactly what ways do the Service's incentives on MDAPs characteristically differ from those of senior OSD leadership?
- Is the way OSD MS B reviews were structured during the 1970–2017 period efficient and effective? What are plausible alternatives?
- Should we explore ways in which incremental funding could be used safely in certain circumstances?

**There is Cost Growth and then there is
Cost Growth; Do They Have the Same
Causes?**

**Presentation to the 17th Annual
Naval Postgraduate School
Acquisition Research Symposium**

May 14, 2020

**David L. McNicol
Adjunct Research Staff Member
Institute for Defense Analyses**

Original Title

There is Cost Growth and then there is *Cost Growth*
and the Two are Not the Same

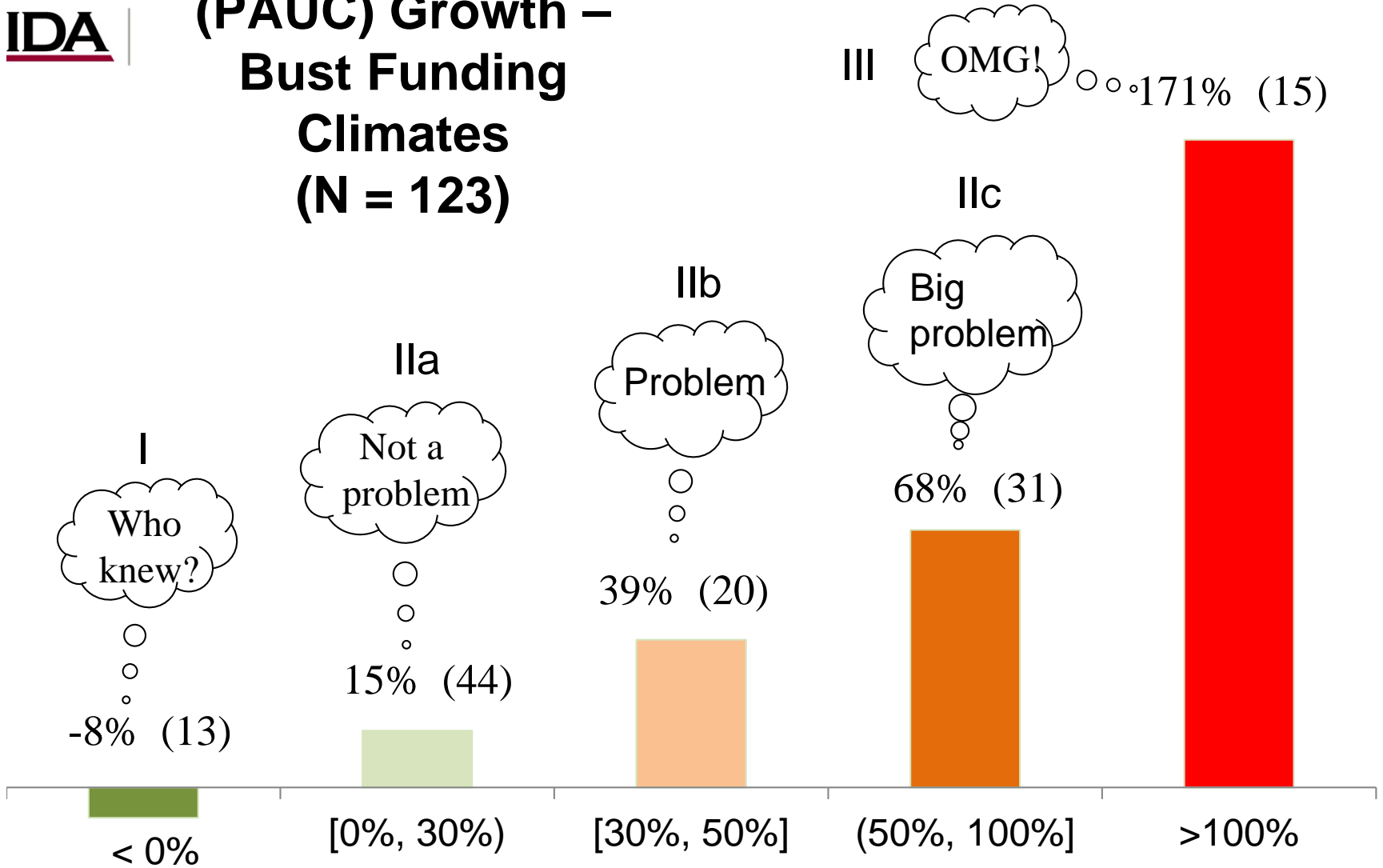
After thrashing on the topic for a few weeks I concluded:

1. I did not have a story that would hold water; and
2. Getting one would be a lot of work.

New Title

There is Cost Growth and then there is *Cost Growth*;
Do They Have the Same Causes?

(PAUC) Growth – Bust Funding Climates (N = 123)



These data provide a test for our understanding of the causes of cost growth.

A non-answer – Congressional Staff Report from 2014

Two main causes of cost growth:

- Organizational culture
- Misaligned incentives

Observation

These cannot by their nature explain the range of cost growth observed. Factors that remain constant cannot explain variation.

113th Congress 2nd Session	COMMITTEE PRINT	S. PRt. 113-28
-------------------------------	-----------------	-------------------


**DEFENSE ACQUISITION REFORM:
WHERE DO WE GO FROM HERE?
A Compendium of Views by Leading Experts**

STAFF REPORT

PREPARED BY THE
PERMANENT SUBCOMMITTEE ON
INVESTIGATIONS
OF THE
COMMITTEE ON HOMELAND SECURITY
AND GOVERNMENTAL AFFAIRS
UNITED STATES SENATE
ONE HUNDRED THIRTEENTH CONGRESS
SECOND SESSION
OCTOBER 2, 2014

Available via the World Wide Web: <http://www.fdsys.gov>

Printed for the use of the
Committee on Homeland Security and Governmental Affairs



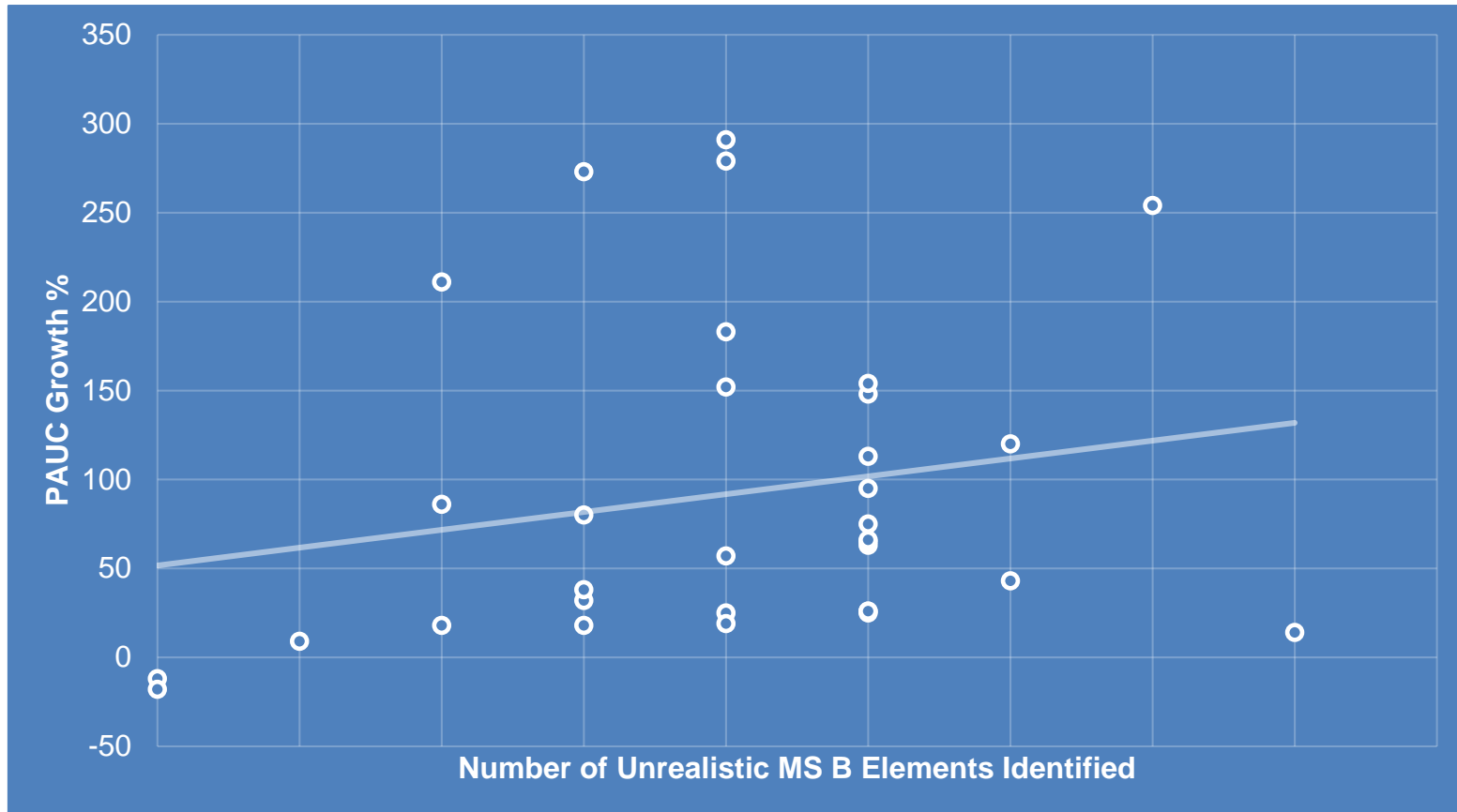
U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 2014

90-719 PDF

- The following features were characteristic of six Air Force programs from 1998 to 2002 with extremely high PAUC growth:
 - Immature technology; integration complexity
 - Unclear, unstable, or unrealistic requirements
 - Problematic contract type or program structure
 - Granted Milestone (MS) C authority along with MS B
 - Unrealistic cost estimates
- These characteristics were entirely absent in two of four programs from the same period with low PAUC growth.
- This excellent study does not:
 - Examine the causes of negative cost growth; or
 - Directly tell us anything about the 95 programs in Category II, with PAUC growth between zero and 100 percent.

- Category II cost growth is governed by the number of poisons administered; i.e., the number of unrealistic elements in the MS B baseline.
- This is testable and appears not to be the case.

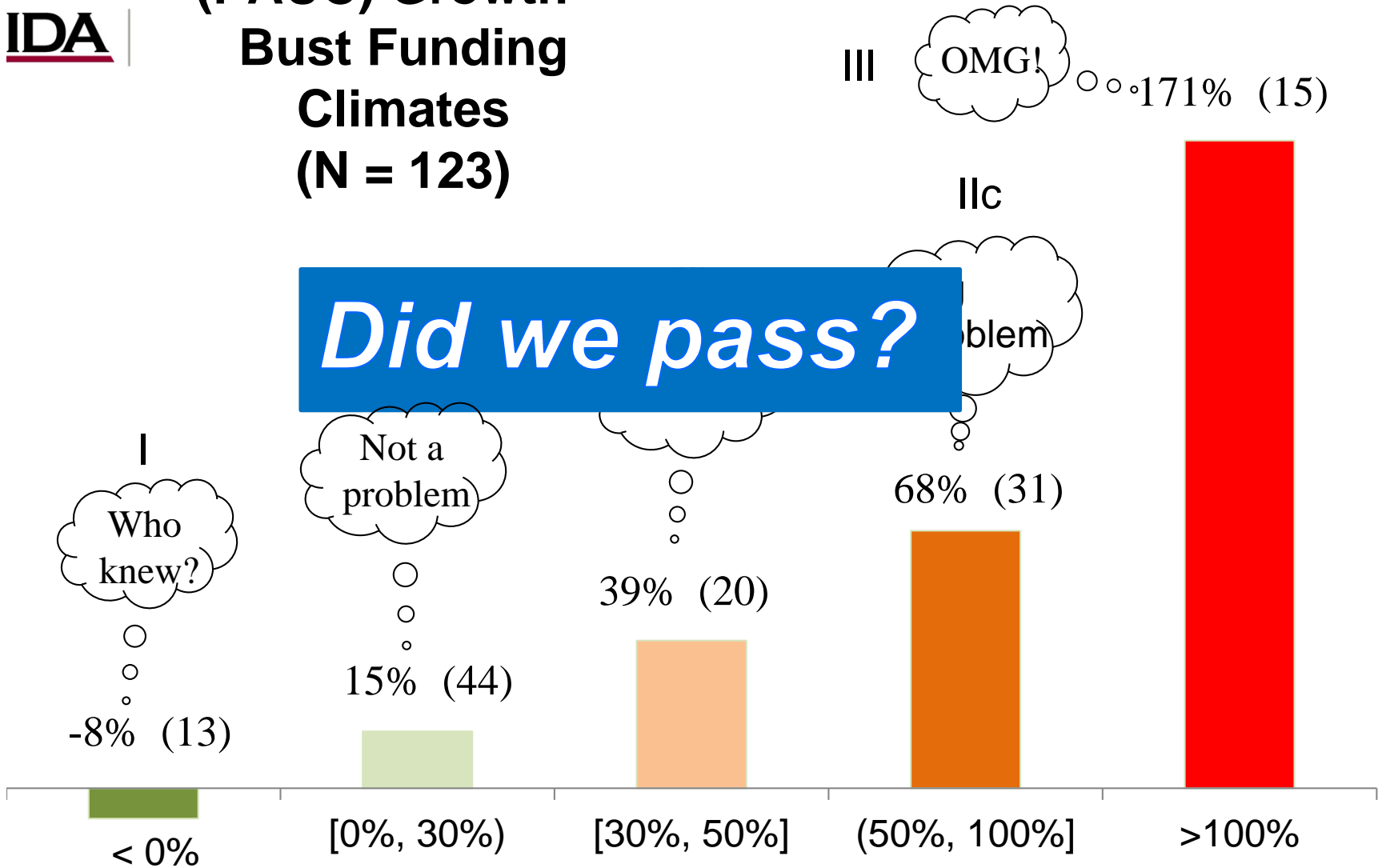
The Evidence From Three Studies



The association of PAUC growth with the number of issues found is small and statistically insignificant.

- It could be that the magnitude of cost growth in Category II varies with the magnitude of the doses of poisons administered; e.g., the degree to which cost estimates are unrealistic varies widely.
- Another possibility is that higher cost growth results from particularly toxic combinations of unrealistic MS B elements, e.g., immaturity of some critical technologies that appear early on the critical path and an unrealistic EMD schedule.
- Note that:
 - These two have not been tested and doing so would be very difficult.
 - They have different implications for acquisition policy and practice.

(PAUC) Growth – Bust Funding Climates (N = 123)



These data provide a test for our understanding of the causes of cost growth.

Concluding Opinion – How the analytical community approaches acquisition policy should be rethought

- This opinion rests on two points:
 - Studies of proximate causes are expensive to do and are unlikely to provide a breakthrough.
 - Acquisition policy and process can usefully be approached via root causes.*
- The following sorts of issues arise in a root causes approach:
 - In exactly what ways do the Service's incentives on MDAPs characteristically differ from those of senior OSD leadership?
 - Is the way OSD MS B reviews were structured from 1970 to 2017 efficient and effective? What are plausible alternatives?
 - Should we explore ways in which incremental funding could be used safely in certain circumstances?

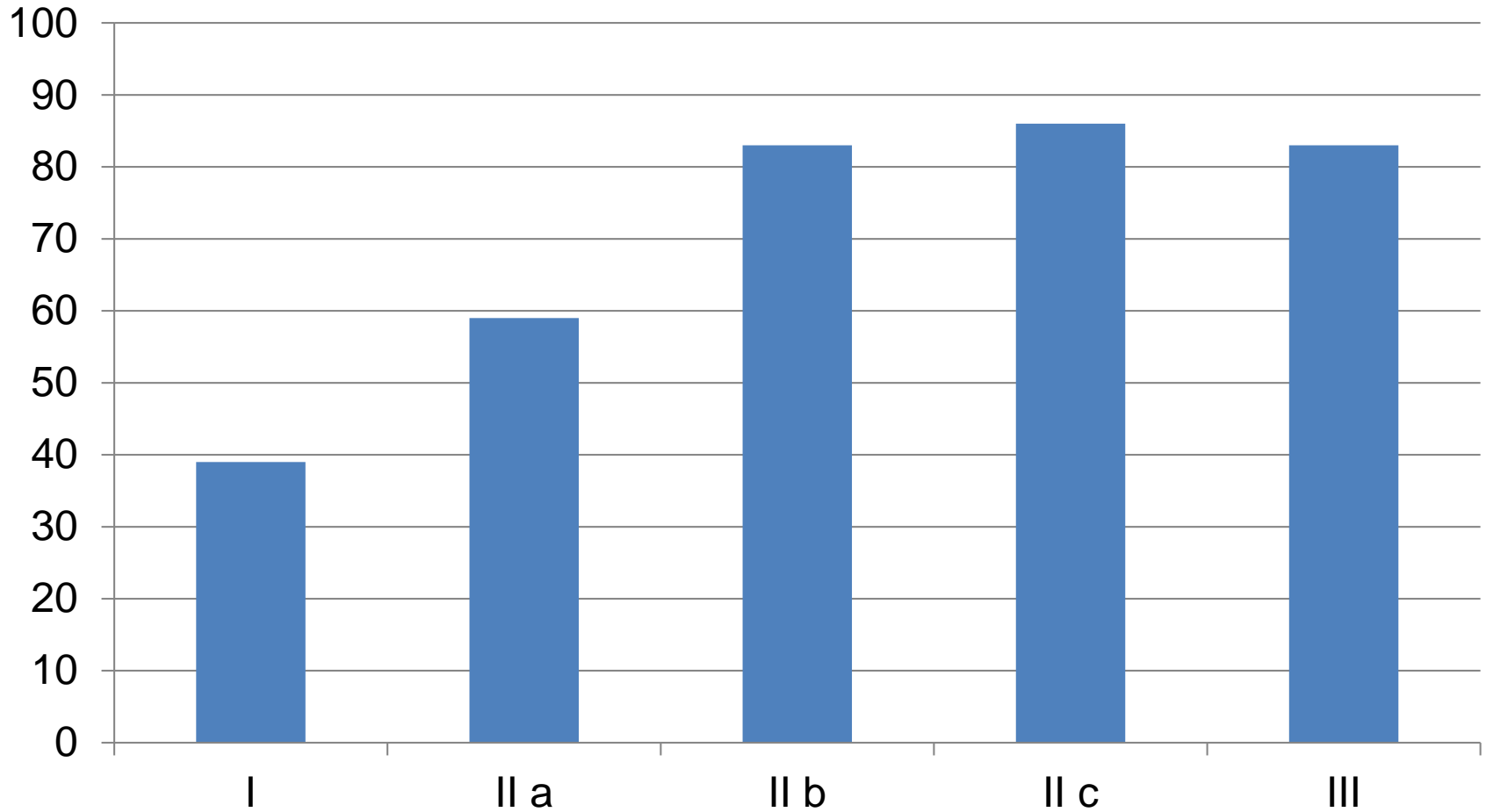
* The root causes of cost growth are imbalances that persist for several years between funding and factors like force structure, missions, and equipment age profiles that determine the demand for funding. Moreover, it seems likely that highly optimistic MS B baselines often receive tacit acceptance by senior DoD officials. See D. L. McNicol, *Acquisition Policy, Cost Growth, and Cancellations of Major Defense Acquisition Programs*, IDA Report R-8396, 2018.

Backup

- There was some history associated with the 2014 Staff Report.
- In 2005, the late Senator John McCain held a hearing concerned with cost growth. At the time, he said that he wanted somebody to explain to him the causes of cost growth. The three witnesses were John Hamre, President of CSIS; IDA's Gene Porter; and the late Gary Christle of CNA. Reduced to quips: Hamre pointed to competition among programs for funding; Porter largely blamed unrealistic baselines at MS B; and Christle said that all MDAPs experienced cost growth and that the causes were systemic.
- In 2009, the Congress passed the Weapon Systems Acquisition Reform Act (WSARA).
- In 2014, Sen. McCain was at least one of the main people in the Senate calling for the staff report.
- In the National Defense Authorization Acts for FY 2016 and FY 2017, the Congress more or less removed OSD from the business of overseeing MDAPs after MS A.

- Three published studies provide proximate cause analyses for several MDAPs. In chronological order, these are:
 1. Gene H. Porter et al. “The Major Causes of Cost Growth in Defense Acquisition, Volume I: Executive Summary.” IDA Paper P-4531. Alexandria, VA: Institute for Defense Analyses, December 2009.
 2. Richard Diehl et al. “Root Causes of Nunn-McCurdy Breaches—A Survey of PARCA Root Causes Analyses, 2010–2011: Interim Report.” IDA Paper P-4911. Alexandria, VA: Institute for Defense Analyses, August 2012.
 3. Mark A. Lorell et al. “Program Characteristics That Contribute to Cost Growth.” RR-1761. Santa Monica, CA: The RAND Corporation, 2017.
- Each of these uses PAUC growth computed in program base year dollars and adopts a generally similar approach, but they do not use the same taxonomy of proximate causes of PAUC growth.

Percent of Category that Passed MS B in a Bust Climate



**Table 16 from D. L. McNicol, *Acquisition Policy*,
IDA Report R-8396, Sept. 2018, p. 38**

	Coefficients	p-value
Intercept	73.1%***	< 0.001
Funding Climate		
Climate	-28.7%***	0.009
T _{boom}	3.8%/yr***	0.021
T _{bust}	0.59%/yr	0.515
Acquisition Policy		
DSARC	-56.7%***	< 0.001
P-C DSARC	-50.3%***	0.001
DAB	-59.5%***	< 0.001
AR	-80.2%***	< 0.001

*** Statistically significant at less than the 1 percent level.

R-Squared = 0.26, F = 7.02 (P < 0.001), N= 149. Estimated using OLS. Bust2 programs and the three mid-1980s MDAPs acquired using TPP-like contracts omitted. Wald's test for the equality of the estimated coefficients of the categorical variables for acquisition policy periods with the Bonferroni correction yields F= 1.43, p = 0.0.946.

**Table 3 from D. L. McNicol, *Acquisition Policy*,
IDA Report R-8396, Sept. 2018, p. 13**

Average PAUC Growth for Completed MDAPs that Passed MS B in Bust and Boom Climates

Bust (Fiscal Years)		Boom (Fiscal Years)	
1965–1980	46% (65)	1981–1986	18% (35)
1987–2002	37% (45)	2003–2009	2% (11)
Total	42% (110)	Total	15% (46)

REPORT DOCUMENTATION PAGE

*Form Approved
OMB No. 0704-0188*

The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.

1. REPORT DATE (DD-MM-YYYY)		2. REPORT TYPE		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (Include area code)

