

# Self-Assessment: Which set of terminology are you comfortable with in THEORY and in PRACTICE?

OSD CAPE

Level 1



Dollars (\$)

Level 2



Then-Year Dollars (TY\$)  
Base-Year Dollars (BY\$)

Inflation

Level 3



TY\$  
Constant-Year Dollars (CY\$)  
Constant Price (CP\$)

Inflation  
Escalation  
Real Price Change

Level 4



TY\$ obligations  
TY\$ expenditures  
CY\$ obligations  
CY\$ expenditures  
CP\$

Inflation  
Escalation  
Real Price Change

Level 5



Level 4 plus commodity-specific index identification/creation



OFFICE OF THE SECRETARY OF DEFENSE  
COST ASSESSMENT AND PROGRAM EVALUATION

# Inflation and Escalation Best Practices for Cost Analysis

2022

CAPE Public Website:  
<https://www.cape.osd.mil/>

The overall classification of this briefing is:  
UNCLASSIFIED

Presented for the ICEAA OEM COG: [www.iceaaonline.com/oemcog](http://www.iceaaonline.com/oemcog)

# Background and Problem Statement

OSD CAPE

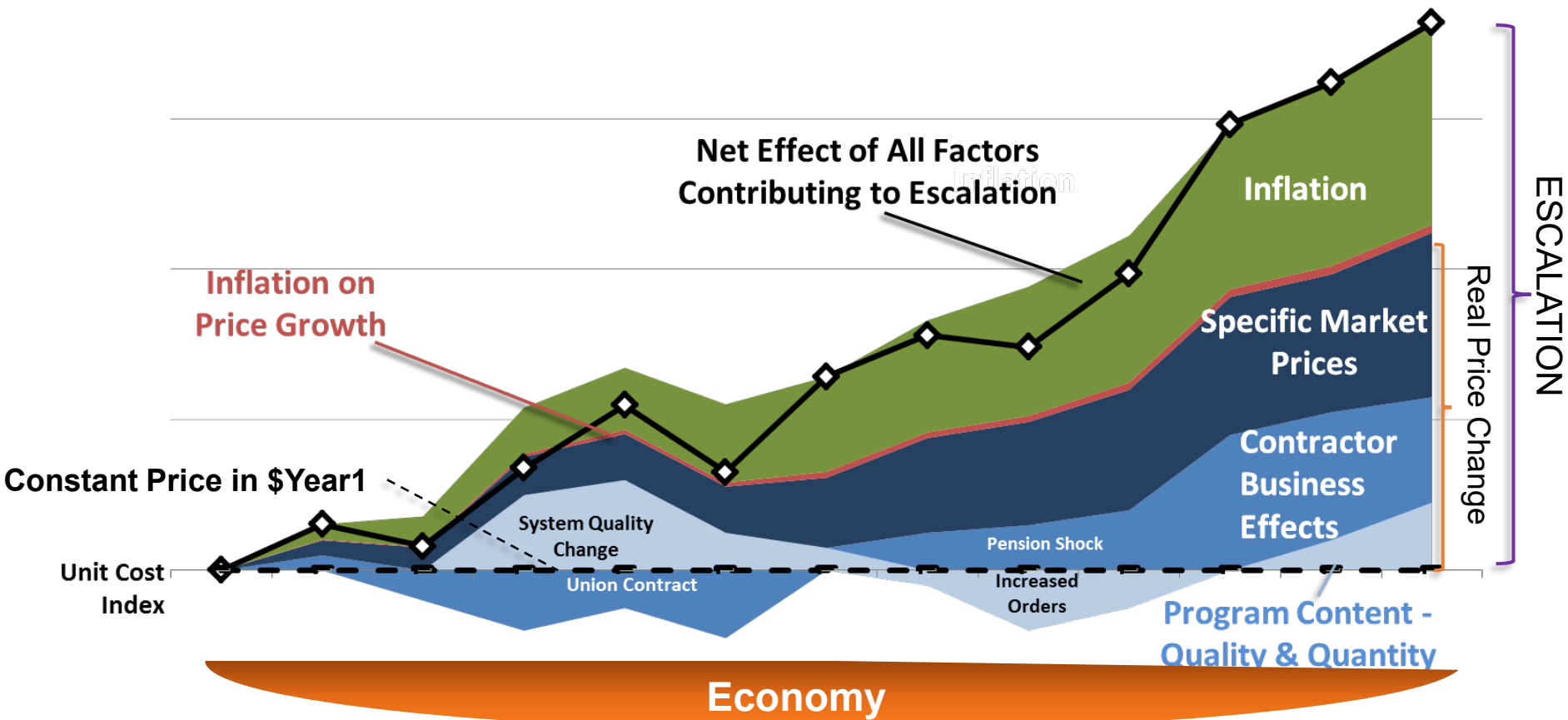
- **Cost analysis requires proper accounting for growth in the prices of military commodities and resources, to include:**
  - Economy-wide inflation
  - Commodity-specific price escalation
- **Department committed to new methodology for price escalation ~2015, but still lacks consistent understanding and application in cost analysis**
- **Improper accounting for escalation distorts budgeting, make-buy decisions, and affordability assessments, and creates challenges for estimate traceability**

**DoD cost estimates do not account for price change in a consistent manner. A shared understanding is a prerequisite for improved cost estimating practices.**

# Economist's framework for understanding real price change

OSD CAPE

Inflation affects all commodities in the economy. Other forces driving Real Price Change may be specific to particular program, broader commodity type, particular contractor, etc.  
 – analysts must research all cost inputs & characterize RPC effects.



# Terminology Warm-Up

OSD CAPE

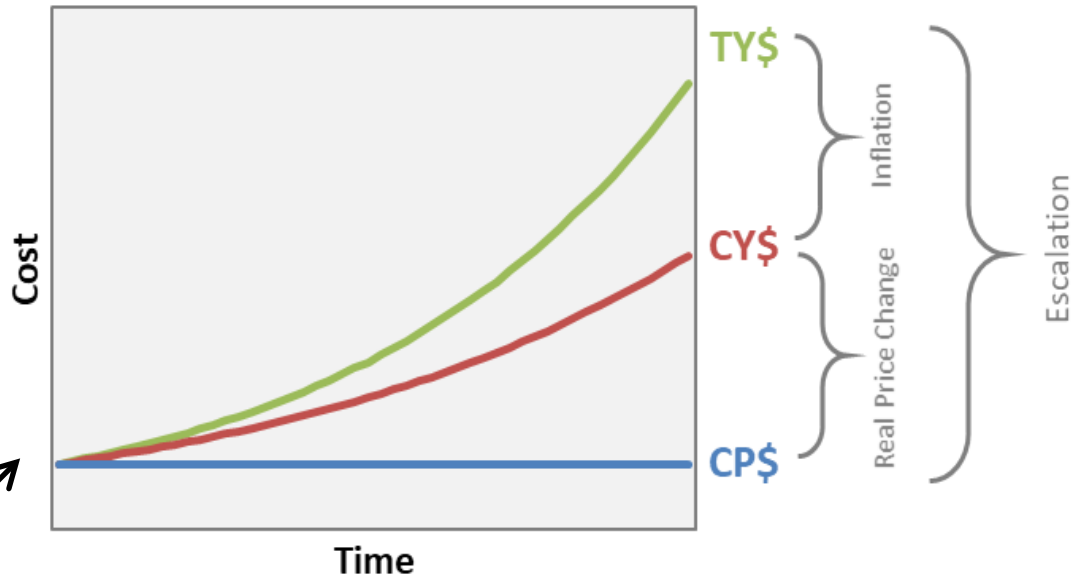
- **Indices** may measure inflation or escalation
  - **Inflation** = economy-wide (DoD uses the GDP price index for inflation)
  - **Escalation** = commodity-specific
- **Obligations** are for budget outputs, **expenditures** are a common input type
  - **Outlay profile** = appropriation-specific spending pattern
  - Obligations include an outlay profile, expenditures do not
- **TY\$** have real-world significance, **CY\$** and **CP\$** are normalized for analytical purposes
  - TY\$ may represent obligations or expenditures (TY\$ obs or TY\$ exp)
  - Removing inflation from TY\$ obs → CY\$ obs; removing inflation from TY\$ exp → CY\$ exp
  - There are FIVE dollar types: TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, CP\$
- Indices may be raw or weighted
  - **Weighted indices** include an outlay profile, **raw indices** do not
  - Use weighted indices with obligations, raw indices with expenditures
- Latest handbook cancels “base-year dollars (BY\$)” as a term in inflation/escalation best practices, but “base years” still exist
  - The old term “BY\$” is ambiguous, may refer to either CY\$ or CP\$
  - **Base year** = analyst-selected reference year for CY\$ or CP\$ (e.g., 2008 is the base year for CY08\$)

**TY\$ = Then-Year Dollars**  
**CY\$ = Constant-Year Dollars**  
**CP\$ = Constant Price**

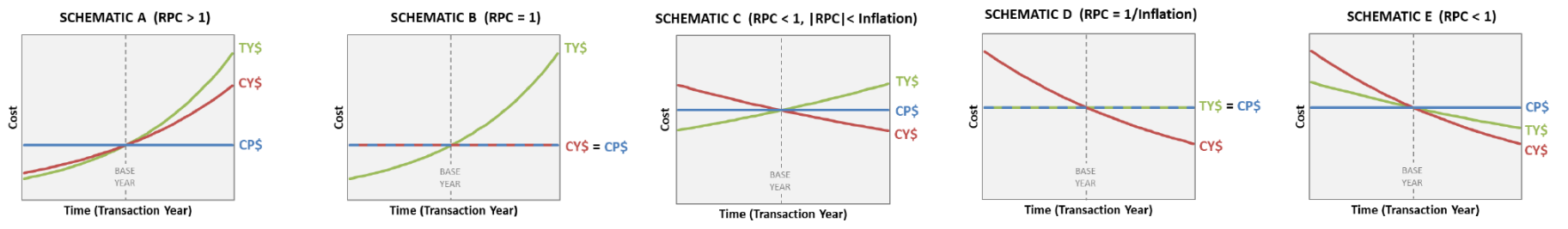
# Terminology Relationships

OSD CAPE

## TERMINOLOGY SCHEMATIC



Dollar type relationships depend on the magnitude and sign of real price change (RPC) relative to inflation



# Basic Terminology: MILPAY Example

OSD CAPE

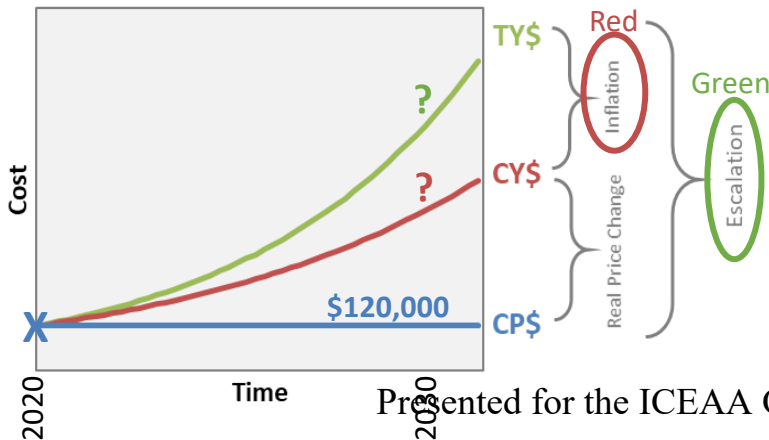
**Question:** Given a military member's salary of \$120,000 in FY 2020, what will the person's salary be in FY 2030, in TY\$ exp and CY20\$ exp?

**Answer:**

$$\text{TY\$ in 2030} = \text{Blue line CP\$ } \$120,000 * \text{Green circle MILPAY raw } 1.3439 = \text{Green line TY\$ } \$161,268$$

$$\text{CY20\$ in 2030} = \text{Green line TY\$ } \$161,268 / \text{Red circle GDPPI } 1.2190 = \text{Red line CY\$ } \$132,295$$

(all indices notional)	GDP Price Index	Military Pay	
		Raw	Weighted
2015	0.9057	0.8626	0.8626
2016	0.9238	0.8885	0.8885
2017	0.9423	0.9151	0.9151
2018	0.9612	0.9426	0.9426
2019	0.9804	0.9709	0.9709
2020	1.0000	1.0000	1.0000
2021	1.0200	1.0300	1.0300
2022	1.0404	1.0609	1.0609
2023	1.0612	1.0927	1.0927
2024	1.0824	1.1255	1.1255
2025	1.1041	1.1593	1.1593
2026	1.1262	1.1941	1.1941
2027	1.1487	1.2299	1.2299
2028	1.1717	1.2668	1.2668
2029	1.1951	1.3048	1.3048
2030	1.2190	1.3439	1.3439



**KEY BEST PRACTICE:**  
 Build your models in CP\$,  
 then escalate to TY\$,  
 then deflate to CY\$.

# When to use each dollar type

OSD CAPE

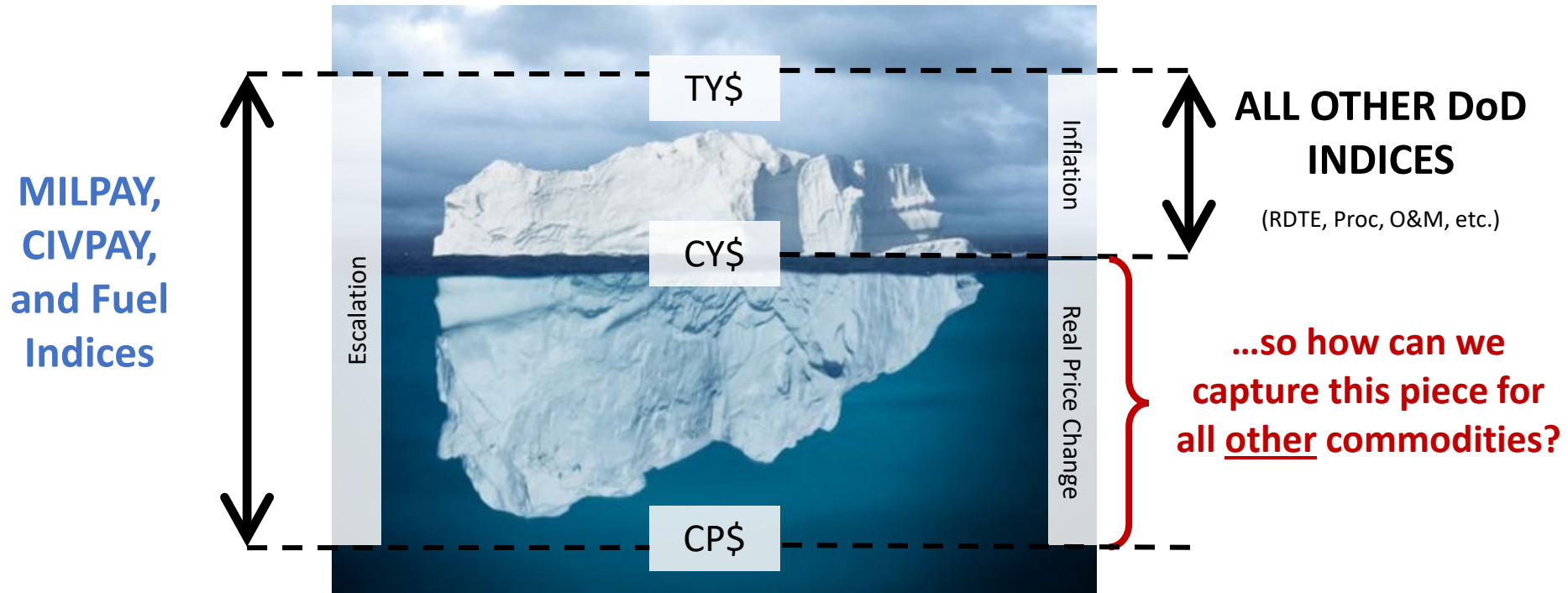
	Recommended for...	Not recommended for...
CP\$	<p><i>Intermediate calculations:</i></p> <ul style="list-style-type: none"> <li>• Average cost factors</li> <li>• Cost Estimating Relationships (CERs)</li> <li>• Cost Improvement Curves (CICs)</li> <li>• Visualizing programmatic trends</li> </ul>	<p><i>Reporting final values:</i></p> <ul style="list-style-type: none"> <li>• External reports beyond DoD cost community, unless well-documented and necessary to explain cost estimate methodology</li> </ul>
TY\$ obs and CY\$ obs	<p><i>Reporting final values:</i></p> <ul style="list-style-type: none"> <li>• Total costs</li> <li>• Reports for stakeholders beyond DoD cost community: <ul style="list-style-type: none"> <li>– Budget (actual budget values in TY\$ obs, with CY\$ obs for comparison in some displays)</li> <li>– Acquisition Program Baseline (APB)</li> <li>– Selected Acquisition Report (SAR)</li> <li>– Analysis of Alternatives (AoA)</li> <li>– Business Case Analysis (BCA)</li> <li>– Affordability Analysis</li> </ul> </li> </ul>	<p><i>Intermediate calculations:</i></p> <ul style="list-style-type: none"> <li>• Calculations other than addition and subtraction with other values of same type (and same base year if CY\$ obs)</li> <li>• Average cost factors across multiple years</li> <li>• CERs</li> <li>• CICs</li> </ul>
TY\$ exp and CY\$ exp	<p><i>Displaying data obtained from primary sources that capture expenditures</i></p>	<p><i>Intermediate calculations or reporting final values (see above)</i></p>

Presented for the ICEAA OEM COG: [www.iceaaonline.com/oemcog](http://www.iceaaonline.com/oemcog)



# Categorizing and Understanding Indices

OSD CAPE

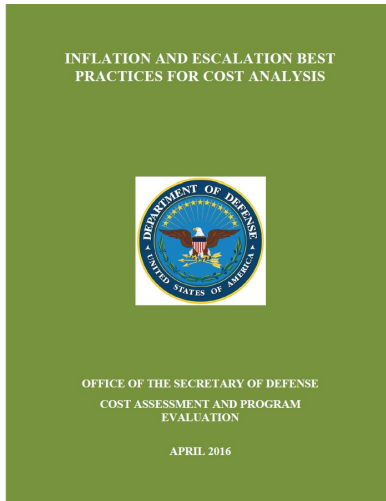


- Many forces cause price change over time
- DoD indices can only fully describe price change for certain commodities

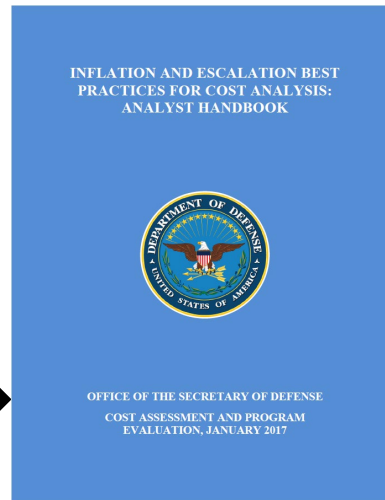
# History of the Inflation/Escalation Best Practices Handbook

OSD CAPE

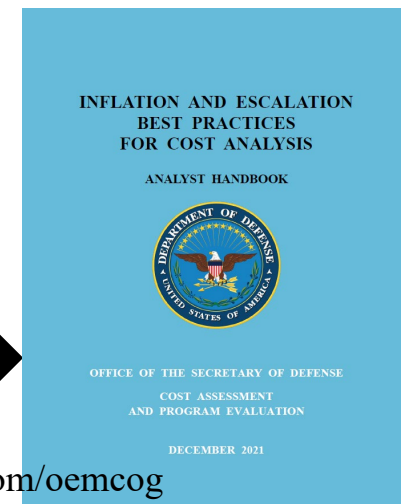
**2016:** Introduced escalation, real price change



**2017:** Expanded on escalation theory, some applications



**2021:** Added step-by-step instructions, clarified definitions for ease of implementation

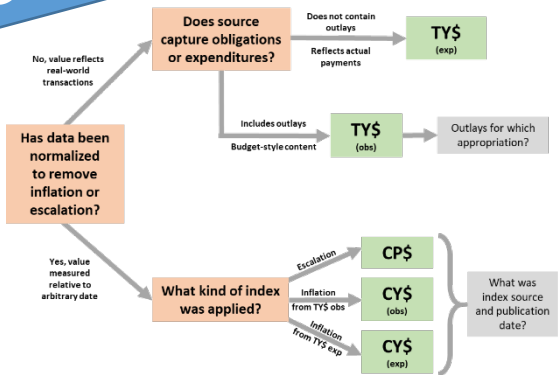


Presented for the ICEAA OEM COG: [www.iceaaonline.com/oemcog](http://www.iceaaonline.com/oemcog)

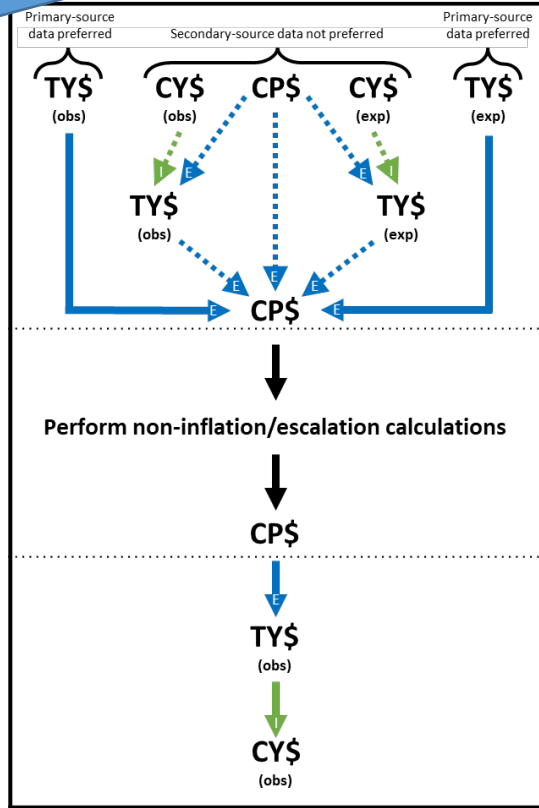
# Flowchart Preview

OSD CAPE

## The CARROT Chart



## The PITCHFORK Chart

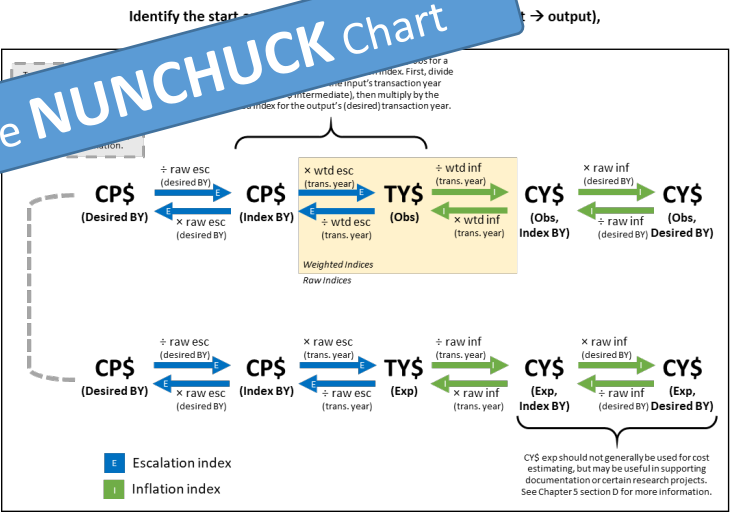


**Phase 1: Gather and normalize inputs.**  
Starting with inputs characterized according to the instructions in Chapter 3, normalize inputs to CP\$. Inputs already normalized to CY\$ or CP\$ may require an intermediate conversion to TY\$ via the index with which they were originally normalized.

**Phase 2: Model costs.**  
Complete any calculations that do not require an inflation or escalation index, such as using the CP\$ input in a cost estimating relationship, to create an average cost factor, to divide by number of units or usage rates, etc. The dollar type remains unchanged.

**Phase 3: Report results.**  
Escalate all CP\$ to create a TY\$ obs estimate by year, including outlays for use in budget preparation and comparisons. Deflate TY\$ obs values for each year to CY\$ obs using appropriation-specific inflation indices for comparative analyses and cost threshold determinations.

## The NUNCHUCK Chart



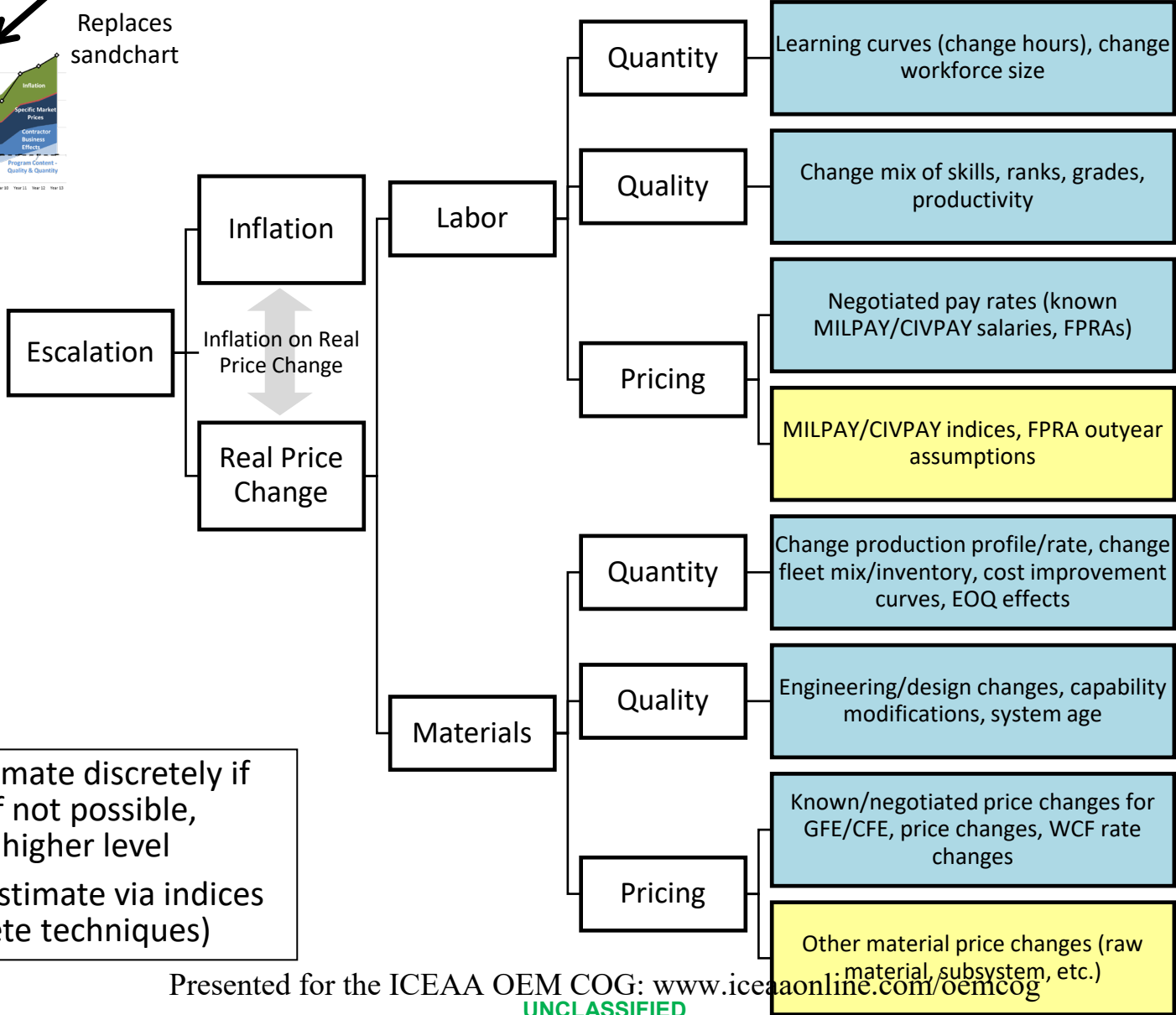
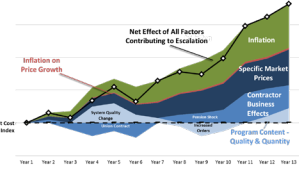
E Escalation index    I Inflation index    No index required

See Chapter 6 for more guidance on index selection.

# New Framework for Analyzing Escalation

OSD CAPE

Replaces sandchart



**Blue** = estimate discretely if possible; if not possible, analyze at higher level  
**Yellow** = estimate via indices (not discrete techniques)

Tailored as applicable to each cost element

# “Where are we now?”

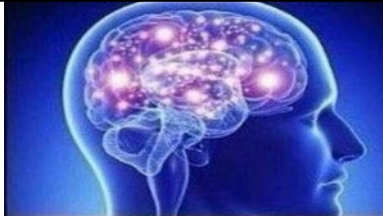
OSD CAPE

**Level 1**



Dollars (\$)

**Level 2**



Then-Year Dollars (TY\$)  
Base-Year Dollars (BY\$)

Inflation

**Level 3**



TY\$  
Constant-Year Dollars (CY\$)  
Constant Price (CP\$)

Inflation  
Escalation  
Real Price Change



**Level 4**



TY\$ obligations  
TY\$ expenditures  
CY\$ obligations  
CY\$ expenditures  
CP\$

Inflation  
Escalation  
Real Price Change

**OSD CAPE**



**Level 5**



Level 4 plus commodity-specific index identification/creation

Further research is needed to identify DoD-relevant indices, and to describe the process for selecting estimate-specific indices.

TRAINING

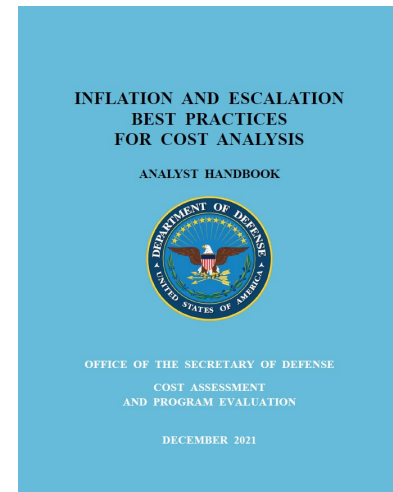
RESEARCH

# BACKUP

# Handbook Chapters (Published December 2021)

OSD CAPE

1. Introduction
2. Terminology (significant expansion)
3. Framework for Analyzing Escalation (NEW)
4. Diagnosing Input Types (NEW)
5. Deciding Output Types (NEW)
6. Choosing an Index (NEW)
7. Calculations and Examples (NEW)
8. How to Minimize Errors and Bias (NEW)
9. Documenting Inflation & Escalation
10. Conclusion
11. Appendices

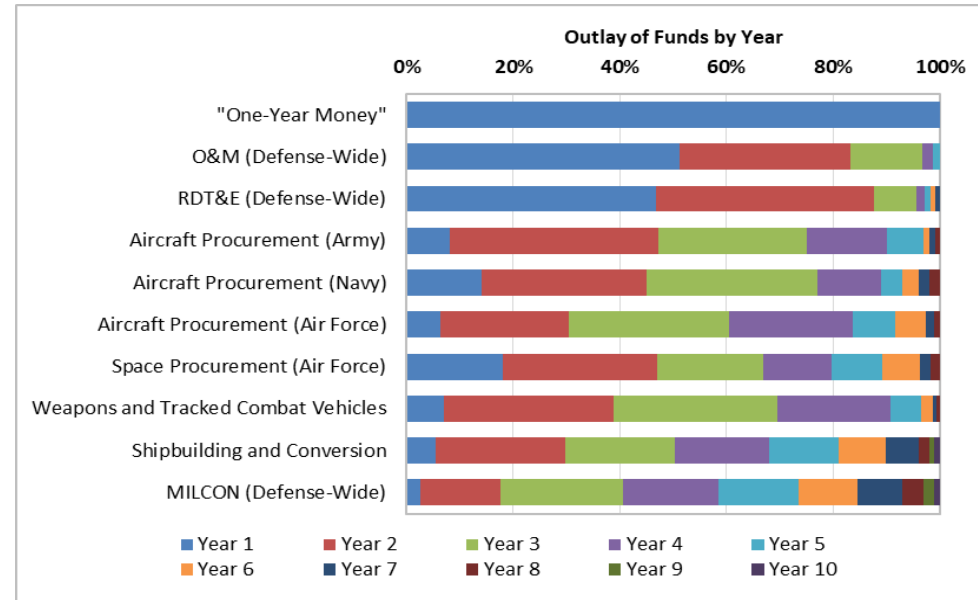


124 pages

# Basic Terminology “One-Slide Wonder”

OSD CAPE

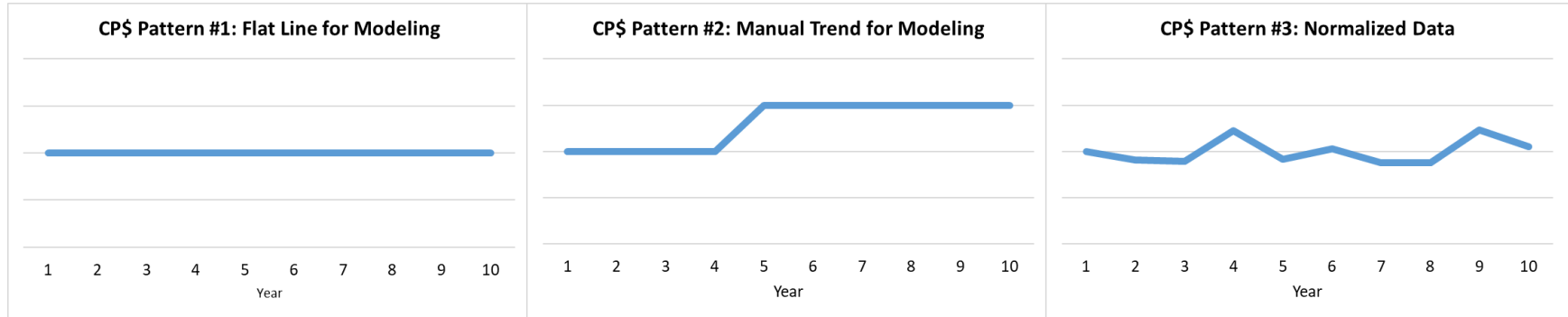
- **Outlay profile:** appropriation-specific spending pattern over time (up to 10 years); see examples on right
- **TY\$** have real-world significance: dollars obligated or dollars expended at particular point in time (**transaction year**)
- **Obligations (TY\$ obs):** typically used for budgets; include an adjustment to account for change in dollar value over time (i.e., over the course of the outlay profile)
- **Expenditures (TY\$ exp):** represent dollars at the time they leave the US Treasury to pay a bill; do not include above adjustment (i.e., no outlay profile applies)
- **Indices** measure price changes over time relative to a given **base year**
  - May measure **inflation** (GDP price index) or **escalation** (any other index)
  - May include the effect of an outlay profile (**weighted indices**) or not (**raw indices**)
- **CY\$** and **CP\$** are normalized relative to a selected **base year** for analytical purposes
  - CY\$ are produced from TY\$ using an inflation index; they may represent obligations (**CY\$ obs**) or expenditures (**CY\$ exp**) based on the type of TY\$ from which they were produced
  - CP\$ may be produced from TY\$ using an escalation index, or may be used to represent analytical assumptions for cost estimate inputs (see next slide)





# Prices don't have to "look constant" to be CP\$

OSD CAPE



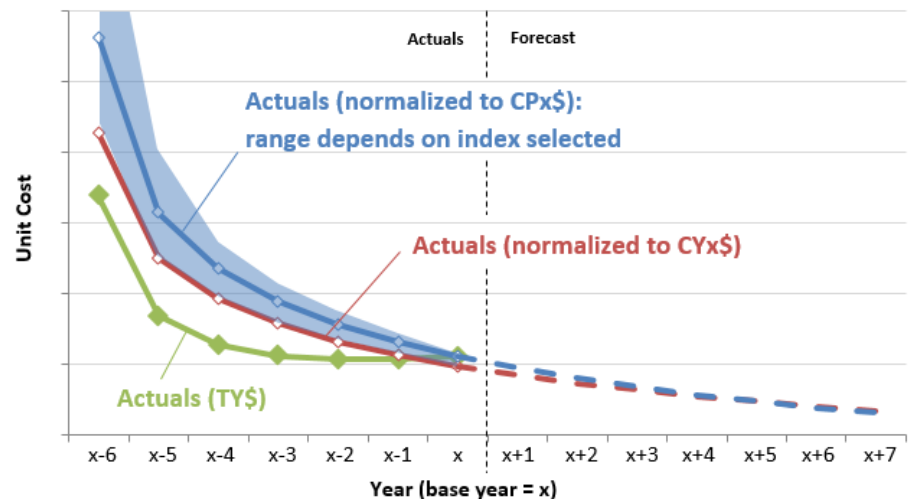
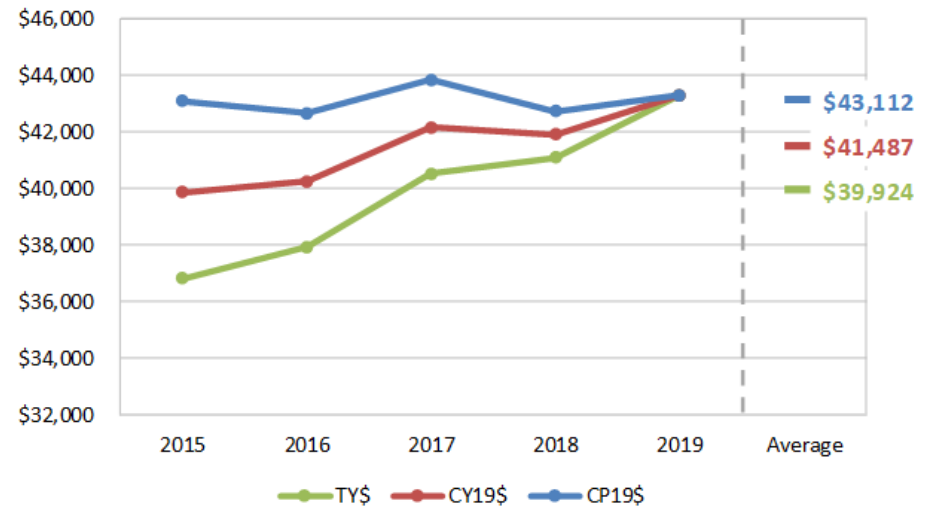
- **CP\$ inputs are useful for modeling purposes, often used to represent constant input value before applying escalation in later steps (Pattern #1) or to represent an input with known, step-function-like cost changes in quantity or quality (Pattern #2)**
- **Normalizing TY\$ data to CP\$ (Pattern #3) is a key step in generating average cost factors, CERs, and cost improvement curves**
  - There are many potential escalation indices for any given normalization, analysts must use their judgment to select appropriate indices
  - Variation that remains after normalization to CP\$ may include quantity changes, quality changes, or price changes that were not captured by the escalation index selected

# Using CP\$ for average cost factors and cost improvement curves

OSD CAPE

- Normalizing TY\$ historical data prior to calculating average cost factors, CERs, and cost improvement curves illuminates trends by removing price variations
- Index selection influences results (e.g., inflation vs. escalation, various available escalation indices)

Full examples available in handbook.



Presented for the ICEAA OEM COG: [www.iceaaonline.com/oemcog](http://www.iceaaonline.com/oemcog)

# Example Calculation

OSD CAPE

## Given:

FY17 cost = \$100  
 FY18 cost = \$105  
 FY17-18 inflation = 2%

$$\text{Price Escalation} = \text{Inflation} * \text{RPC}$$

## Solve for rate of RPC:

Price escalation =  $(\$105 - \$100) / \$100 = 0.05 \rightarrow 5\%$   
 Real Price Change = Price Escalation / Inflation  
 $= 1.05 / 1.02 = 1.0294 \rightarrow 2.94\%$

## How can I visualize these rates as dollar values?

$$\begin{aligned} \$105 &= \$100 * \text{Price Escalation} \\ &= \$100 * (\text{Inflation}) * (\text{RPC}) \\ &= \$100 * (1.02) * (1.0294) \\ &= \$100 * (1 + 0.02) * (1 + 0.0294) \end{aligned}$$

"FOIL" Method:  
 First Outer Inner Last

$$= \$100 * (1 + 0.02 + 0.0294 + [0.02 * 0.0294])$$

Original = \$100    Inflation = \$2    RPC = \$2.94    Inflation on RPC = \$0.06

Rates are multiplicative,  
 dollars are additive.

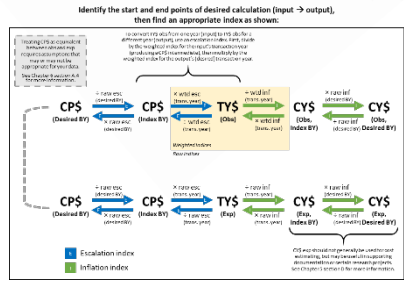
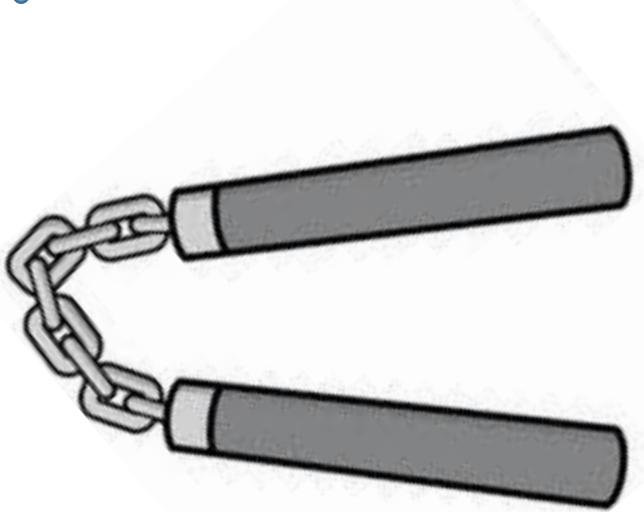
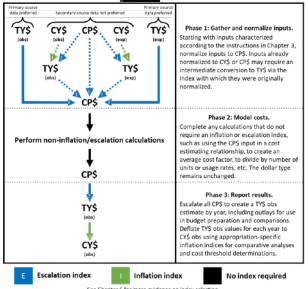
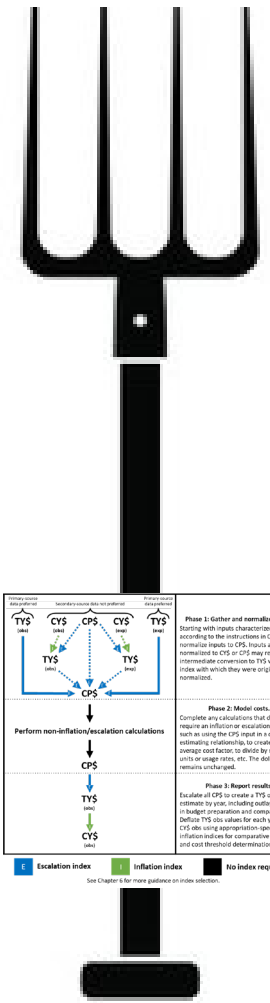
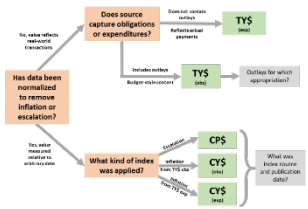
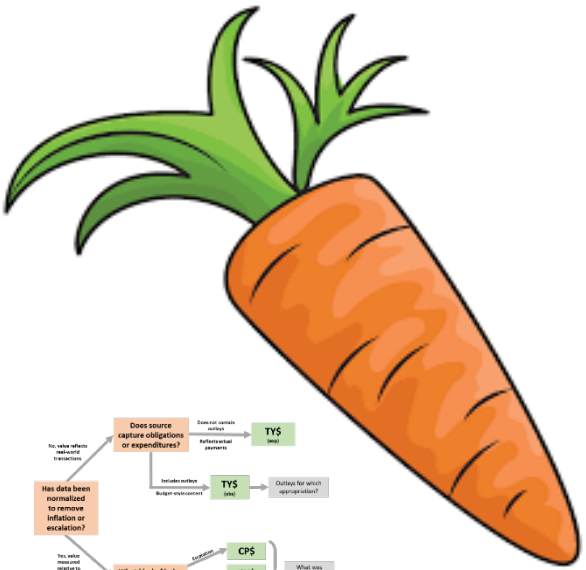
# Tools of the Escalation Trade

OSD CAPE

## The PITCHFORK Chart

## The CARROT Chart

## The NUNCHUCK Chart



# Input Types from Common Data Sources

OSD CAPE

## For TY\$ obs:

- Budget documents
- Acquisition Program Baseline (APB)
- Selected Acquisition Report (SAR)
- Air Force Total Ownership Cost (AFTOC)

## For TY\$ exp:

- Cost and Software Data Report (CSDR)
- Contractor Performance Report (CPR)
- Invoices
- Price lists (e.g., Federal Logistics record [FEDLOG], Army Price and Credit Table [APACT], Air Force D043)
- Naval Visibility and Management of Operations and Support Costs (Naval VAMOSOC)
- Operation and Support Management Information System (OSMIS)

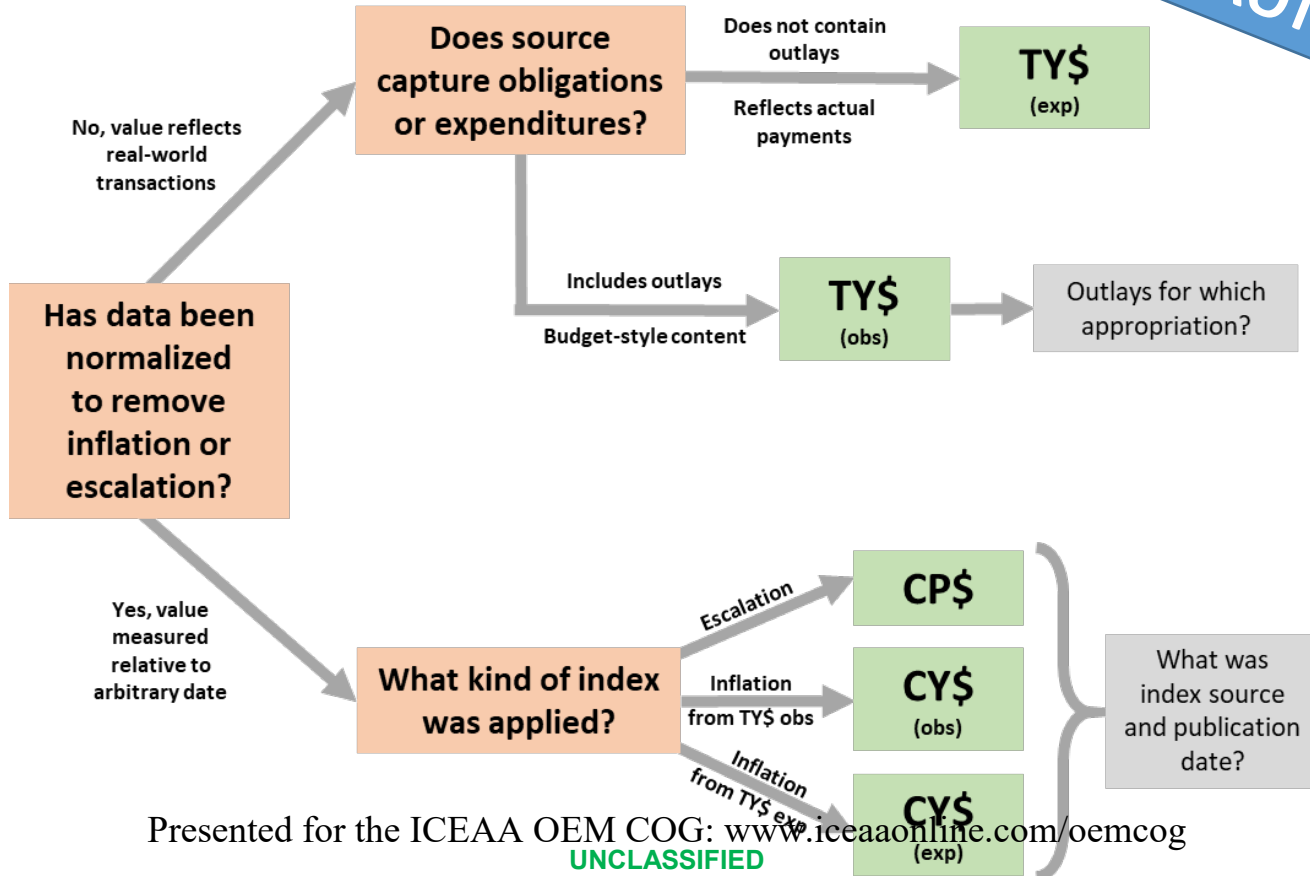
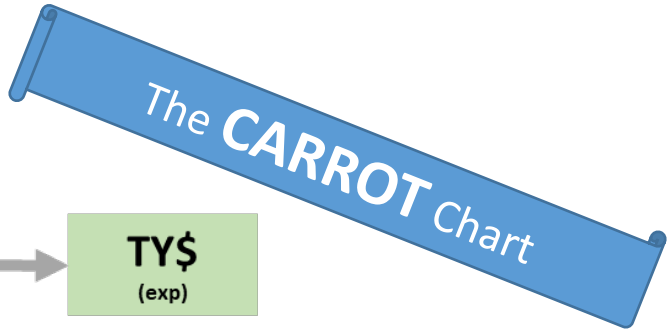
Note: Some of these sources also offer reports in normalized dollars for convenience (e.g., CY\$, CP\$, or carrying other labels). CAPE recommends that analysts perform their own normalization to ensure that they are using the correct kinds of indices for the desired conversions, as some sources do not conform to CAPE's best practices or terminology.

# Input Diagnosis: "How should I treat inputs from unknown or poorly labeled sources?"

OSD CAPE

**DOCUMENTATION CHECKLIST**

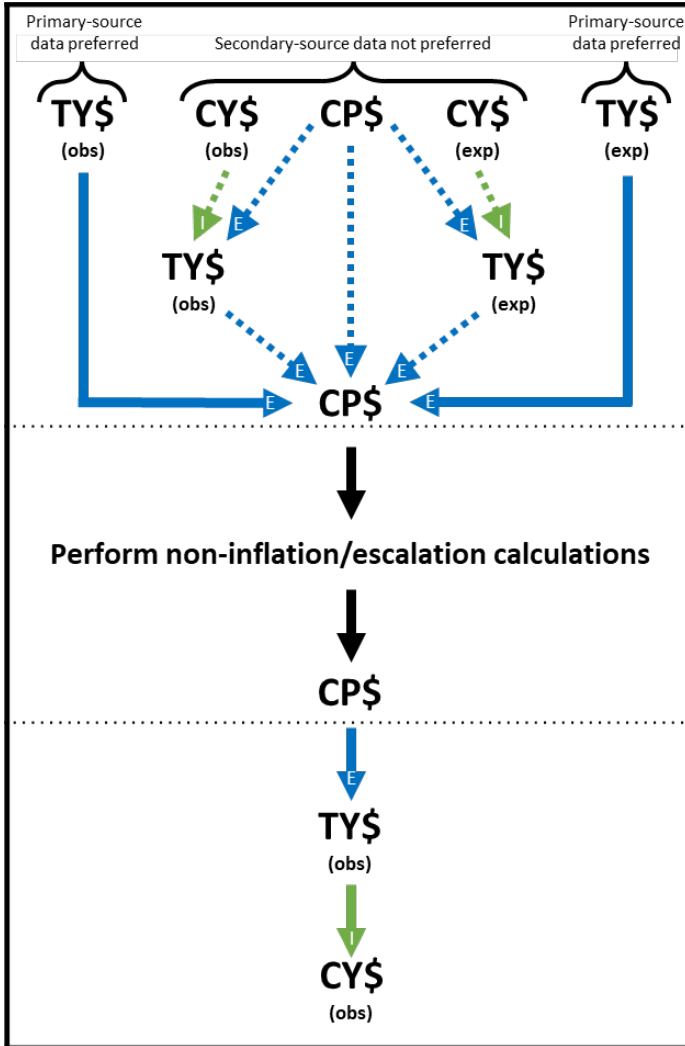
- Value
- Transaction year
- Dollar type (TY\$ obs, TY\$ exp, CY\$ obs, CY\$ exp, CP\$)
- Base year (if CY\$ or CP\$)
- Index applied (if CY\$, CP\$, or future TY\$), including publication date



# Proper Use of Dollar Types in Cost Estimates

OSD CAPE

The **PITCHFORK** Chart



**Phase 1: Gather and normalize inputs.**  
Starting with inputs characterized according to the instructions in Chapter 3, normalize inputs to CP\$. Inputs already normalized to CY\$ or CP\$ may require an intermediate conversion to TY\$ via the index with which they were originally normalized.

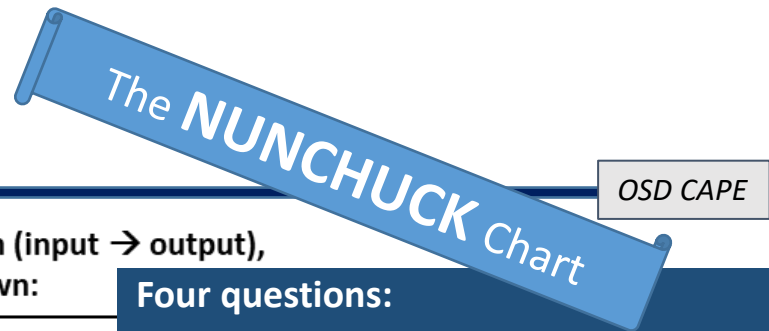
**Phase 2: Model costs.**  
Complete any calculations that do not require an inflation or escalation index, such as using the CP\$ input in a cost estimating relationship, to create an average cost factor, to divide by number of units or usage rates, etc. The dollar type remains unchanged.

**Phase 3: Report results.**  
Escalate all CP\$ to create a TY\$ obs estimate by year, including outlays for use in budget preparation and comparisons. Deflate TY\$ obs values for each year to CY\$ obs using appropriation-specific inflation indices for comparative analyses and cost threshold determinations.

- KEY BEST PRACTICES:**
- Use CP\$ for intermediate calculations, not external reporting
  - Use TY\$ obs and CY\$ obs for external reporting, not intermediate calculations
  - Use TY\$ exp and CY\$ exp as inputs only (not for intermediate calculations or external reporting)

**E** Escalation index      **I** Inflation index      **■** No index required

# Index Selection based on Input & Output Types



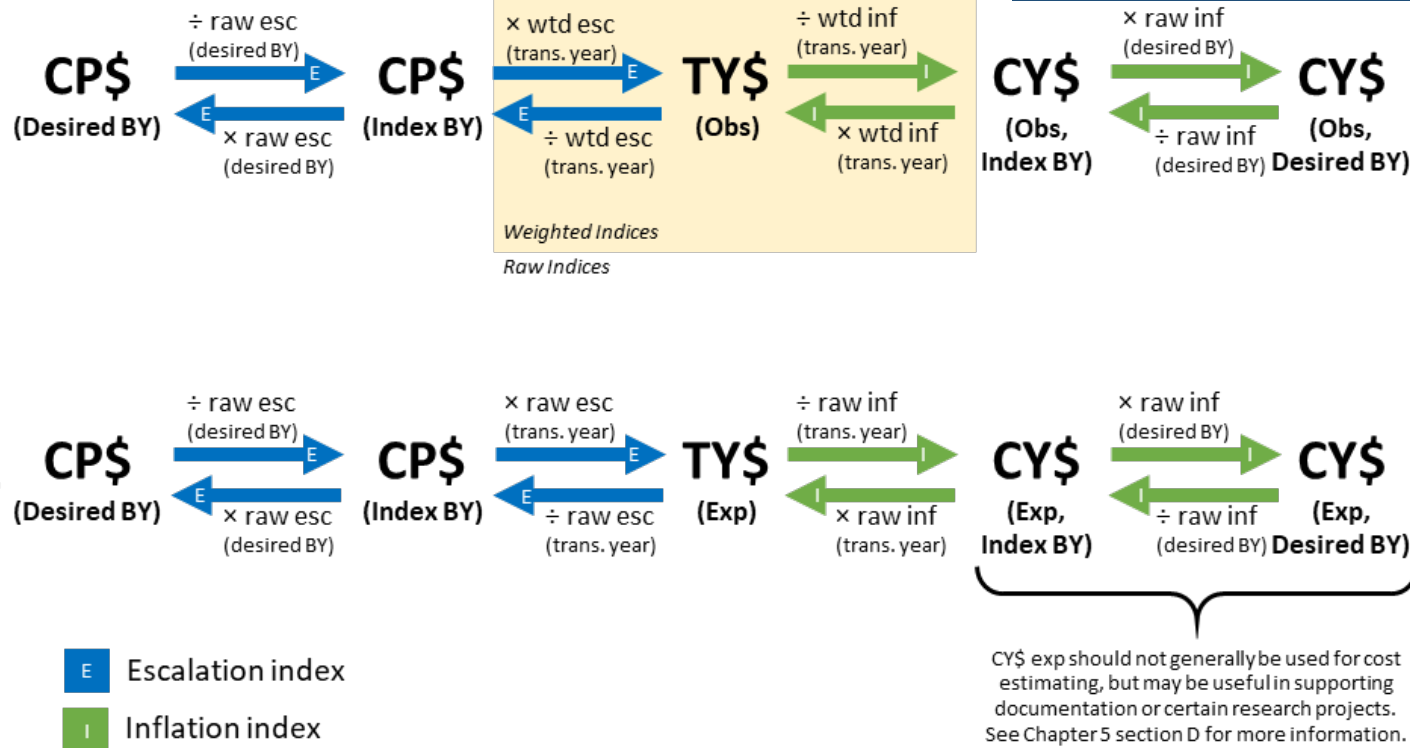
Identify the start and end points of desired calculation (input → output), then find an appropriate index as shown:

Treating CP\$ as equivalent between obs and exp requires assumptions that may or may not be appropriate for your data. See Chapter 6 section A.4 for more information.

To convert TY\$ obs from one year (input) to TY\$ obs for a different year (output), use an escalation index. First, divide by the weighted index for the input's transaction year (producing a CP\$ intermediate), then multiply by the weighted index for the output's (desired) transaction year.

Four questions:

1. What kind of price change?
2. What indices are available?
3. Does input or output have outlays?
4. Does index have all years required?





# See Handbook for Further Information

OSD CAPE

- **Chapter 7: Calculations and Examples**
  - General instructions
  - Working with multi-year or cross-year input values
  - Basic sample calculations
  - Making custom indices
  - Making weighted indices
  - Changing the base year of an index
- **Chapter 8: How to Minimize Errors and Bias**
  - Avoiding avoidable errors
  - Understanding unavoidable bias
  - Reaching valid conclusions
    - Affordability analysis
    - Comparing current and baseline costs
    - Comparing alternative purchases
- **Chapter 9: Documenting and Comparing Estimates**
  - Documenting assumptions
  - Dollar labels on charts and tables
  - Documenting use of a published index
  - Estimate review and reconciliation

# New Handbook Material

OSD CAPE

- More detail on outlay profiles and difference between obligations and expenditures (for TY\$ and CY\$)
- Expanded definition of CP\$ to differentiate between normalized historical data and modeling for forecasts
- Concept of “transaction year” as distinct from “base year”
- Relationship of real price change to quality and quantity changes, effects on cost models when they overlap
- Discrete modeling of RPC vs. modeling via indices
- New “X Chart” showing how to pick an index type
- Step-by-step instructions for basic calculations
- How to assume a midpoint for multi-year inputs, or how to manually allocate to single years
- How to make a custom index
- How to make a weighted index
- How to change the base year of an index
- Chapter discussing uncertainty:
  - What mistakes are avoidable and how do you avoid them?
  - What unavoidable sources of uncertainty are present under certain circumstances, and what should you do about them?