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Do We Need a Different Approach to Statistical Analysis of Research, Development, Test and Evaluation Cost Growth?

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Research Question

- A paper I presented to last year's NPS Acquisition Research Symposium* provided statistical estimates of a model of root causes of growth in Program Acquisition Unit Cost (PAUC) of Major Defense Acquisition Programs (MDAPs). Very good statistical results were obtained for that model using PAUC.
- There are two components to acquisition cost – Research, Development, Test, and Evaluation (RDT&E) cost and procurement cost.
- This paper asks whether the model that yields such strong results for PAUC also does so for Average Procurement Unit Cost (APUC) and, especially, for RDT&E cost growth.

* David L. McNicol, "Further Evidence on Program Duration and Unit Cost Growth," in Vol. I of *Proceedings of the Fifteenth Annual Acquisition Research Symposium* (Monterey, CA: Naval Postgraduate School, April 30, 2018), 89–105.

The Short Story

- The model includes three categories of explanatory variables:
  - Funding climate, which is a proxy for the intensity of competition for acquisition funds
  - Variables marking different acquisition policy and process configurations
  - Program duration, with time in bust periods distinguished from time in boom periods.
- As noted before, statistically strong results are obtained for PAUC. The results for APUC also are strong, which is expected since procurement cost generally is four to five time RDT&E cost.
- The explanatory power of the model applied to RDT&E cost growth is low, and the estimated coefficient of only one of the explanatory variables is statistically significant.
- But each of the estimated coefficients has the expected sign and a reasonable magnitude. This suggests that one or more important variables have been omitted from the model.

Definitions of the Variables

$$PAUC_i = a_0 + a_1 Climate_i + a_2 DSARC_i + a_3 PCDSARC_i + a_4 DAB_i + + a_5 AR_i + a_6 T_{boom,i} + a_7 T_{bust,i} + e_i$$

Funding Climate		
Climate	bust climates	1965–1982 1987–2002
	boom climates	1983–1987 2003–2008
Acquisition Policy and Process Periods		
McNamara-Clifford	McNamara-Clifford	1965–1969
Defense System Acquisition Review Council	DSARC	1970–1982
Post-Carlucci DSARC	PC DSARC	1983–1989
Defense Acquisition Board	DAB	1990–1993 2001–2009
Acquisition Reform	AR	1994–2000
Duration		
T_{bust}	years in bust periods	
T_{boom}	years in boom periods	

Estimate of the Funding Climate-Acquisition Policy Model for APUC Growth

	Coefficients	p-value
Intercept	74.8%***	< 0.001
Errors of Inception – Intensity of Competition for Funds		
Climate	-26.7%**	0.02
Error of Inception – Acquisition Policy		
DSARC	-58.8%***	< 0.001
PC DSARC	-46.4%**	0.004
DAB	-60.8%***	< 0.001
AR	-81.0%***	< 0.001
Errors of Execution and Program Changes		
T_{boom}	3.8%/yr**	0.03
T_{bust}	0.5%/yr	0.61

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

** Statistically significant at less than the 5 percent level.

Note: R-Squared = 0.22, F = 5.46 (P < 0.001), N= 145. Estimated using ordinary least squares (OLS). The regression was computed using the 145 MDAPs in the database for which both APUC growth and RDT&E growth are available.

Estimate of the Funding Climate-Acquisition Policy Model for RDT&E Cost Growth

	Coefficients	p-value
Intercept	75.4%**	0.018
Errors of Inception – Intensity of Competition for Funds		
Climate	-13.1%	0.602
Error of Inception – Acquisition Policy		
DSARC	-50.2%*	0.101
PC DSARC	-34.9%	0.309
DAB	-53.8%	0.122
AR	-33.2%	0.397
Errors of Execution and Program Changes		
T_{boom}	2.2%/yr	0.573
T_{bust}	0.8%/yr	0.662

** Statistically significant at less than the 5 percent level.

* Marginally statistically significant at the 10 percent level.

Note: R-Squared = 0.04, F = 0.763 (P = 0.619), N= 145. Estimated using ordinary least squares (OLS). The regression was computed using the 145 MDAPs in the database for which both APUC growth and RDT&E growth are available.

Some Extensions of the RDT&E Model

- The search for “missing variables” is conducted within the logic of the Funding Climate-Acquisition Policy model.
- We are mainly interested in influences on competition for acquisition funding during the POM cycle.
- An obvious possibility is program priority. Lacking a measure of program priority, we used a categorical variable (High Priority), defined as 1 for platforms that have a central role in the acquiring Service’s main warfighting missions and zero for all other programs.
- A second possibility is program size, which is problematic because program size is correlated with priority and we do not have complete data on program size. To ameliorate this problem, three additional variables were included:
  - The number of MDAPs that passed MS B each year (#Competing).
  - Categorical variables for satellites, which have large RDT&E funding requirements, and ships, which at MS B require relatively little RDT&E funding.
- The results for this expanded model are presented on the following chart.

Estimate of an Extended Funding Climate-Acquisition Policy Model for RDT&E Cost Growth

	Coefficients	p-value
Intercept	77.0%	0.021**
Errors of Inception--Intensity of Competition for Funds		
Climate	-12.8%	0.613
High Priority	-14.5%	0.529
#Competing	1.0%	0.741
Satellites	63.0%	0.113
Ships	-37.1%	0.216
Error of Inception--Acquisition Policy		
DSARC	-41.2%	0.179
PC DSARC	-31.6%	0.363
DAB	-52.8%	0.128
AR	-24.3%	0.547
Errors of Execution and Program Changes		
T_{boom}	0.2%	0.957
T_{bust}	1.0%	0.615

** Statistically significant at less than the 5 percent level.

Note: R-Squared =0.08, F = 1.060 (P = 0.399), N= 145. Estimated using ordinary least squares (OLS). The regression was computed using the 145 MDAPs in the database for which both APUC growth and RDT&E growth are available.

The estimated coefficients of the variables introduced have the expected signs and the explanatory power of the model is improved.

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Conclusions

- No consensus model of RDT&E cost growth currently exists, and the only contender in the lists seems to be the Funding Climate-Acquisition Policy model.
- In view of the results provided above, the answer to the question asked in the title of this paper is part “no,” since the Funding Climate-Acquisition Policy model provides a reasonable basis for further work.
- The answer also is in part “yes,” in that much remains to be done for that model to provide a solid statistical account of RDT&E cost growth of MDAPs.