



## QUANTIFYING THE FUTURE



# The Rate You Want

## *Rethinking Cost Escalation in FAA Development*

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# Agenda

- Introduction
- Escalation Review
- FAA Case
- Weighted Index Computation
- Conclusion
- Further Inquiry

# Introduction

## A High Level Base Year Cost Estimate

Base Year 2017	2017	2018	2019	2020	2021	2022	2023-42	TOTAL
Prime Mission Product	\$ 10.00	\$ 10.00	\$ 10.00					\$ 30.00
System Test and Evaluation			\$ 3.00	\$ 3.00				\$ 6.00
System Engineering	\$ 2.00	\$ 2.00	\$ 2.00	\$ 2.00	\$ 2.00	\$ 2.00		\$ 12.00
Program Management	\$ 1.50	\$ 1.50	\$ 1.50	\$ 1.50	\$ 1.50	\$ 1.50		\$ 9.00
Implementation				\$ 2.00	\$ 2.00	\$ 2.00		\$ 6.00
O&M							\$ 40.00	\$ 40.00
<b>TOTAL</b>	<b>\$ 13.50</b>	<b>\$ 13.50</b>	<b>\$ 16.50</b>	<b>\$ 8.50</b>	<b>\$ 5.50</b>	<b>\$ 5.50</b>	<b>\$ 40.00</b>	<b>\$ 103.00</b>

What is the Then-Year Cost?

# Inflation

- Inflation is defined as an increase in the volume of money and credit relative to available goods and services resulting in a continuing rise in the general price level
  - Inflation is an external economic effect
    - Not all prices rise at the same rate — in fact, some could fall or stay even
    - The inflation rate is used to measure this rise (or fall) of the price level
  - Escalation is adjusting a dollar amount to account for the effects of inflation
  - De-escalation is removing inflation effects from a dollar amount

SOURCE: CeBOK v1.1, Module 5

# How to Escalate?

- It depends!!!
- Lots of choices
  - CPI, OMB, Billion Price Index
  - Global Insight
- Estimate purpose
  - Government vs Non-Government
  - Role of Appropriations
    - Appropriated vs Expended

# Appropriations

- DoD Appropriations
  - Numerous codes and appropriations with separate funding rules
  - Examples
    - Military Personnel
      - Military Army
      - Reserve Air Force
    - O&M
      - O&M Army
      - O&M Navy
      - O&M Defense
      - Environmental Restoration, Formerly Used Defense Sites
    - Procurement
      - Aircraft Army
      - Missile Army
      - Ammunition Army
      - Shipbuilding Navy
- Each appropriation has its own funding laws (years to obligate)
- Result, appropriated funds might not be spent uniformly

# Weighted Inflation Indices

- Accounts for how a given year's appropriated funds are spent
- Each DoD appropriation has its own weighted index
  - Based on outlay profile
  - Base Year to Then Year conversion
- Depending on outlay pattern, \$100 BY17 could be less than \$100 TY
  - Extra purchasing power to account for escalation at time of expenditure

# FAA Case

- FAA programs funded via several accounts:
  - Research, Engineering and Development (R, E & D)
    - Research, engineering, development programs
    - Basic research, Applied research
    - Incremental, three-year funds
  - **Facilities and Engineering (F&E)**
    - **Capital improvement, improving facilities, equipment, safety systems**
    - **Construction, capital lease, spares, software required for operational capability**
    - **Incremental, three-year funds**
  - Operations and Maintenance (O&M)
    - Single year funds
  - Airport Improvement (AIP)
    - Grant program assisting in development of adequate public-use airports
    - Zero year funds
- Focus on F&E programs
  - Programs governed by AMS
    - Separate regulations from other agencies
  - Incremental funding account, much larger than R, E & D (\$2.8B vs \$0.2B per FY17 PB)<sup>1</sup>

<sup>1</sup> Source "FAA FY17 President's Budget Submission <https://www.transportation.gov/sites/dot.gov/files/docs/FAA-FY-2017-CJ.pdf>



# FAA Case – Escalation Guidance

- FAA Salary Escalation 3% per year
- Raw Escalation
  - OMB Inflation Indices
  - Current table (using FY17 as base year)

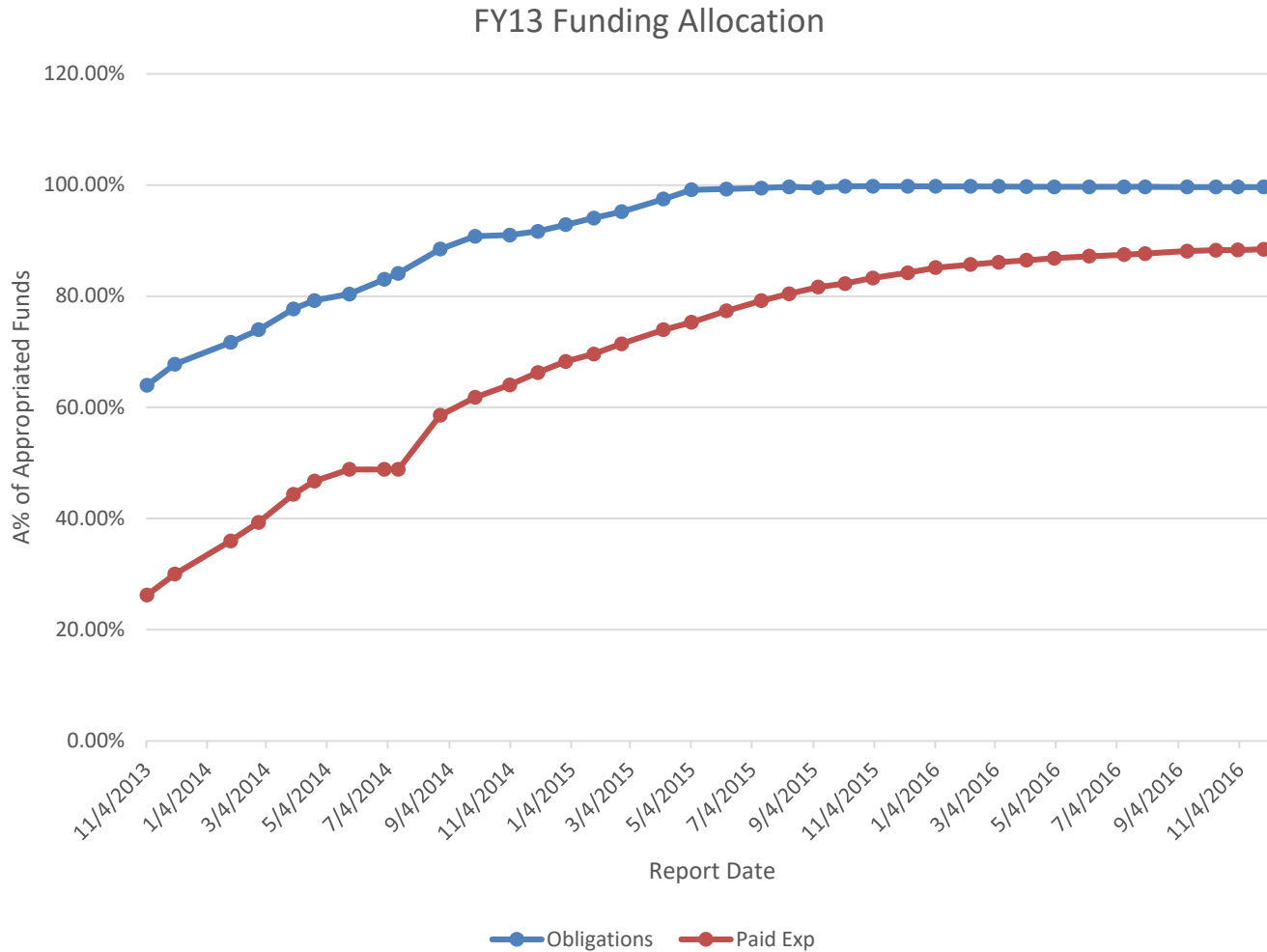
2017	2018	2019	2020	2021	2022
1.000	1.020	1.040	1.061	1.082	1.104

- FAA currently does not use weighted indices
  - But F&E has three year obligation period (and two year expired)
  - F&E programs include software development, procurement activities
    - Automation systems, information systems, surveillance etc.
  - Do outlay patterns justify a weighted approach?
- What would the impact be?

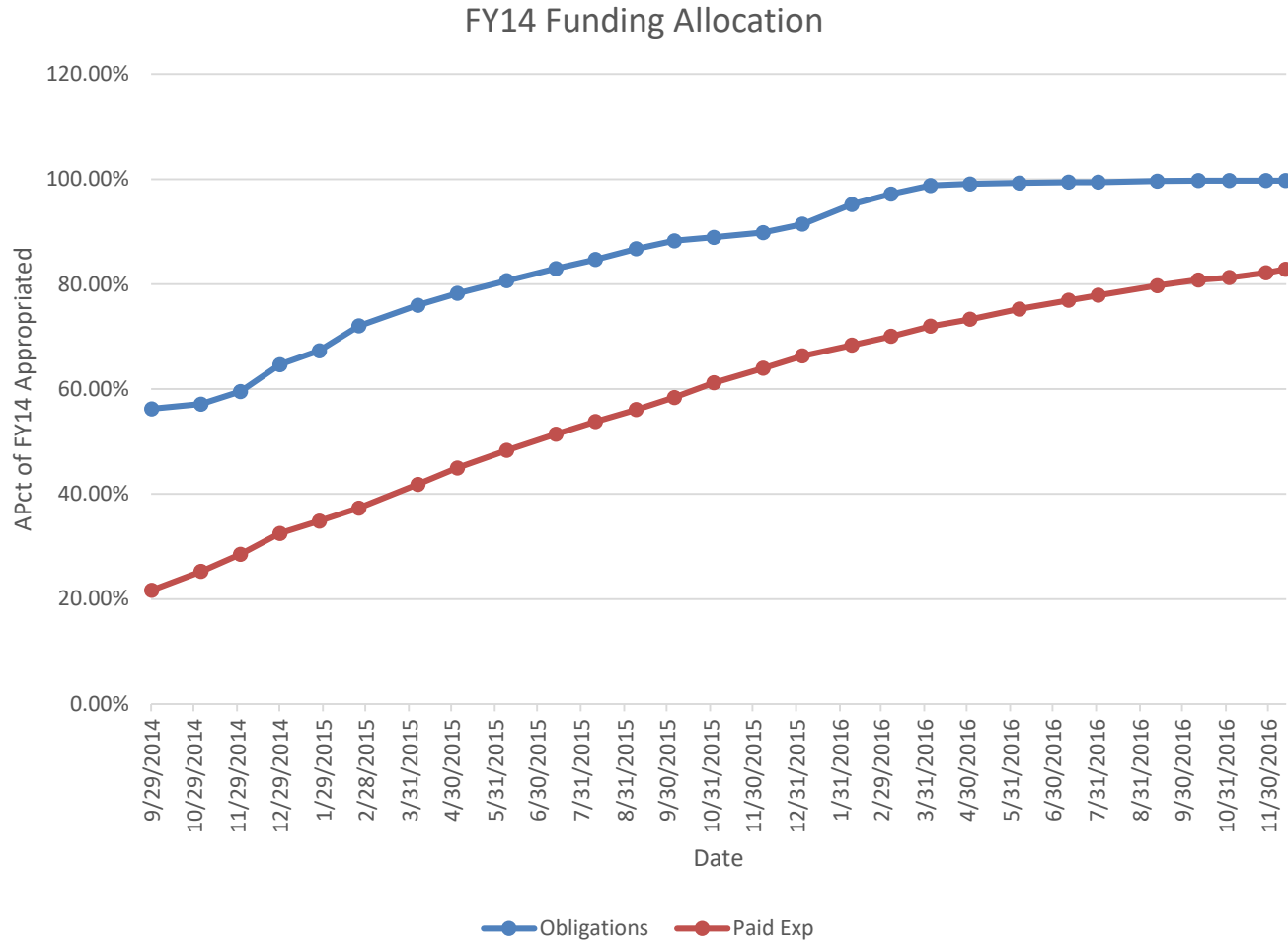
# Methodology

- Reviewed obligation reports for all active F&E accounts
  - November 2013 through December 2016
  - Four year history of FY13 funds, three year history of FY14 funds
  - Tracked data for obligation data, paid expenditure data
- How are appropriated funds being spent vs obligated?

# FY13 Funding Allocation



# FY14 Funding Allocation



# Outlay Patterns

- Clear evidence of expenditures significantly trailing obligations

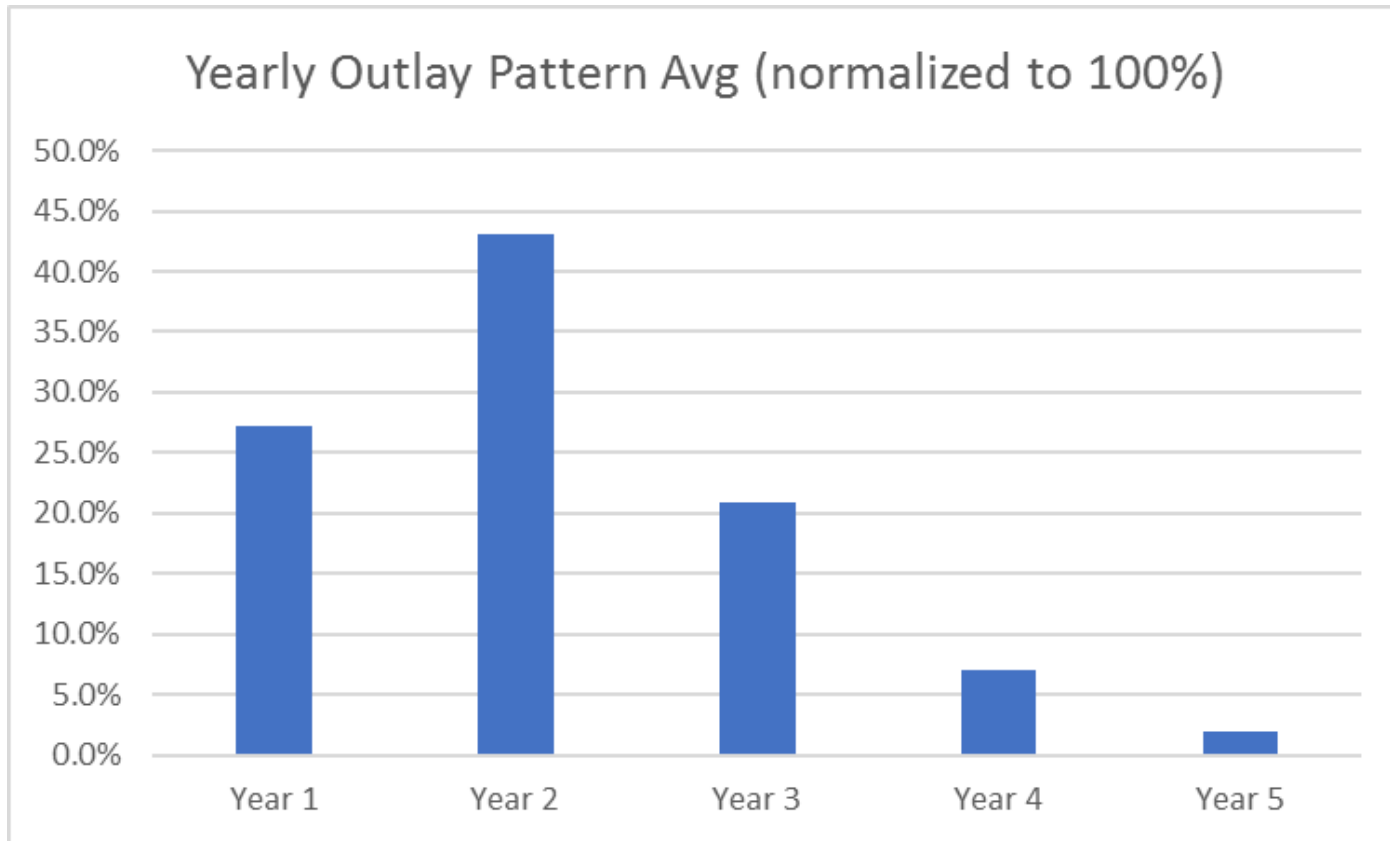
Obligations	Year 1	Year 2	Year 3
FY11			99.77%
FY12		92.07%	99.84%
FY13	63.97%	90.98%	99.78%
FY14	57.16%	88.95%	99.76%
FY15	60.34%	92.18%	
FY16	59.82%		

Paid Expenditures	Year 1	Year 2	Year 3	Year 4	Year 5
FY11			81.84%	89.29%	X
FY12		66.34%	84.82%	89.94%	90.98%
FY13	26.20%	64.03%	83.26%	88.31%	
FY14	25.25%	61.22%	81.27%		
FY15	25.91%				
FY16	21.46%				

X = unavailable

# Outlay Patterns

- Average Outlay Pattern



# Weighted Index Computation

- FY17 Calculation
  - Formula =  $1/Q$
  - $Q = \text{Outlay \% Year 1} + \text{Outlay \% Year 2}/(\text{Yr1 to Yr2 Escalation} + \dots + \text{Outlay\% Year 5}/(\text{Yr1 to Yr5 Escalation}))$
  - $Q = 27.16\% + 43.04\%/1.02 + 20.81\%/(1.02)^2 + 7.02\%/(1.02)^3 + 1.98\%/(1.02)^4 = 0.978$
  - FY17 to FY17 (weighted) = **1.023**

# Weighted Index Computation

- Apply similarly to other years
- Result

	2017	2018	2019	2020	2021	2022
Raw	1.000	1.020	1.040	1.061	1.082	1.104
Weighted	1.023	1.043	1.064	1.085	1.107	1.129

- Weighted Index is equivalent to an extra year of inflation



# Conclusions

- Relatively small amount of FY budget authority actually expended in that year
- Outlay patterns for FAA F&E account show significant evidence that a weighted index would make sense
- Weighted index could more accurately portray purchasing power necessary for given year's budget authority

# Further Inquiry

- Are the outlay patterns different by category?
  - Automation Systems vs NextGen
  - ANOVA, between groups variation
- One factor ANOVA conducted on first year expenditure by system type
  - Automation, Communication, Surveillance, Facilities, NextGen, Mission Support, Navigation, Weather

# ANOVA

Anova: Single Factor						
SUMMARY						
Groups	Count	Sum	Average	Variance		
A	18	5.032344	0.279575	0.083589		
C	7	0.251962	0.035995	0.001376		
F	19	2.607727	0.137249	0.034576		
G	49	4.145037	0.084593	0.025273		
M	34	7.247645	0.213166	0.068951		
N	12	1.33713	0.111428	0.035303		
S	9	0.478879	0.053209	0.006262		
W	4	0.221142	0.055285	0.008935		
ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	0.865249	7	0.123607	<b>2.963923</b>	<b>0.006223</b>	2.07373
Within Groups	6.005355	144	0.041704			
Total	6.870604	151				

Evidence of between group variation

# Further Inquiry

- Tech Refresh vs New Development
- Re-examining time phasing of cost estimates
  - Lag between obligation and expenditure
    - Continuing Resolutions (Built-in Behavior?)

# Questions?