

Department of the Air Force

Integrity - Service - Excellence

Sustainment Contracts Cost Growth Analysis



**Candice Schultheis
May 2023**



Agenda

-
- Abstract/Bottom Line Up-Front (BLUF)
 - Background & Literature Review
 - Project Description
 - Definitions & Measures Used in Study
 - Summary of Data Sources
 - Overview of Methodologies
 - Analytical Results & Conclusions
 - Potential for Future Research



Abstract/BLUF

■ Scope

- Analyze O&S contract cost growth over time & compare between contract-type groups
- Identify root causes and contract characteristics that may impact O&S contract cost growth outcomes

■ Analysis

- Calculate cumulative cost growth over baseline values for time-series analysis
- Conduct statistical tests to evaluate differences in cost growth rates between contract types
- Compare contributing factors based on lower-level contract details

■ Conclusion

- At the individual contract level, for some programs, there is enough evidence to infer cost growth rates for fixed-price contracts are higher than those for cost-type contracts.
- At an aggregated level, across all contracts, and at a task level, results show no statistical difference in contract cost growth rates between contract-type groups.
- When evaluating potential relationships between contract & work characteristics and cost growth outcomes, results are inconclusive.



Background

- Contract data can be a tool for assessing programs & measuring cost growth.
 - Provides insight into what work occurred, when, and for how much
 - Documents changes over time
 - Identifies contract line item (CLIN) price details
 - Traces to funding source

- Contract data is one of many sources that supports cost estimating.
 - Important to understand what contract data represents



Literature Review

- Contract type is largely based on a program's position in the acquisition lifecycle and its associated risks.
 - Fixed-price contracts are recommended when: requirements are stable, systems are mature, technologies are proven in field, risks are low, and historical data are available.
- Prior cost growth studies and reports have centered on acquisition cost growth during development and production lifecycle phases.
 - Growth is typically measured as an increase in actual costs and/or EAC over baseline over time with EVM-type data
- Common root causes for cost growth include:
 - Cost, Schedule, and Technical
- Results from prior studies show no strong indications that contract type minimizes contract cost growth.



Project Description

■ **Problem Statement:**

- Negotiated fixed-price contracts may lead to the perception of “locked in” program costs. Claims of savings as a result of fixed-price contracts may not reflect actual contract cost changes that occur over time.

■ **Study Objectives:**

- To measure and analyze sustainment contract cost growth by contract type over time,
- To determine if growth on fixed-price contracts is, on average, greater than growth on cost-type contracts, and
- To identify root causes and potential relationships contributing to sustainment contract cost growth.



Project Description

■ **Hypothesis Statement:**

- Sustainment contract cost growth is not dependent on the type of contract, with actual costs growing higher than negotiated values due to various factors (i.e. labor rate changes, schedule extensions, requirements changes, and scope increases) regardless of contract type.
- Even in fixed-price constructs, contract cost growth is apparent; however, the magnitude of growth may be impacted by contract type.



Definitions & Measures

- Categories used to calculate total cost growth rates over time in the study (as defined by the AFCAA KDB tool):
 - Baseline: Anticipated scope changes and exercising of anticipated options
 - Growth:
 - Technical: Unanticipated changes through design or scope
 - I.E. ECPs, definitization of technical scope, new options
 - Schedule: Value changes attributable to unanticipated schedule compression/extension
 - Cost: Unanticipated changes without a change in design or scope
 - I.E. Unanticipated rate changes, cost overruns/underruns, price changes
 - Cumulative Percent Cost Growth over Baseline:
 - Cumulative growth dollars as categorized by a modification at a given time (mod date) divided by the cumulative baseline value at the last modification



Methodologies

■ Time-Series Analysis

- Develop time-series plots of cumulative sustainment contract cost growth over the baseline by contract type to generate averages for each contract and draw comparisons across contract-type groups.

■ Statistical Analysis

- Perform Wilcoxon Rank Sum tests
 - To determine significance in cost growth differences between contract type groups
- Document results of “no significance” vs “significance” for each program & contract

■ Comparative/Root Cause Analysis

- Link changes in contract costs with the timeline of contract modifications to derive root cause and categorize reason for growth.
- Identify trends in lower-level data that may be contributors to contract cost growth outcomes and findings of statistical significance.



Summary of Data Sources

■ Primary Data Source:

- AFCAA KDB (KDB-Contracts-Pivot-Tool-v6.0_211101)
 - Repository of contracts data over time
 - Key data elements used in this study:

Data Elements
ContractProgramName
MasterContract
DeliveryOrder
ContractDescription
ContractType
ContractComplete
ModDate
ModCategory
ModDescription
CLIN
CLINDescription
TYDollar

- Contract values by modification examined using the pre-defined Baseline & Growth (Cost, Schedule, Technical) categories.
- Secondary Data Source: AFLCMC/LZIA DART contracts database
 - Used to identify EEIC-level detail for mapping tasks into work categories for contracts included in study



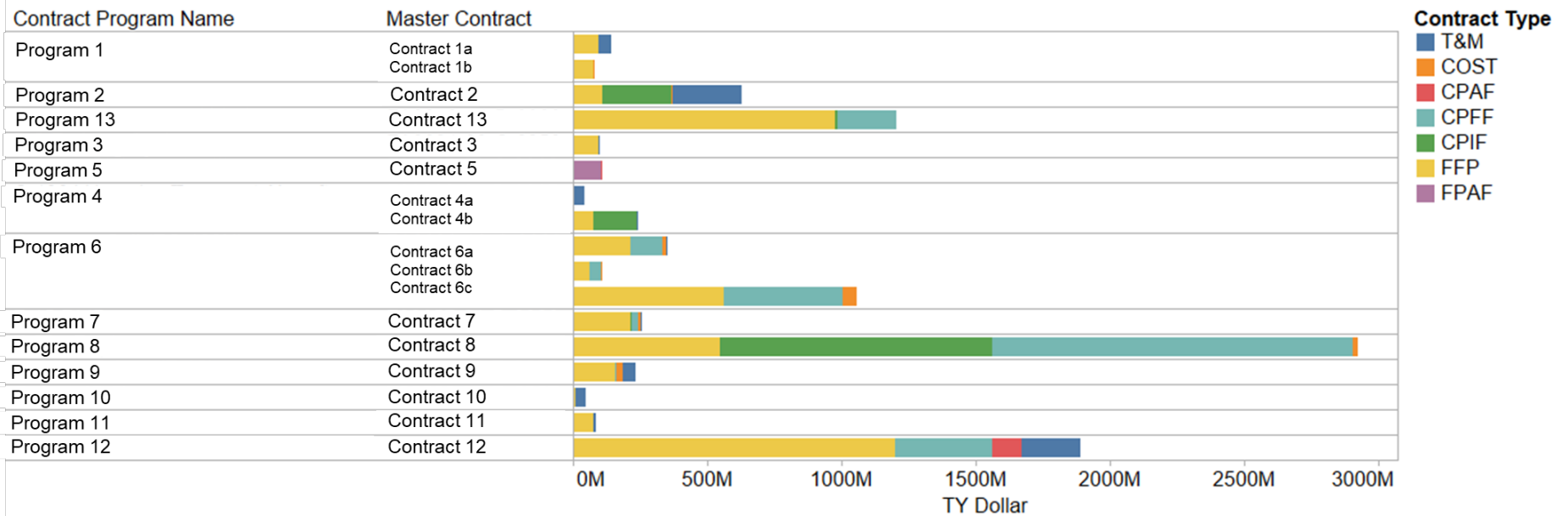
Dataset

- Overarching criteria for dataset:
 - Air Force, Aircraft, O&S phase, 3400 appropriation, non-FMS, TY\$
- Further “cleaning” to finalize dataset:
 - Removed records with indistinguishable labels (“Other”, “NA”)
 - Eliminated “Administrative” Mods – no cost data
 - Removed contracts with only one year of data & no baseline costs
- Summary sample description:
 - A total of 55 unique actual individual contract records
 - Covers 13 programs, 17 master contracts
 - Contract types included:
 - FFP/FPAF (FixedPrice Group) = 17 unique contract records
 - CPIF/CPFF/CPAF/COST/T&M (CostType Group) = 38 unique contract records
 - Range of years: 2000 - 2021
 - Mod dates aggregated to “Year” for time-series analysis
 - Years differ by contract depending on work scheduled



Programs & Contract Values in Dataset

Total Contract Values by Program & Contract Type





Comparison of Descriptive Statistics Grouped by Contract Type

Fixed Price Group	Total % Cumulative Growth	Total		
		Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)
Average	103.71%	97.86%	4.79%	2.99%
Median	11.03%	5.71%	0.06%	2.17%
Max	990.55%	1035.86%	73.34%	10.33%
Min	0.15%	0.03%	-45.31%	-0.05%
Range	990.40%	1035.83%	118.66%	10.38%
Variance	593%	658%	5%	0%
S.D	244%	256%	23%	4%
CV	235%	262%	476%	130%

On average, the fixed-price group's average total cumulative growth over the baseline is higher than that of the cost-type group.

The cost-type group's median total cumulative growth over the baseline is higher than the median for the fixed price group.

Cost Type Group	Total % Cumulative Growth	Total Cumulative Technical Growth	Total Cumulative Cost Growth	Total Cumulative Schedule Growth
		(Technical \$\$/Total Baseline \$)	(Cost \$\$/Total Baseline \$)	(Schedule \$\$/Total Baseline \$)
Average	70.71%	49.11%	23.63%	55.74%
Median	23.43%	11.76%	4.67%	1.11%
Max	745.53%	334.13%	212.26%	533.27%
Min	-32.72%	-0.15%	-32.72%	-0.30%
Range	778.25%	334.28%	244.98%	533.57%
Variance	190%	68%	27%	282%
S.D	138%	82%	52%	168%
CV	195%	168%	220%	301%

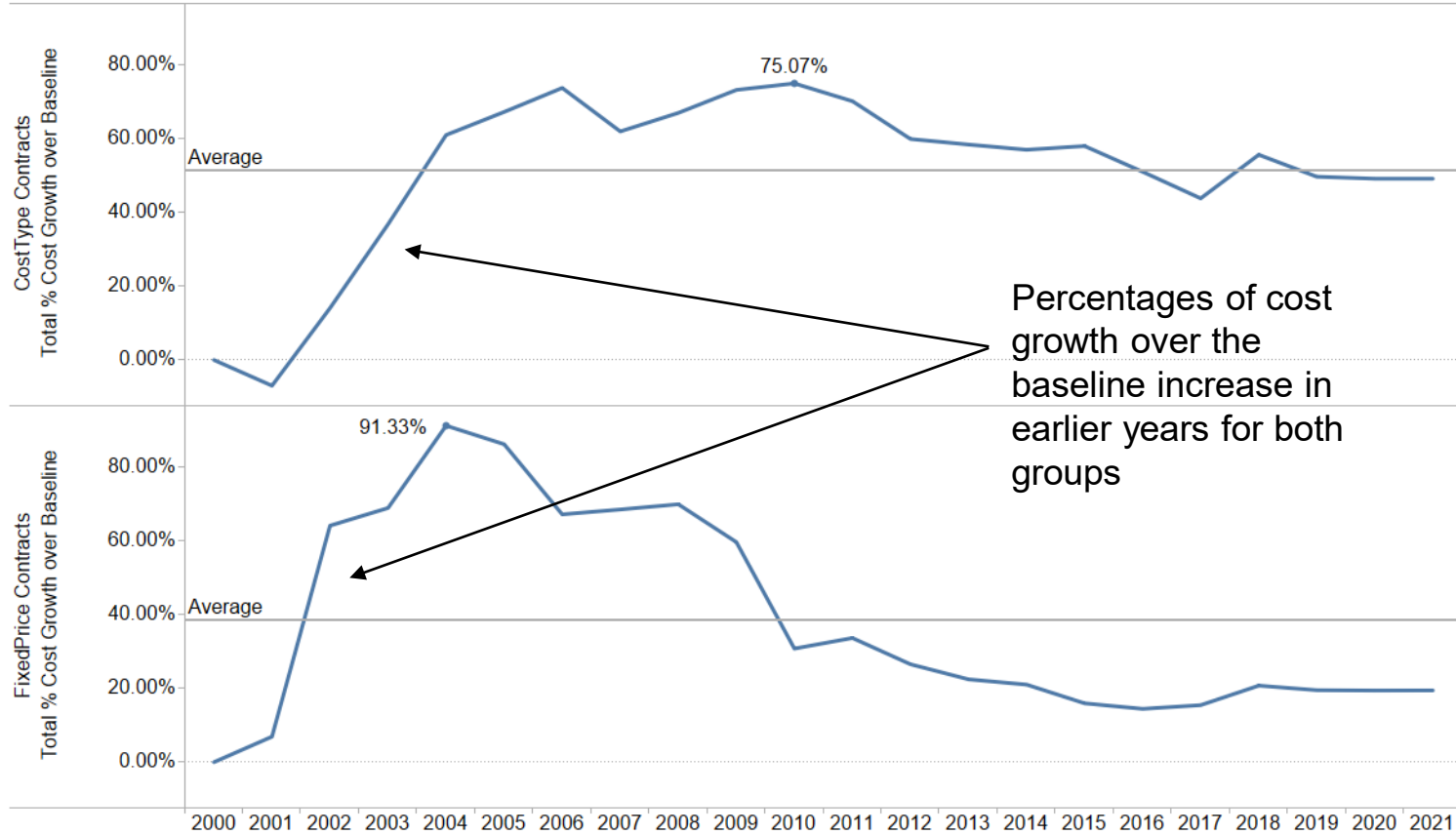
Cost growth rates are more disperse among fixed-price contracts.



Contract Cost Growth over Time

Grouped by Contract Type

Cumulative Growth Rate by Contract Type Group Over Time



Cost-Type Group reaches peak growth in 2010 and maintains a higher overall growth rate over time.

Fixed-Price Group reaches peak growth in 2004 and then, overall, that rate decreases over time.

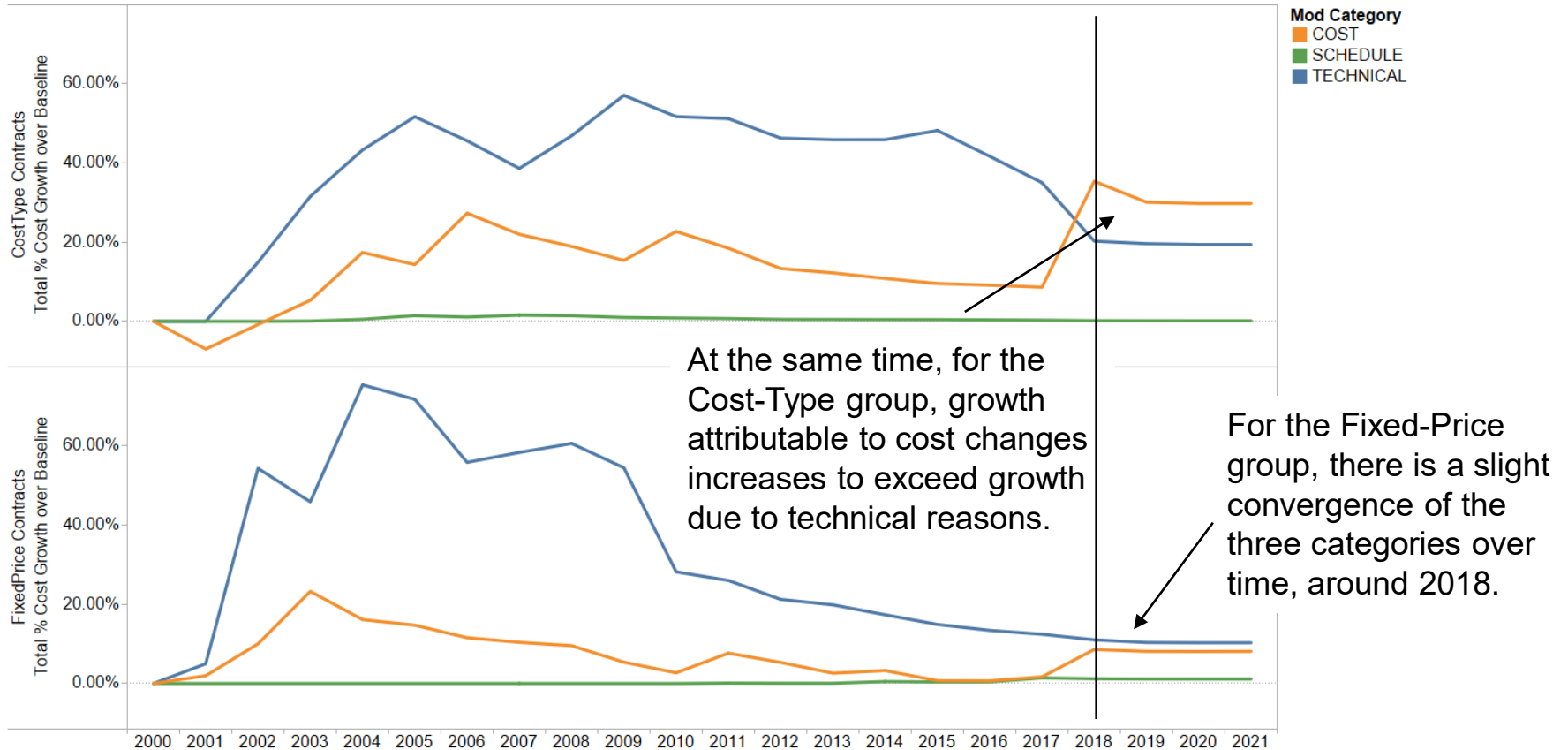
Percentages of cost growth over the baseline increase in earlier years for both groups



Contract Cost Growth over Time

Shown by Growth Category & Grouped by Contract Type

Cumulative Growth over Baseline by Growth Category & Contract Type Group over Time



For both groups, most variability occurs in the Cost & Technical categories, and technical-related growth contributes most to the overall contract cost growth rates.



Conclusions & Results

Aggregated, Contract-Level Analysis

■ Overall conclusions:

- Growth is observed on O&S contracts, regardless of contract type
- For both cost-type and fixed-price contracts, technical changes are the largest contributor to growth over the baseline.
- Over the time period examined, contract cost growth rates are higher, on average, for cost-type contracts.

■ Results of statistical tests:

- No strong correlation found between Contract Type and Total % Contract Cost Growth over Baseline
- In comparing growth rates between the two groups of contract types:
 - At the 5% significance level, not enough evidence to infer that contract cost growth percentages are different for cost-type and fixed-price contracts
 - Cannot conclude that cost growth rates on fixed-price contracts are greater than those on cost-type contracts



Individual Contract Comparative Analysis

- At the aggregated level, cost growth over time is recorded for both fixed-price and cost-type contracts.
 - However, no inference can be made that cost growth is higher on fixed-price contracts.
- Next, the study analyzes contract cost growth by comparing contract type groups within the same master contract for each program in the dataset.



Individual Contract Comparative Analysis

Wilcoxon Rank Sum Test

Wilcoxon Rank Sum (W-R-S)	Evaluating between 2 groups of contract types
No significance between any contract type	Tested whether difference exists, if it can be attributed to FP % growth
Contract 2	Program 2
Contract 4a	Program 4
Contract 6a	Program 6
Contract 10	Program 10
Contract 12	Program 12
Contract 13	Program 13

Wilcoxon Rank Sum (W-R-S)						
Partial or All Significance		FFP vs COST	FFP vs CPIF	FFP vs CPFF	FFP vs T&M	FPAF vs CPAF
Contract 1a	Program 1				Yes	
Contract 1b	Program 1	Yes				
Contract 3	Program 3				Yes	
Contract 4b	Program 4	Yes			Yes	
Contract 5	Program 5					Yes
Contract 6b	Program 6	No		Yes	Yes	
Contract 6c	Program 6	No		Yes		
Contract 7	Program 7	Yes	Yes	Yes		
Contract 8	Program 8	No	No	Yes		
Contract 9	Program 9	Yes	No	No	No	
Contract 11	Program 11			Yes	No	



Individual Contract Comparative Analysis

Type of Growth by Program/Contract & Contract Type

Programs with No Significant Growth on Fixed-Price Contracts by Growth Category

Contract Program Name	Master Contract	COST	CPAF	CPFF	CPIF	FFP	T&M
Program 2	Contract 2	■ ■ ■			■ ■	■ ■	■ ■ ■
Program 4	Contract 4a			■	■	■ ■	■ ■
Program 6	Contract 6a	■ ■		■		■ ■ ■	
Program 10	Contract 10	■ ■				■ ■	■ ■
Program 12	Contract 12		■ ■	■ ■	■	■ ■	■ ■
Program 13	Contract 13			■ ■ ■	■	■ ■ ■	

Mod Category
 ■ COST
 ■ SCHEDULE
 ■ TECHNICAL

Programs with Significant Growth on Fixed-Price Contracts by Growth Category

Contract Program Name	Master Contract	COST	CPAF	CPFF	CPIF	FFP	FPAF	T&M
Program 1	Contract 1a Contract 1b					■ ■ ■		■ ■ ■
Program 3	Contract 3	■ ■				■ ■		■ ■
Program 5	Contract 5		■				■ ■	
Program 4	Contract 4b	■ ■				■ ■		■ ■
Program 6	Contract 6b Contract 6c	■ ■ ■		■		■ ■ ■		■
Program 7	Contract 7	■ ■		■	■	■ ■		
Program 8	Contract 8	■		■ ■	■	■ ■		
Program 9	Contract 9	■ ■		■ ■	■ ■	■ ■ ■		■ ■ ■
Program 11	Contract 11			■ ■		■ ■ ■		■ ■ ■

Mod Category
 ■ COST
 ■ SCHEDULE
 ■ TECHNICAL



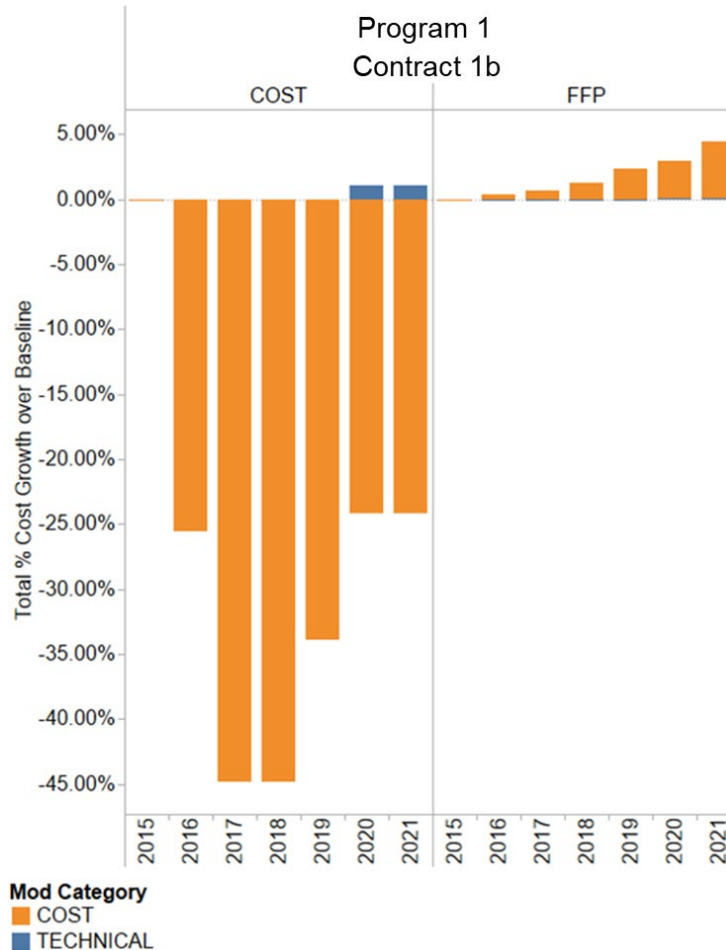
Individual Contract Comparative Analysis Significance

Contract Description:
O&S for Support
Equipment Including
Training Devices

Magnitude of total
contract values
influence growth
percentage
calculations.

~\$75.5M TY on FFP
~\$0.43M TY on COST

Total % Growth over Baseline by Contract Type over Time



For FFP, increases over the baseline are the result of CBA wage adjustments for courseware, training, and instruction.

For COST, cost decreases over the baseline due to de-obligations of excess funding on incidental costs and travel.



Individual Contract Comparative Analysis Significance

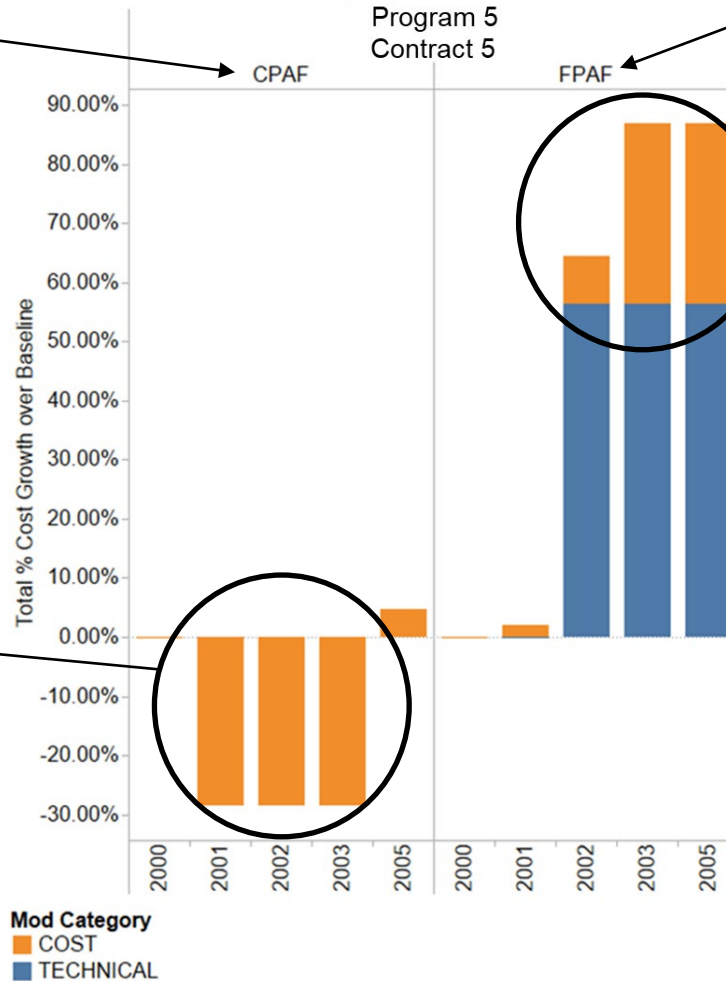
Flexible Sustainment -
Labor & Material

Total Contract Value:
\$1.1M

One factor, cost, is influencing changes to cost growth on the CPAF contract.

Flying Hour/Engine Cycle Adjustments in FY01

Total % Growth Over Baseline by Contract Type over Time



Propulsion System CLS

Total Contract Value:
\$103.2M TY

Flying Hour/Engine Cycle Adjustments in FY01 – FY03

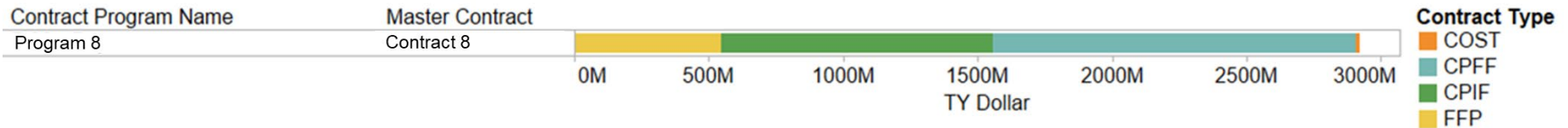
Spares Support

For the FPAF contract, two factors, cost and technical changes, are driving an increase in cost growth over time.



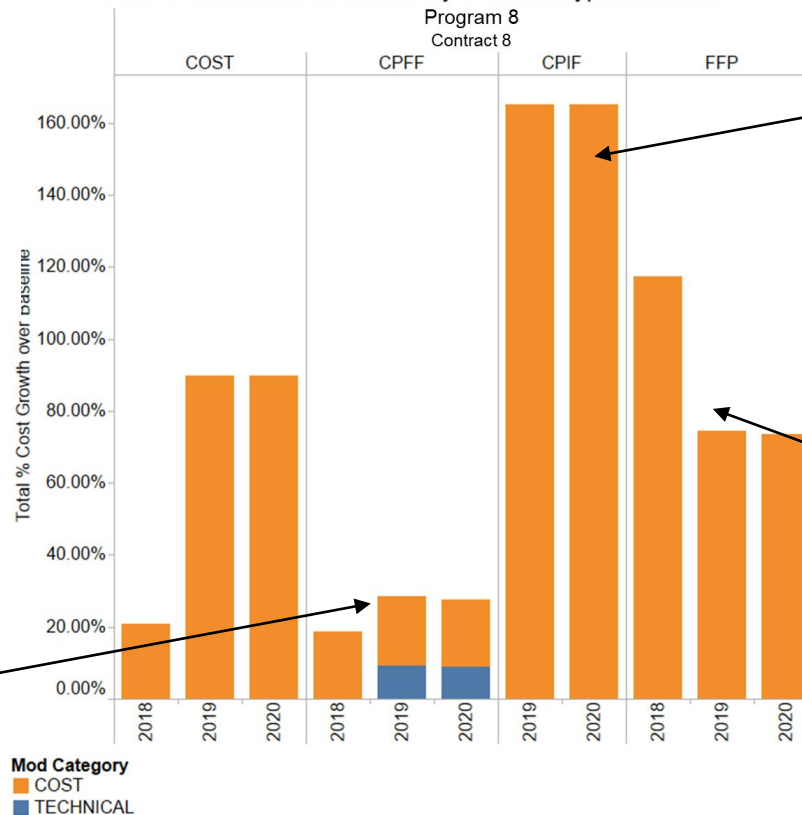
Individual Contract Comparative Analysis Mixed Significance within Same Contract/Program

Total Contract Values by Program & Contract Type



Majority of contract content described as sustainment and support work as part of a Performance Based Logistics (PBL) structure.

Total % Growth over Baseline by Contract Type over Time



Cost-related growth on the CPIF contract is related to the authorization of a UCA for Weapon System Sustainment CY19 Material.

Cost-related growth on the FFP contract is largely due to is related to the authorization of a UCA for Weapon System Sustainment CY19 Labor.

Cost-related growth on the CPFF contract is largely due to realignment of Weapon System Sustainment CY18 Material funding.



Conclusions & Results

Individual Contract Comparative Analysis

■ Overall Conclusions:

- Based on the results, we can say with some confidence that there are cases where cost growth on fixed-price contracts is greater than growth on cost-type contracts.
- Within the same program and same contract, results can vary.
- Although the results indicate some differences in drivers of cost growth across contract types, in most cases, cumulative cost growth is occurring for similar reasons, regardless of contract type.

■ Results of Statistical Tests:

- For some programs in the study, there is enough evidence, at the 5% significance level, to infer that contract cost growth percentages are higher for fixed-price contracts compared to cost-type contracts.



Contract Task-Level Analysis ***By Program, Contract Type, and Work Category***

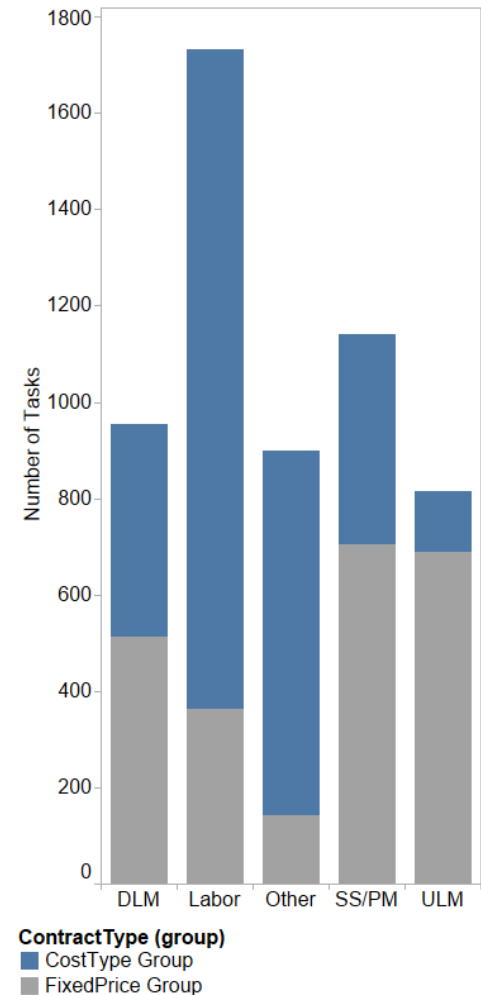
- Based on findings at the contract level, the study then examines tasks for each contract to determine whether differences in work being performed among the contracts drives growth outcomes.
 - Work categories defined by mapping CLIN data available in the AFCAA KDB & AFLCMC/LZIA DART tools to capture EEIC elements
 - EEICs with EEIC Descriptions bucketed into WSS EEIC Category list (see backup)
 - EEIC Categories further mapped to a Work Category
 - Work Categories defined:
 - Labor – Maintenance/Mission Personnel, Contract Maintenance Services, Sustaining Contract Engineering
 - Unit-Level Maintenance (ULM) – Intermediate & Consumable Parts & DLRs
 - Depot-Level Maintenance (DLM) – Depot Overhaul & Non-DMAG DPEM Tasks
 - SS/PM – TDY/Travel, Technical Data Procurement & Sustainment, & All Sustaining Support activities
 - Other – Software Maintenance & Mod Kit Installation/Installation Support
-



Contract Task-Level Analysis Descriptive Data

- By contract type:
 - The total number of tasks for the dataset is 5,542 tasks
 - 56.5% of all tasks in the dataset are on cost-type contracts
 - Of those tasks, 68.1% are categorized as Labor and Other
 - SS/PM and ULM make up the majority of the tasks on fixed-price contracts
 - Overall, the Labor category has the highest number of tasks (31.3% of Total Number of Tasks)

Work Category Count by Contract Type





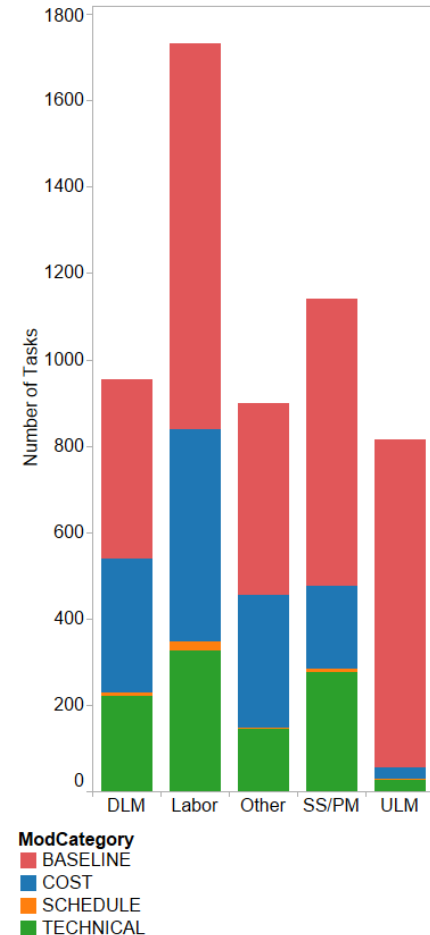
Contract Task-Level Analysis

Descriptive Data

■ By Growth Category:

- Overall, most tasks (57.3%) in the dataset are classified as Baseline, meaning they are “anticipated” work events
- Of the tasks classified as one of the three Growth Categories, Cost and Technical represent majority of those tasks.
 - Majority of tasks within the Cost, Technical, and Schedule growth categories are categorized as Labor

Work Category Count by Baseline & Growth Categories

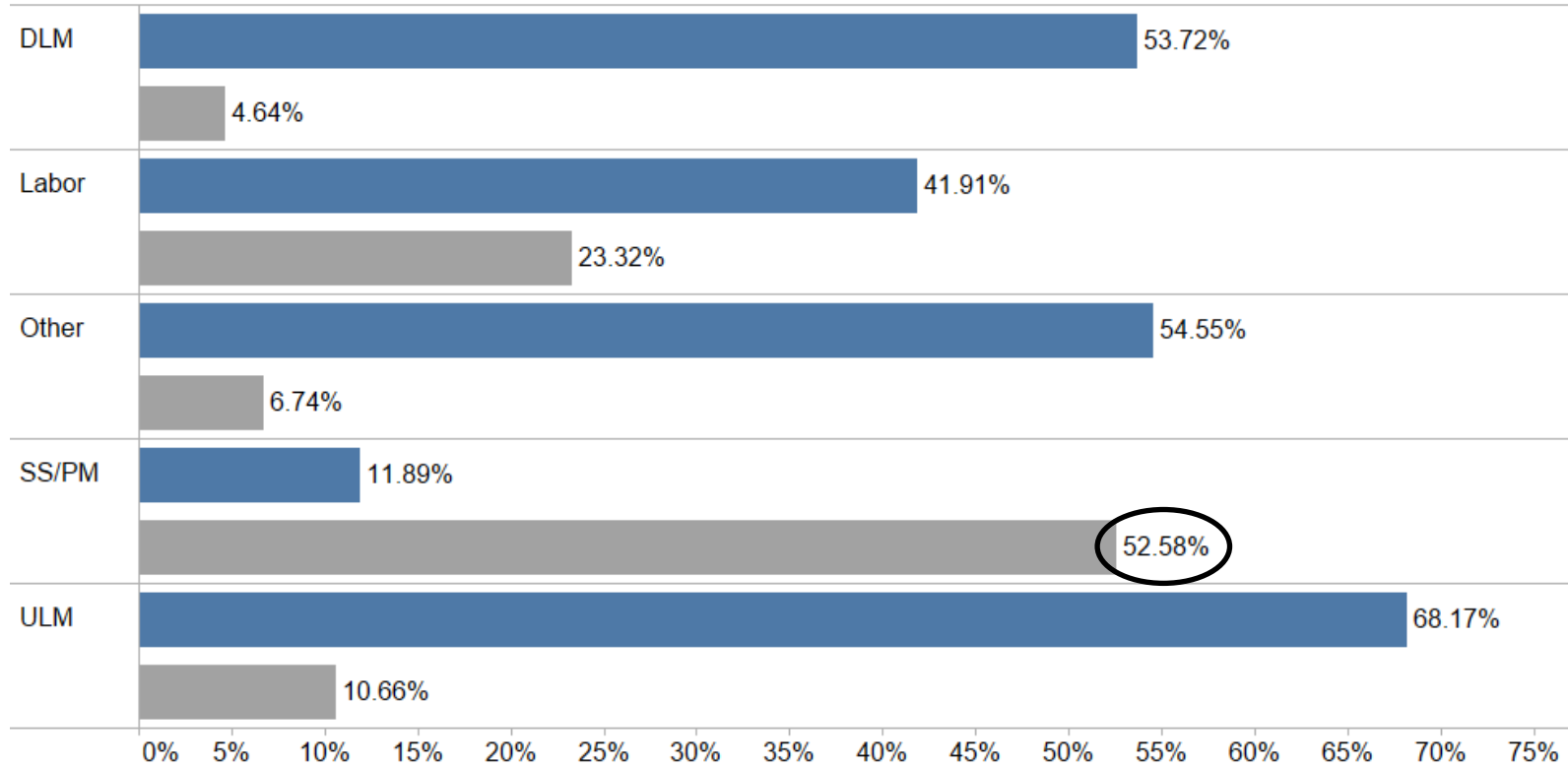




Contract Task-Level Analysis

Total Contract Cost Growth by Work Category and Contract Type

Growth by Work Category & Contract Type



Total % Cost Growth over Baseline

ContractType (group)

- CostType Group
- FixedPrice Group

CostType Group Average % Cost Growth = 46.05%

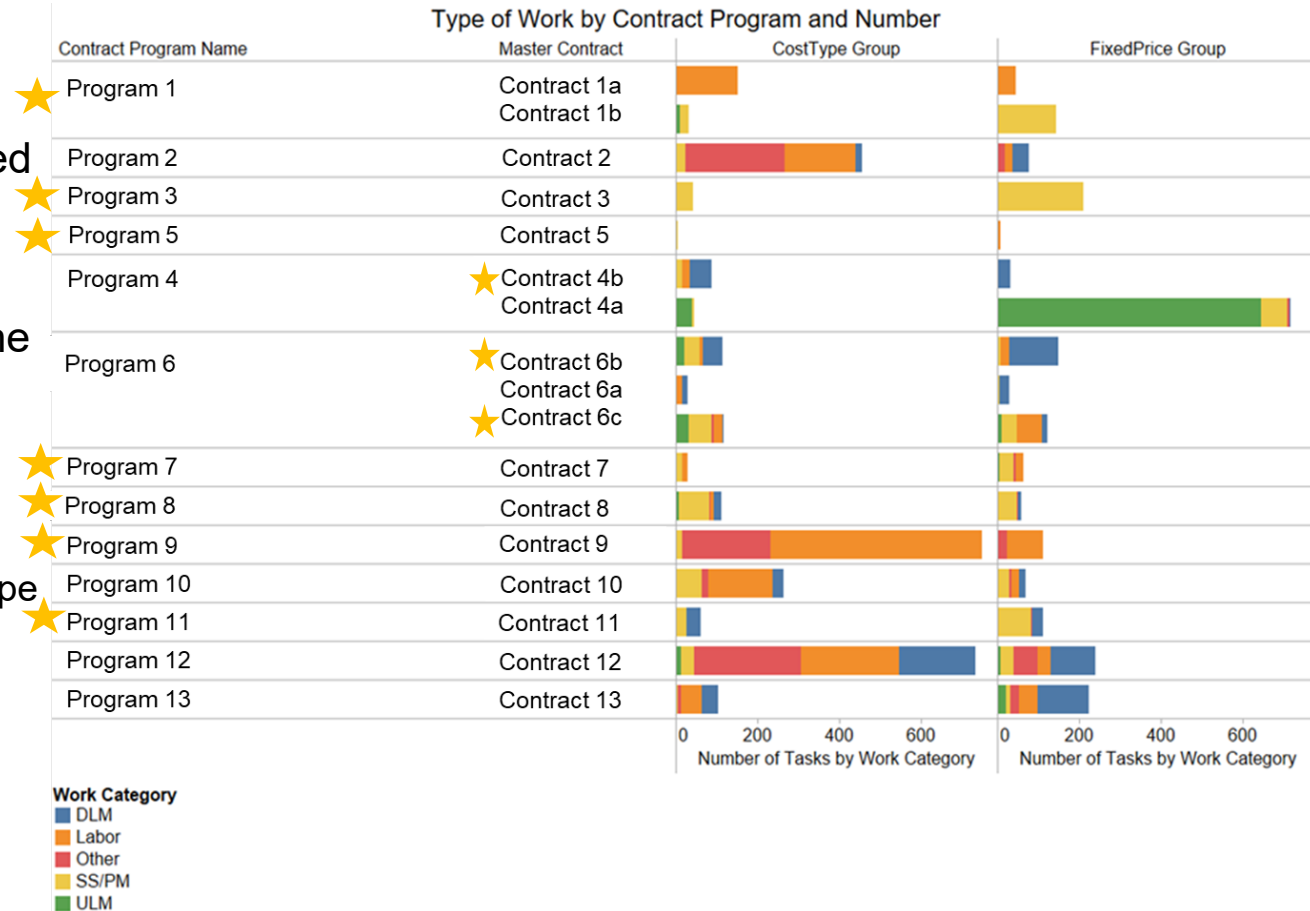
FixedPrice Group Average % Cost Growth = 19.59%



Contract Task-Level Analysis

Diversity of Tasks by Program & Contract Number

- Focused on programs where higher fixed-price cost growth can be inferred (★)
- Comparing between contract type groups, is the work being performed different?
 - Similar work category defined on contracts, regardless of contract type
- Do contracts with a more diverse set of tasks experience higher cost growth rates?
 - No clear relationship





Conclusions & Results

Contract Task-Level Analysis

■ Overall Conclusions:

- Cost growth occurs regardless of the type of work on contract.
 - Across all work categories, cost growth is observed.
- When comparing across contract type groups, the type of work being performed, based on the work categories used in the study, is not a clear indicator of cost growth outcomes.
- Having a more diverse set of work being performed does not appear to impact growth outcomes for a program.

■ Statistical Results:

- There is not enough evidence to infer that differences exist in cost growth rates between the contract type & work category groups.
 - There is no significant difference in cost growth rates for the work categories or contract types studied.



Contract Task-Level Analysis

Other Special Areas of Analysis

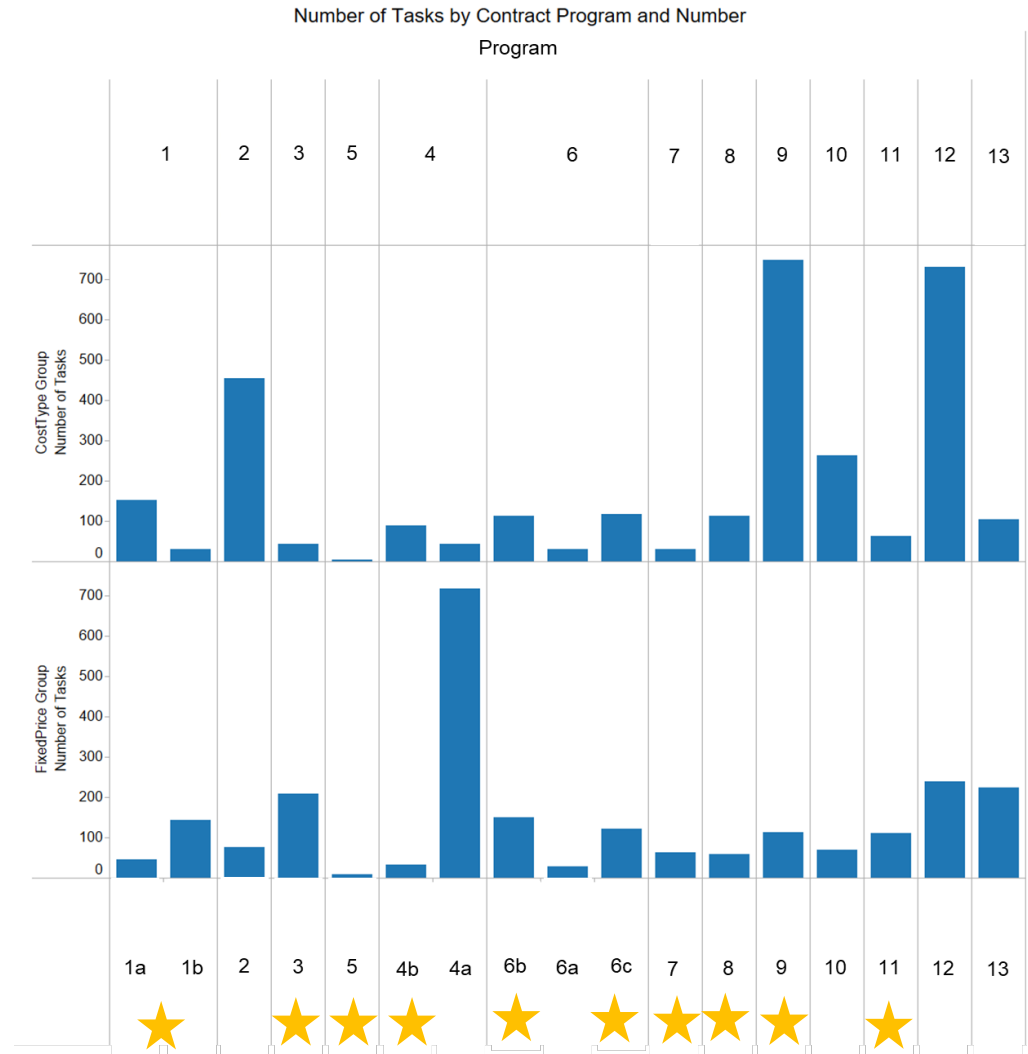
- This study examines how other work-level characteristics of contracted work may or may not contribute to the earlier findings of significant cost growth on fixed-price contracts:
 - For the programs with significant cost growth on fixed-price contracts, this study analyzes the following to identify trends:
 - Do programs & contracts with significant cost growth on fixed-price contracts have:
 - 1) Higher number of tasks on fixed-price contracts, compared to cost-type contracts?
 - 2) More “Over & Above”-defined work on fixed-price contracts, compared to cost-type contracts?
 - 3) More Unscheduled Maintenance on fixed-price contracts, compared to cost-type contracts?



Contract Task-Level Analysis

Number of Tasks by Program & Contract Number

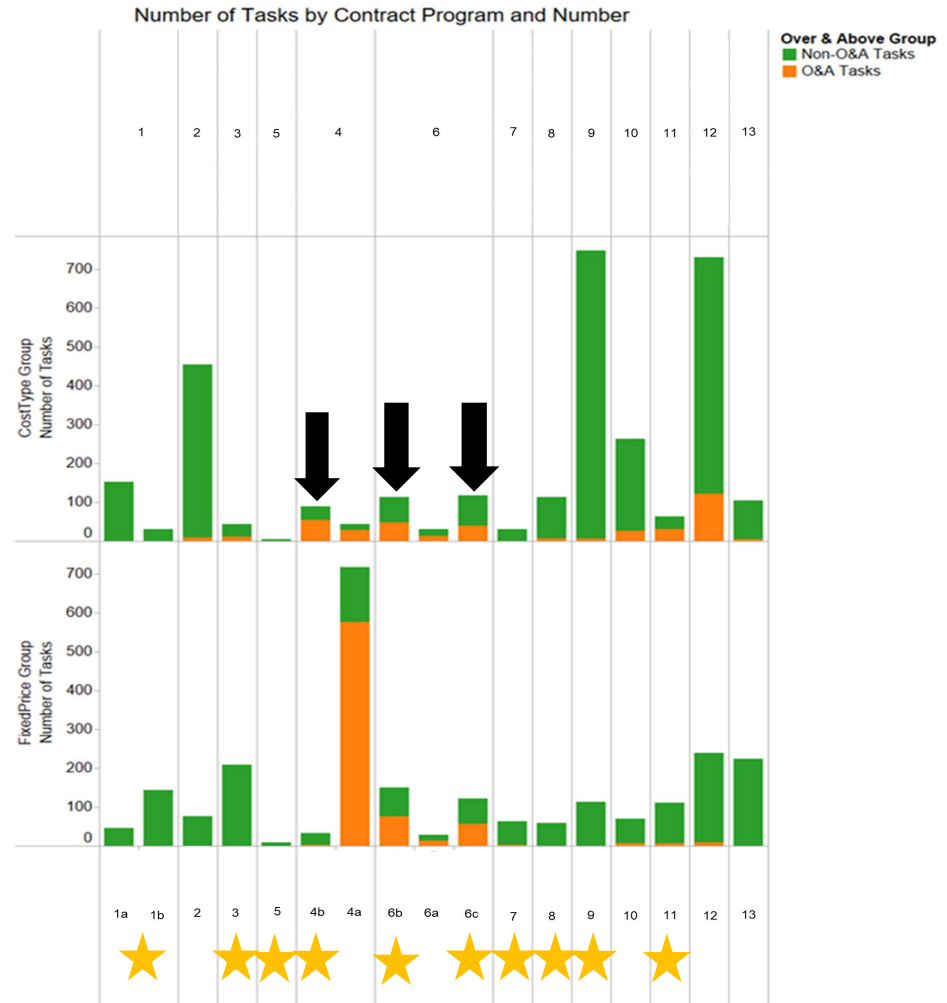
- Focused on programs where higher cost growth on fixed-price contracts can be inferred (★)
 - Comparing between contract type groups, is the number of tasks greater on fixed-price contracts?
 - Mixed results across sample of programs/contracts





Contract Task-Level Analysis Over & Above (O&A) Work

- Tasks grouped into two categories:
 - 1) O&A and 2) Non-O&A
 - Comparing contract type groups, where do O&A-defined tasks have the highest occurrence?
 - Can any relationship be observed between having O&A-defined tasks and experiencing higher growth rates on fixed-price contracts?

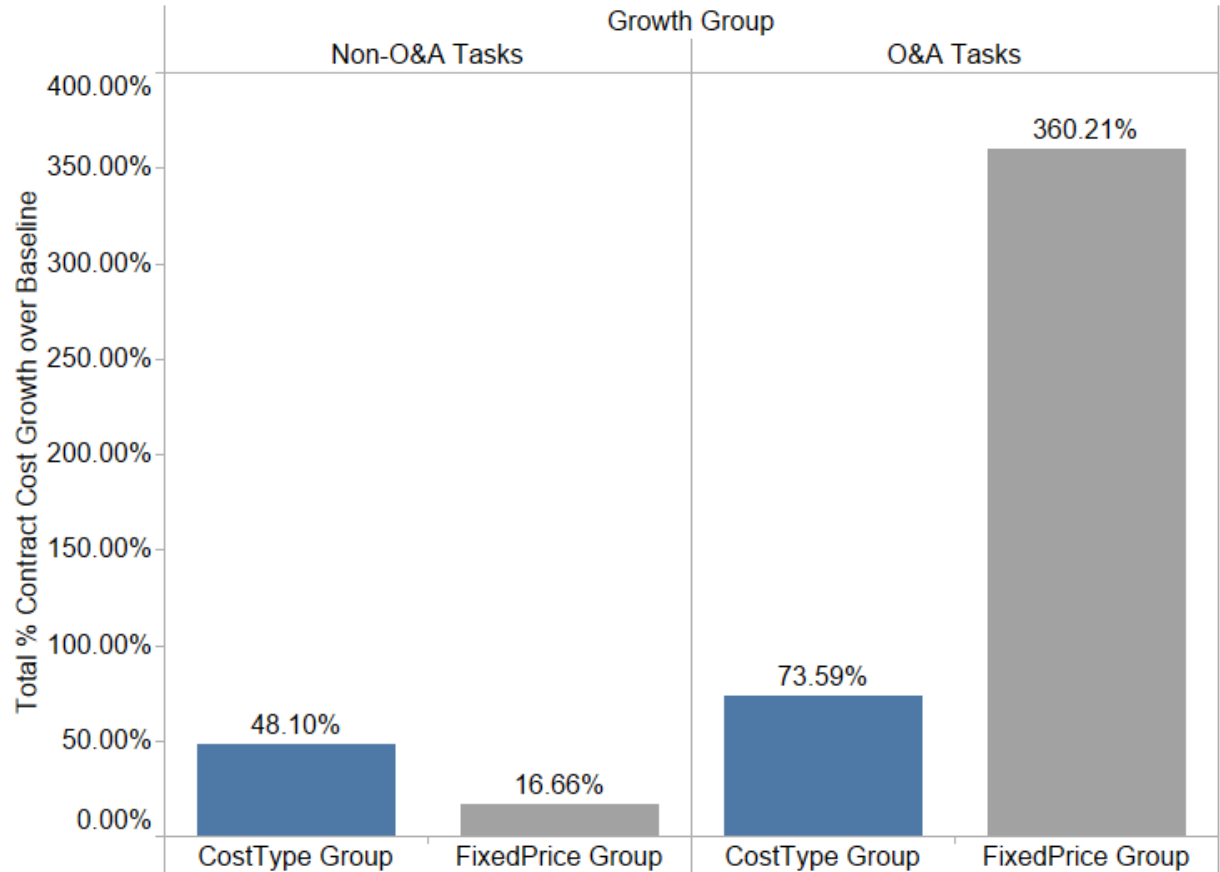




Contract Task-Level Analysis Over & Above (O&A) Work & Growth

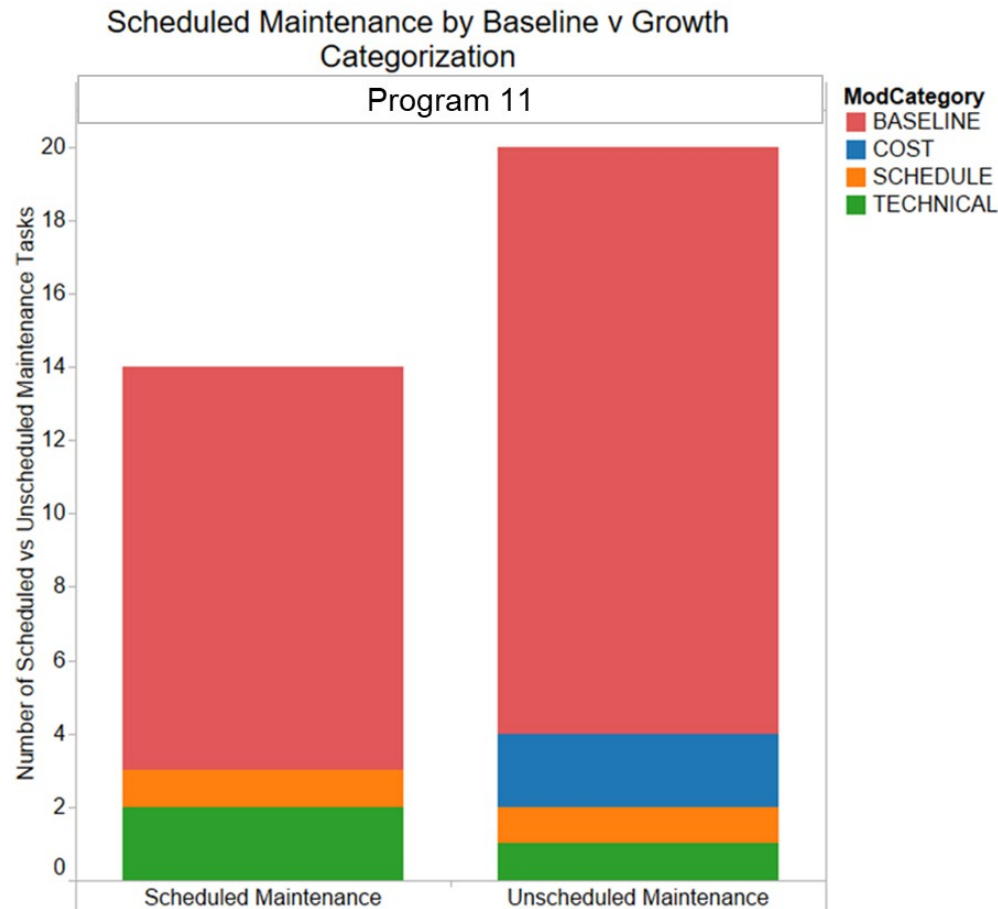
125.31%
cost growth occurred for work defined as O&A, compared to 30.87% cost growth for non-O&A-type work

Total Cost Growth for Non-O&A and O&A Tasks





Contract Task-Level Analysis Unscheduled Maintenance & Growth



All **Unscheduled Maintenance** is found on a **T&M** contract, within the **CostType** group, compared to **Scheduled Maintenance** found on a **Firm Fixed Price** contract.

For Program 11,
26.03%
cost growth occurred for work defined as **Unscheduled Maintenance**, compared to 6.62% cost growth for **Scheduled Maintenance**.



Future Research Suggestions/Ideas

- Expand dataset as more sustainment contracts are updated & added to database
- Refine how EEIC-level details map to work categories to further define & distinguish contract tasks
- Potential to use data analytics methodologies to perform Clustering
 - Identify groups with commonalities based on descriptive contract language (unlabeled data)
 - Expand dataset to examine other factors, compare groups, and estimate relationships to contract cost growth
 - Example: “Material” vs. “Labor” from CLIN Descriptions
 - What types of contracts are typical for these groups?
 - Do we see a different rate of growth based on these groups?



Questions?




Backup



Common Definitions & Terms

Contract Types & When to Use (based on DAU):

	Firm-Fixed Price (FFP)	Fixed-Price Award Fee (FPAF)	Cost-Plus-Incentive-Fee (CPIF)	Cost-Plus-Award-Fee (CPAF)	Cost-Plus-Fixed-Fee (CPFF)	Cost or Cost-Sharing (C or CS)	Time & Materials (T&M)
Use When...	The requirement is well-defined. <ul style="list-style-type: none"> Contractors are experienced in meeting it. Market conditions are stable. Financial risks are otherwise insignificant. 	Judgmental standards can be fairly applied by the fee determining official. The potential fee is large enough to both: <ul style="list-style-type: none"> Provide a meaningful incentive. Goodwill is the value of the name, reputation, location, and intangible assets of the firm. Justify related administrative burdens. 	An objective relationship can be established between the fee and such measures of performance as actual costs, delivery dates, performance benchmarks, and the like.	Objective incentive targets are not feasible for critical aspects of performance. Judgmental standards can be fairly applied. Potential fee would provide a meaningful incentive.	Relating fee to performance (e.g., to actual costs) would be unworkable or of marginal utility.	The contractor expects substantial compensating benefits for absorbing part of the costs and/or foregoing fee or the vendor is a non-profit entity.	No other type of contract is suitable (e.g., because costs are too low to justify an audit of the contractor's indirect expenses).
Elements	A firm-fixed-price for each line item or one or more groupings of line items.	<ul style="list-style-type: none"> Fixed-price Award amount Award fee evaluation criteria and procedures for measuring performance against the criteria 	<ul style="list-style-type: none"> Target cost A minimum, maximum, and target fee A formula for adjusting fee based on actual costs and/or performance Performance targets (optional) 	<ul style="list-style-type: none"> Estimated cost Base amount, if applicable, and an award amount Award fee evaluation criteria and procedures for measuring performance against the criteria 	<ul style="list-style-type: none"> Estimated cost Fixed fee 	<ul style="list-style-type: none"> Total estimated cost No fee If CS, an agreement on the Government's share of the cost. 	<ul style="list-style-type: none"> Ceiling price A per-hour labor rate that also covers overhead and profit Provisions for reimbursing direct material costs
Typical Application	Commercial supplies and services.	Performance-based contracts.	Research and development of the prototype for a major system.	Large scale research study.	Research study.	Joint research with educational institutions.	Emergency repairs to heating plants and aircraft engines.



Overall Dataset Descriptive Statistics

The average is higher than the median, telling us the data is skewed to the right.



The median might provide a more consistent measure of central location.

	Total % Cumulative Growth	Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Total Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)
Average	80.91%	67.95%	17.35%	35.96%
Median	17.96%	9.45%	2.92%	1.23%
Max	990.55%	1035.86%	212.26%	533.27%
Min	-32.72%	-0.15%	-45.31%	-0.30%
Range	1023.27%	1036.02%	257.57%	533.57%
Variance	308.37%	291.48%	20.36%	176.09%
S.D.	175.60%	170.73%	45.13%	132.70%
C.V.	217.04%	251.26%	260.12%	369.04%

High variability in the data.



Overall Growth Calculations for Dataset Grouped by Program

When looking at the data across contract-type groups, we observe high and low cost growth percentages, regardless of contract type.

Program	Contract Number	Contract Type	Range of Years (Mod Date Year)	Total % Cumulative Growth	Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Total Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)	Average % Cumulative Growth Over Time Period
Program 1	Contract 1a	T&M	2001 - 2013	9.73%	8.53%	-0.35%	1.56%	9.41%
Program 1	Contract 1a	FFP	2001 - 2014	28.56%	18.29%	-0.06%	10.33%	112.46%
Program 1	Contract 1b	COST	2015 - 2020	-23.09%	1.06%	-24.15%		-28.71%
Program 1	Contract 1b	FFP	2015 - 2021	4.47%	0.03%	4.44%		1.72%
Program 2	Contract 2	COST	2003 - 2013	6.18%	3.23%	0.87%	2.08%	21.32%
Program 2	Contract 2	CPIF	2009 - 2014	14.44%	14.74%	14.74%	-0.30%	16.50%
Program 2	Contract 2	T&M	2002 - 2016	8.67%	0.95%	7.10%	0.62%	25.94%
Program 2	Contract 2	FFP	2002 - 2015	9.82%	9.94%	-0.12%		307.02%
Program 3	Contract 3	T&M	2009 - 2018	89.27%	46.51%	42.76%		45.20%
Program 3	Contract 3	FFP	2009 - 2017	327.24%	327.27%	-0.04%		159.42%
Program 5	Contract 5	CPAF	2000 - 2005	4.78%		4.78%		-18.26%
Program 5	Contract 5	FFAF	2000 - 2003	86.97%	56.27%	30.71%		54.55%
Program 4	Contract 4b	COST	2005 - 2010	40.28%	60.21%	-19.92%		34.02%
Program 4	Contract 4b	T&M	2002 - 2010	247.91%	203.54%	44.27%		140.35%
Program 4	Contract 4b	FFP	2003 - 2010	990.55%	1035.86%	-45.31%		1345.92%
Program 10	Contract 4b	COST	2002 - 2008	19.21%	19.69%	-0.48%		30.24%
Program 10	Contract 4b	T&M	2002 - 2011	94.17%	94.91%	-0.74%		69.32%
Program 10	Contract 4b	FFP	2002 - 2008	17.96%	16.50%	1.46%		17.36%
Program 4	Contract 4a	CPIF	2016 - 2019	17.63%		17.63%		40.34%
Program 4	Contract 4a	CPFF	2016 - 2017	6.27%	6.27%			3.13%
Program 4	Contract 4a	T&M	2016 - 2018	6.30%	5.94%		0.35%	2.10%
Program 4	Contract 4a	FFP	2016 - 2019	0.15%	0.09%	0.06%		0.17%
Program 6	Contract 6b	COST	2011 - 2018	80.60%	14.18%	66.42%		58.41%
Program 6	Contract 6b	CPFF	2010 - 2018	-0.09%		-0.09%		-0.28%
Program 6	Contract 6b	T&M	2011 - 2016	-32.72%		-32.72%		23.82%
Program 6	Contract 6b	FFP	2010 - 2017	8.80%	1.76%	7.09%	-0.05%	6.32%
Program 6	Contract 6a	COST	2015 - 2018	65.87%	18.69%	47.18%		79.34%
Program 6	Contract 6a	CPFF	2015 - 2018	1.76%		1.76%		0.90%
Program 6	Contract 6a	FFP	2015 - 2018	11.03%	1.58%	6.30%	3.15%	8.30%
Program 6	Contract 6c	COST	2016 - 2018	29.12%	14.19%	14.93%		14.56%
Program 6	Contract 6c	CPFF	2016 - 2018	3.48%	0.56%	2.93%		1.74%
Program 6	Contract 6c	FFP	2016 - 2018	18.36%	6.52%	11.83%		9.18%
Program 7	Contract 7	COST	2005 - 2012	109.39%	11.76%	97.62%		112.10%
Program 7	Contract 7	CPIF	2009 - 2012	55.09%	55.09%			13.77%
Program 7	Contract 7	CPFF	2005 - 2008	-10.51%		-10.51%		-6.10%
Program 7	Contract 7	FFP	2003 - 2012	169.56%	176.33%	-6.77%		180.94%
Program 8	Contract 8	COST	2018 - 2019	89.67%		89.67%		66.68%
Program 8	Contract 8	CPIF	2018 - 2019	165.16%		165.16%		143.44%
Program 8	Contract 8	CPFF	2018 - 2020	27.64%	8.96%	18.68%		25.00%
Program 8	Contract 8	FFP	2018 - 2020	73.42%	0.08%	73.34%		88.37%
Program 9	Contract 9	COST	2003 - 2018	-1.850%	0.903%	-2.753%		-0.78%
Program 9	Contract 9	CPIF	2008 - 2013	44.488%		27.197%	17.291%	40.91%
Program 9	Contract 9	CPFF	2007 - 2018	745.529%		212.257%	533.272%	1014.98%
Program 9	Contract 9	T&M	2002 - 2018	-12.109%	0.959%	-14.016%	0.948%	-1.65%
Program 9	Contract 9	FFP	2005 - 2018	1.310%	1.358%	-0.050%	0.001%	0.97%
Program 11	Contract 11	CPFF	2013 - 2016	-23.26%	-0.15%	-23.11%		-5.81%
Program 11	Contract 11	T&M	2007 - 2016	0.39%	0.40%	-1.29%	1.28%	12.63%
Program 11	Contract 11	FFP	2007 - 2017	5.91%	4.81%	-0.07%	1.18%	13.69%
Program 12	Contract 12	CPAF	2002 - 2016	36.55%	11.44%	25.11%		46.36%
Program 12	Contract 12	CPFF	2004 - 2016	314.33%	334.13%	-19.80%		240.44%
Program 12	Contract 12	T&M	2002 - 2016	233.38%	185.79%	47.59%		223.30%
Program 12	Contract 12	FFP	2002 - 2016	8.63%	5.71%	2.92%		18.72%
Program 13	Contract 13	CPIF	2016 - 2019	181.32%	181.32%			45.33%
Program 13	Contract 13	CPFF	2014 - 2019	41.85%	37.03%	4.56%	0.25%	206.01%
Program 13	Contract 13	FFP	2014 - 2019	0.35%	1.28%	-4.28%	3.36%	-2.98%
			Average	80.91%	67.95%	17.35%	35.96%	
			Median	17.96%	9.45%	2.92%	1.23%	



Overall Growth Calculations for Dataset Grouped by Cost Type Contracts

Program	Contract Number	Range of Years (Mod Date Year)	Contract Type	Total % Cumulative Growth	Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Total Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)	Average % Cumulative Growth Over Time Period
Program 1	Contract 1a	2001 - 2013	T&M	9.73%	8.53%	-0.35%	1.56%	9.41%
Program 1	Contract 1b	2015 - 2020	COST	-23.09%	1.06%	-24.15%		-28.71%
Program 2	Contract 2	2003 - 2013	COST	6.18%	3.23%	0.87%	2.08%	21.32%
Program 2	Contract 2	2009 - 2014	CPIF	14.44%		14.74%	-0.30%	16.50%
Program 2	Contract 2	2002 - 2016	T&M	8.67%	0.95%	7.10%	0.62%	25.94%
Program 3	Contract 3	2009 - 2018	T&M	89.27%	46.51%	42.76%		45.20%
Program 5	Contract 5	2000 - 2005	CPAF	4.78%		4.78%		-18.26%
Program 4	Contract 4b	2005 - 2010	COST	40.28%	60.21%	-19.92%		34.02%
Program 4	Contract 4b	2002 - 2010	T&M	247.91%	203.54%	44.27%		140.35%
Program 10	Contract 4b	2002 - 2008	COST	19.21%	19.69%	-0.48%		30.24%
Program 10	Contract 4b	2002 - 2011	T&M	94.17%	94.91%	-0.74%		69.32%
Program 4	Contract 4a	2016 - 2019	CPIF	17.63%		17.63%		40.34%
Program 4	Contract 4a	2016 - 2017	CPFF	6.27%	6.27%			3.13%
Program 4	Contract 4a	2016 - 2018	T&M	6.30%	5.94%		0.35%	2.10%
Program 6	Contract 6b	2011 - 2018	COST	80.60%	14.18%	66.42%		58.41%
Program 6	Contract 6b	2010 - 2018	CPFF	-0.09%		-0.09%		-0.28%
Program 6	Contract 6b	2011 - 2016	T&M	-32.72%		-32.72%		23.82%
Program 6	Contract 6a	2015 - 2018	COST	65.87%	18.69%	47.18%		79.34%
Program 6	Contract 6a	2015 - 2018	CPFF	1.76%		1.76%		0.90%
Program 6	Contract 6c	2016 - 2018	COST	29.12%	14.19%	14.93%		14.56%
Program 6	Contract 6c	2016 - 2018	CPFF	3.48%	0.56%	2.93%		1.74%
Program 7	Contract 7	2005 - 2012	COST	109.39%	11.76%	97.62%		112.10%
Program 7	Contract 7	2009 - 2012	CPIF	55.09%	55.09%			13.77%
Program 7	Contract 7	2005 - 2008	CPFF	-10.51%		-10.51%		-6.10%
Program 8	Contract 8	2018 - 2019	COST	89.67%		89.67%		66.68%
Program 8	Contract 8	2018 - 2019	CPIF	165.16%		165.16%		143.44%
Program 8	Contract 8	2018 - 2020	CPFF	27.64%	8.96%	18.68%		25.00%
Program 9	Contract 9	2003 - 2018	COST	-1.850%	0.903%	-2.753%		-0.78%
Program 9	Contract 9	2008 - 2013	CPIF	44.488%		27.197%	17.291%	40.91%
Program 9	Contract 9	2007 - 2018	CPFF	745.529%		212.257%	533.272%	1014.98%
Program 9	Contract 9	2002 - 2018	T&M	-12.109%	0.959%	-14.016%	0.948%	-1.65%
Program 11	Contract 11	2013 - 2016	CPFF	-23.26%	-0.15%	-23.11%		-5.81%
Program 11	Contract 11	2007 - 2016	T&M	0.39%	0.40%	-1.29%	1.28%	12.63%
Program 12	Contract 12	2002 - 2016	CPAF	36.55%	11.44%	25.11%		46.36%
Program 12	Contract 12	2004 - 2016	CPFF	314.33%	334.13%	-19.80%		240.44%
Program 12	Contract 12	2002 - 2016	T&M	233.38%	185.79%	47.59%		223.30%
Program 13	Contract 13	2016-2019	CPIF	181.32%	181.32%			45.33%
Program 13	Contract 13	2014 - 2019	CPFF	41.85%	37.03%	4.56%	0.25%	206.01%
				Total % Cumulative Growth	Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Total Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)	
Cost Type Group				Average	70.71%	49.11%	23.63%	55.74%
				Median	23.43%	11.76%	4.67%	1.11%
				Max	745.53%	334.13%	212.26%	533.27%
				Min	-32.72%	-0.15%	-32.72%	-0.30%
				Range	778.25%	334.28%	244.98%	533.57%
				Variance	190%	68%	27%	282%
				S.D	138%	82%	52%	168%
				CV	195%	168%	220%	301%



Overall Growth Calculations for Dataset Grouped by Fixed Price Contracts

Program	Contract Number	Range of Years (Mod Date Year)	Contract Type	Total % Cumulative Growth	Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Total Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)	Average % Cumulative Growth Over Time Period	
Program 1	Contract 1a	2001 - 2014	FFP	28.56%	18.29%	-0.06%	10.33%	112.46%	
Program 1	Contract 1b	2015 - 2021	FFP	4.47%	0.03%	4.44%		1.72%	
Program 2	Contract 2	2002 - 2015	FFP	9.82%	9.94%	-0.12%		307.02%	
Program 3	Contract 3	2009 - 2017	FFP	327.24%	327.27%	-0.04%		159.42%	
Program 5	Contract 5	2000 - 2003	FPAF	86.97%	56.27%	30.71%		54.55%	
Program 4	Contract 4b	2003 - 2010	FFP	990.55%	1035.86%	-45.31%		1345.92%	
Program 10	Contract 4b	2002 - 2008	FFP	17.96%	16.50%	1.46%		17.36%	
Program 4	Contract 4a	2016 - 2019	FFP	0.15%	0.09%	0.06%		0.17%	
Program 6	Contract 6b	2010 - 2017	FFP	8.80%	1.76%	7.09%	-0.05%	6.32%	
Program 6	Contract 6a	2015 - 2018	FFP	11.03%	1.58%	6.30%	3.15%	8.30%	
Program 6	Contract 6c	2016 - 2018	FFP	18.36%	6.52%	11.83%		9.18%	
Program 7	Contract 7	2003 - 2012	FFP	169.56%	176.33%	-6.77%		180.94%	
Program 8	Contract 8	2018 - 2020	FFP	73.42%	0.08%	73.34%		88.37%	
Program 9	Contract 9	2005 - 2018	FFP	1.310%	1.358%	-0.050%	0.001%	0.97%	
Program 11	Contract 11	2007 - 2017	FFP	5.91%	4.81%	-0.07%	1.18%	13.69%	
Program 12	Contract 12	2002 - 2016	FFP	8.63%	5.71%	2.92%		18.72%	
Program 13	Contract 13	2014 - 2019	FFP	0.35%	1.28%	-4.28%	3.36%	-2.98%	
				Fixed Price Group	Total % Cumulative Growth	Total Cumulative Technical Growth (Technical \$\$/Total Baseline \$)	Total Cumulative Cost Growth (Cost \$\$/Total Baseline \$)	Total Cumulative Schedule Growth (Schedule \$\$/Total Baseline \$)	
				Average	103.71%	97.86%	4.79%	2.99%	
				Median	11.03%	5.71%	0.06%	2.17%	
				Max	990.55%	1035.86%	73.34%	10.33%	
				Min	0.15%	0.03%	-45.31%	-0.05%	
				Range	990.40%	1035.83%	118.66%	10.38%	
				Variance	593%	658%	5%	0%	
				S.D	244%	256%	23%	4%	
				CV	235%	262%	476%	130%	



Key Acronyms

CLS – Contractor Logistics Support	TO – Technical Orders
CPAF – Cost Plus Award Fee	ULM – Unit Level Maintenance
CPFF – Cost Plus Fixed Fee	WSS – Weapon System Sustainment
CPIF – Cost Plus Incentive Fee	
COST – Cost Reimbursable	
DLM – Depot-Level Maintenance	
DLR – Depot-Level Repairable	
DMAG – Depot Maintenance Activity Group	
DPEM – Depot Purchased Equipment Mx	
EAC – Estimate at Completion	
EEIC – Element of Expense Investment Code	
EVM – Earned Value Management	
FPAF – Fixed Price Award Fee	
FFP – Firm-Fixed Price	
O&A – Over & Above	
O&S – Operations & Sustainment	
OMEI – Other Major End Item	
PBL – Performance-Based Logistics	
PDM – Programmed Depot Maintenance	
SE – Sustaining Engineering	
SS/PM – Sustaining Support/Program Management	
T&M – Time and Materials	



References

- Arnold, Darryl. 2020. *Contract Growth Study*. Study, Arlington, VA: Tecolote Research, Inc.
- Blickstein, Irv, Jeffrey A. Drezner, Brian McInnis, Megan McKernan, Charles Nemfakos, Jerry M. Sollinger, and Carolyn Wong. 2012. *Methodologies in Analyzing the Root Causes of Nunn-McCurdy Breaches*. Technical, Santa Monica: RAND Corporation. https://www.rand.org/pubs/technical_reports/TR1248.html.
- Bolten, Joseph G., Robert S. Leonard, Mark V. Arena, Obaid Younossi, and Jerry M. Sollinger. 2008. *Sources of Weapon System Cost Growth: Analysis of 35 Major Defense Acquisition Programs*. Research, Santa Monica: RAND Corporation. <https://www.rand.org/pubs/monographs/MG670.html>.
- Christensen, David S. 1993. "An Analysis of Cost Overruns on Defense Acquisition Contracts." *Project Management Journal* 43-48.
- Davis, Dan, and Philip S. Anton. 2016. *Annual Growth of Contract Costs for Major Programs in Development and Early Production*. Research, Washington, D.C.: U.S. Department of Defense, PARCA. <https://www.acq.osd.mil/fo/docs/Growth-of-Contracted-Costs-21Mar2016.pdf>.
- Defense Acquisition University. 2022. *Sustainment Contracts*. January 10. Accessed December 27, 2021. <https://aaf.dau.edu/aaf/mca/sustainment-contracts/>.
- Fast, William. 2007. "Sources of Program Cost Growth." *Defense AT&L*, April: 24-27. https://dau.edu/library/defense-atl/DATLFiles/2007_03_04/fas_ma07.pdf.
- Hunter, Andrew. 2017. *Incentives in Performance-Based Logistics Contracting*. Research, Monterey: Center for Strategic and International Studies. <https://defense360.csis.org/performance-based-logistics-contracting/>.
- Lorell, Mark A., Leslie Adrienne Payne, and Karishma R. Mehta. 2017. *Program Characteristics that Contribute to Growth: A Comparison of AF MDAPs*. Research, Santa Monica: RAND Corporation. doi:<https://doi.org/10.7249/RR1761>.
- Lorell, Mark A., Robert S. Leonard, and Abby Doll. 2015. *Extreme Cost Growth: Themes from Six U.S. Air Force MDAPs*. Research, Santa Monica: RAND Corporation. https://www.rand.org/pubs/research_reports/RR630.html.
- McNicol, David L. 2020. *Root Causes of Cost Growth in Major Defense Acquisition Programs*. Research, Alexandria: Institute for Defense Analysis. apps.dtic.mil/sti/pdfs/AD1131691.pdf.
- Office of the Secretary of Defense - Cost Assessment and Program Evaluation. 2020. *Operating and Support Cost Estimating Guide*. Guide, Washington, D.C.: Department of Defense. https://www.cape.osd.mil/files/OS_Guide_Sept_2020.pdf.
- Technomics, Inc. 2021. *Interactive Contract Database & Analysis Tool (Version 6.0)*. User Guide, Arlington: Technomics, Inc.
- U.S. Government Accountability Office. 2020. *Cost-Type Contracts: Procedures Needed for Sharing Information on Contract Choice among Military Departments*. Congressional, Washington, D.C.: U.S. Government Accountability Office. <https://www.gao.gov/products/gao-20-352>.