Risk-Adjusted Contract Price Methodology

Modeling of Final Price Outcomes with Greater Fidelity

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Speaking Today

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Subject Matter Expert

As a Subject Matter Expert, Peter Braxton is responsible for implementing best practices in cost and risk analysis at department- and agency-level defense and intelligence clients. Peter has over 20 years of experience and played a key role in developing the independent risk review process at Northrop Grumman. A long-time ICEAA Board member with a focus on Training and Education, Peter has taught extensively at government, corporate, and society training events throughout North America, Europe, and Australia.

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Orly Olbum is an Associate with Technomics, Inc. She has one year cost analysis experience and is currently performing data acquisition and database management for the Air Force Cost Analysis Agency (AFCAA), as well as supporting Space and Naval Warfare Systems Command (SPAWAR) 1.6. She graduated from Penn State with a BS in Statistics.

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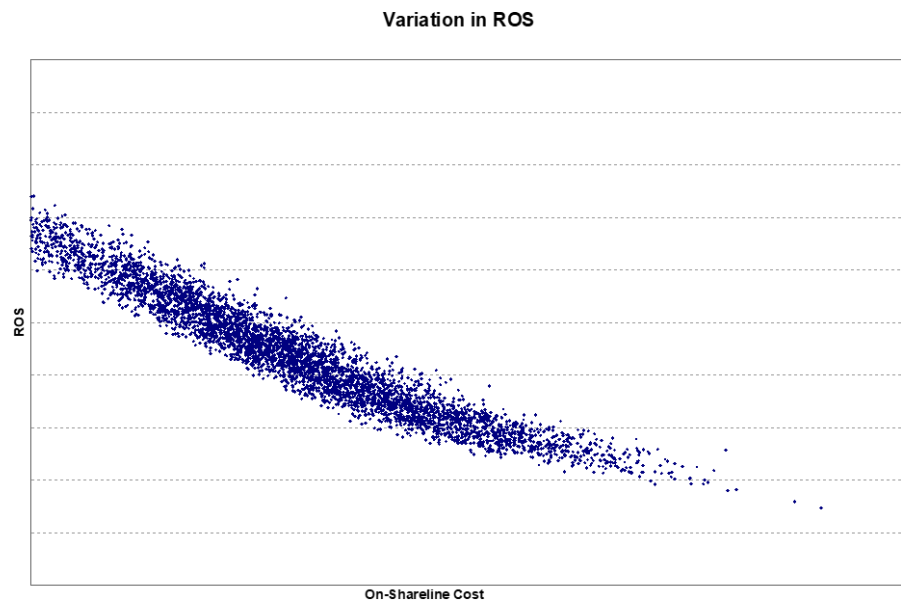*Better Decisions Faster*

The Problem

- Life-cycle cost estimates (LCCEs) for major programs typically ignore contract geometry and Terms & Conditions (Ts & Cs) for major Development and Procurement contracts

- Either they are unknown at time of the estimate, or there is no way to model them correctly

- While contract costs should be *at price* to the Government, risk and uncertainty are generally applied *at cost*

- Applied fee is typically either a flat percentage or an uncertainty distribution fee – may not represent actual distribution

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The Solution

RCPM remedies the situation by modeling "on-the-shareline" and "off-the-shareline" risk

Previous Research

- Contract Ts and Cs introduced to "cover" risk destroy the traditional incentive contract shareline

- For a given amount of cost growth, if more growth "hits" the Ts and Cs, it would result in a higher price for the Government and a higher Return on Sales (ROS) for Industry than if the growth "hits" the shareline

  - Effects use Monte Carlo simulation, displaying scatterplot of ROS vs. Final Cost
  - "Cloud" of points rather than continuous function

Variation in ROS

Example of ROS distribution with Ts & Cs

"Risk-Based Return On Sales (ROS) for Proposals with Mitigating Terms and Conditions" [Braxton, 2009]

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Risk-Adjusted Contract Price Tool (RCPT)

- Monte Carlo simulation runs verify analytical solutions

- No treatment for off-the-shareline risk

- No analytical solutions for cost distributions other than Normal

- RCPT enables sensitivity analysis for changes in both cost distribution and contract geometry
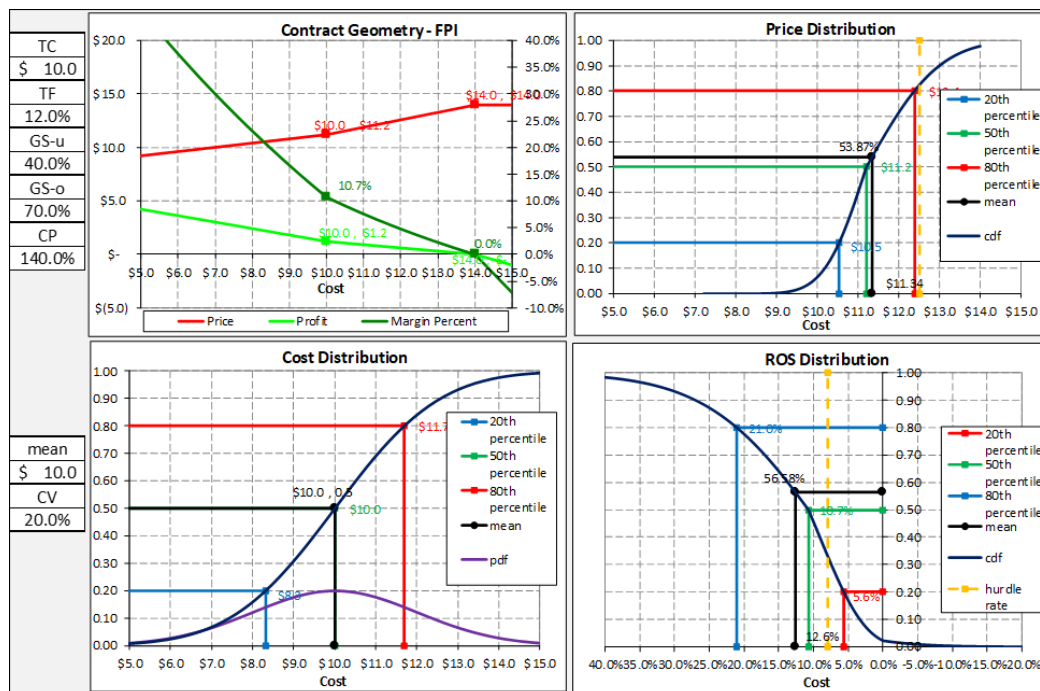
Risk-Adjusted Contract Price Tool (RCPT) dashboard

Contracts Risk Framework

- Take advantage of Contracts Database (KDB) as a rich data source within CADE

- Establish an analytical framework for Contracts Risk that takes into account incentive structures (Contract Geometry)
  - Government perspective (Price) as well as Contractor perspective (ROS)
  - Analyzing historical growth as well as projecting future risk and uncertainty

- Apply data mining techniques to KDB to discern when different contract types and geometries were being applied appropriately (or inappropriately)

- Off-the-shareline growth further divided into "**profit-neutral**" and "**ROS-neutral**"

"Filtered" by contract geometry

On-shareline

Contract cost

Profit-neutral

Off-shareline

ROS-neutral

Contracts Database (KDB)
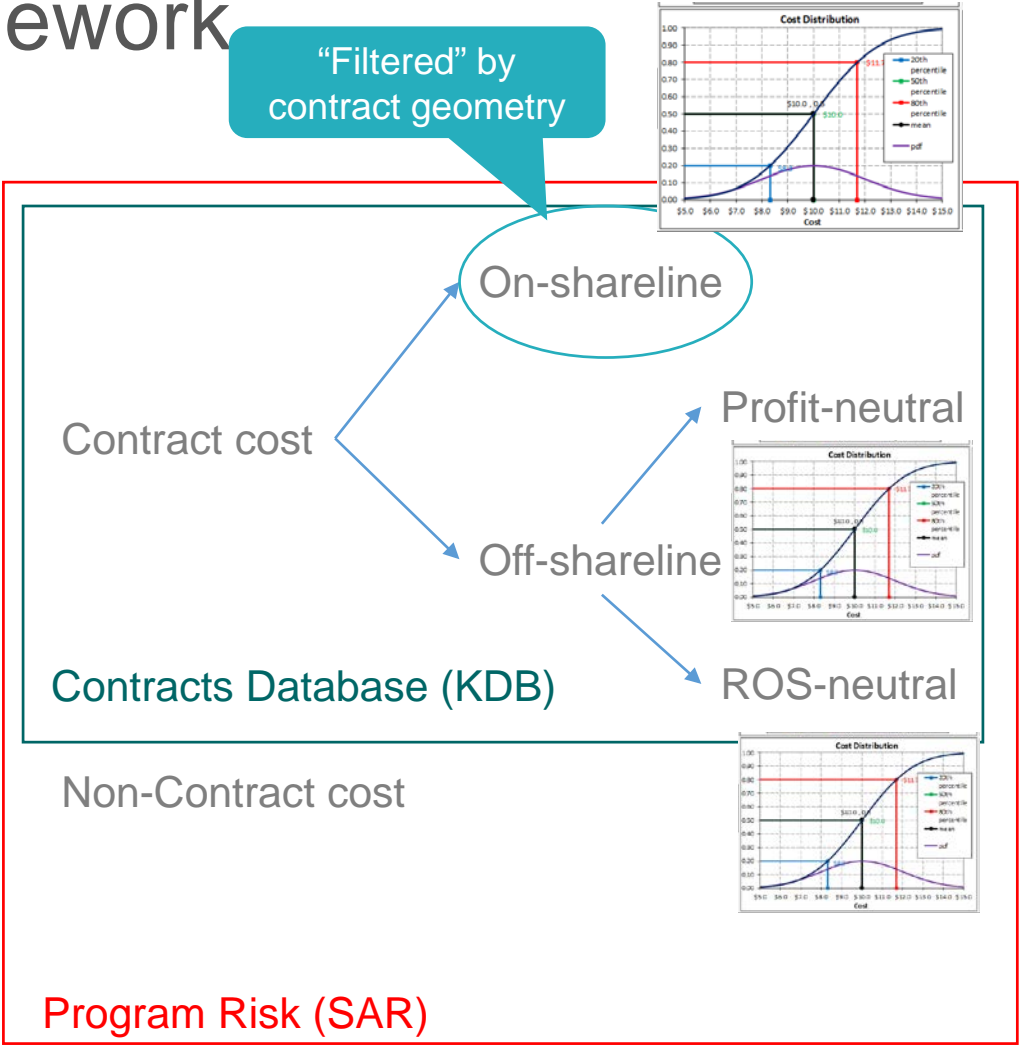
Non-Contract cost

Program Risk (SAR)

Contract cost growth rubric

Analytical Framework

- Analytical framework for RCPM starts with contract geometry

- For each contract type, Price, Profit/Fee, ROS can be defined as piecewise continuous functions of (Final) Cost

- Price function must be monotonically non-decreasing, and Profit/Fee and ROS functions must be monotonically non-increasing to be legitimate Federal Acquisition Regulation (FAR) contract type

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Contract Types – Firm Fixed-Price (FFP)

- FFP arguably has the simplest contract geometry
- Price is fixed, Profit decreases or increases for every dollar with any cost overrun/underrun – essentially a 0/100 shareline
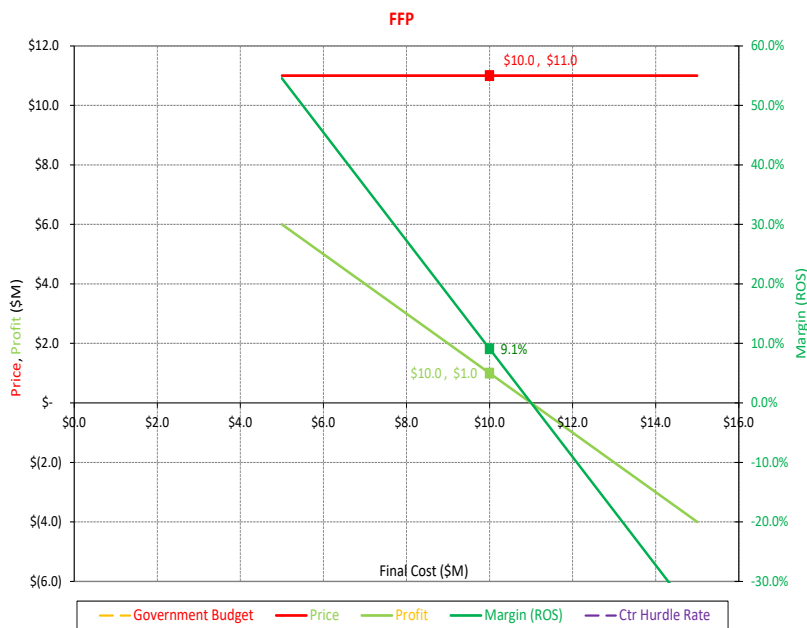
Firm Fixed-Price (FFP) graph from CIIT
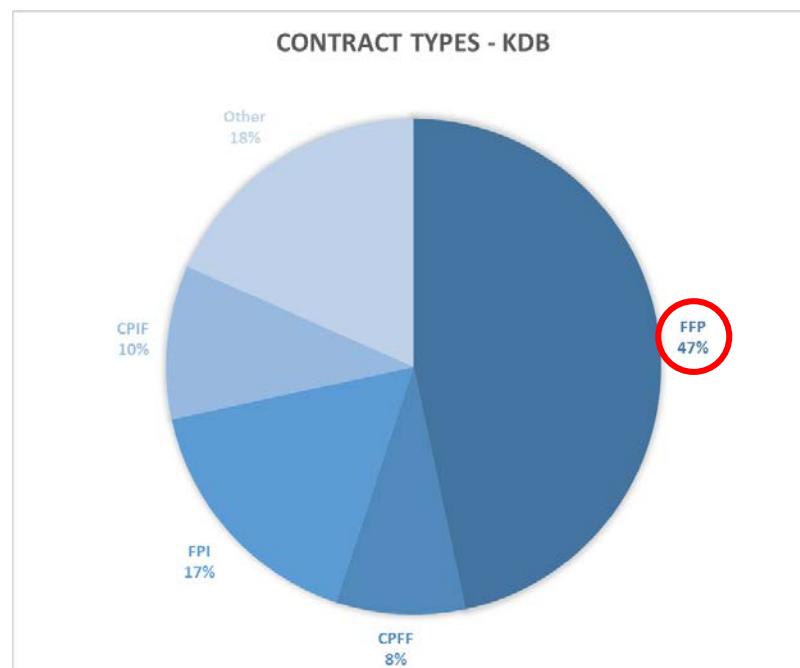
Contract Types from KDB by $$ Total

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Contract Types – Cost Plus Fixed Fee (CPFF)

- CPFF has a simple contract geometry, with Fee being a fixed dollar amount
- Price increases or decreases dollar for dollar with any cost overrun/underrun, respectively – essentially a 100/0 shareline
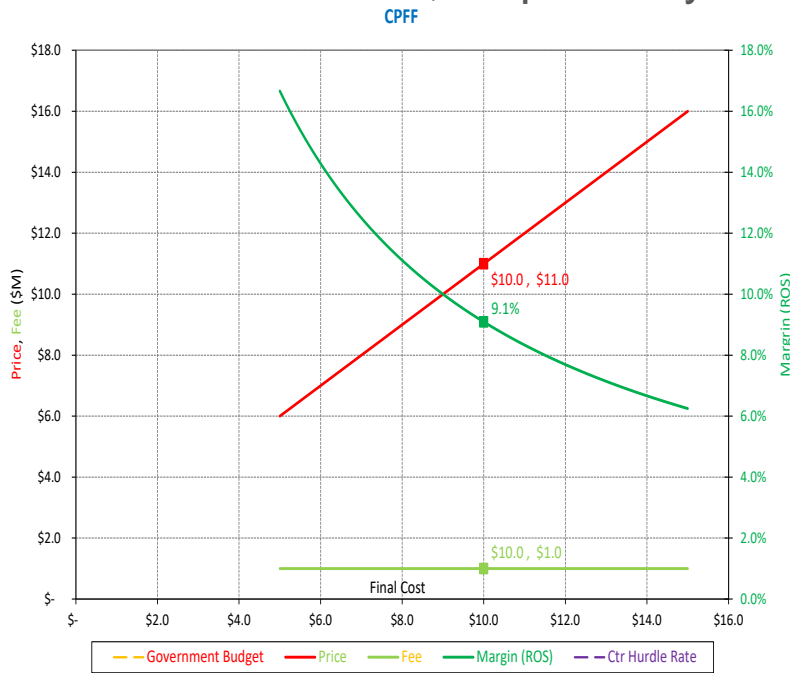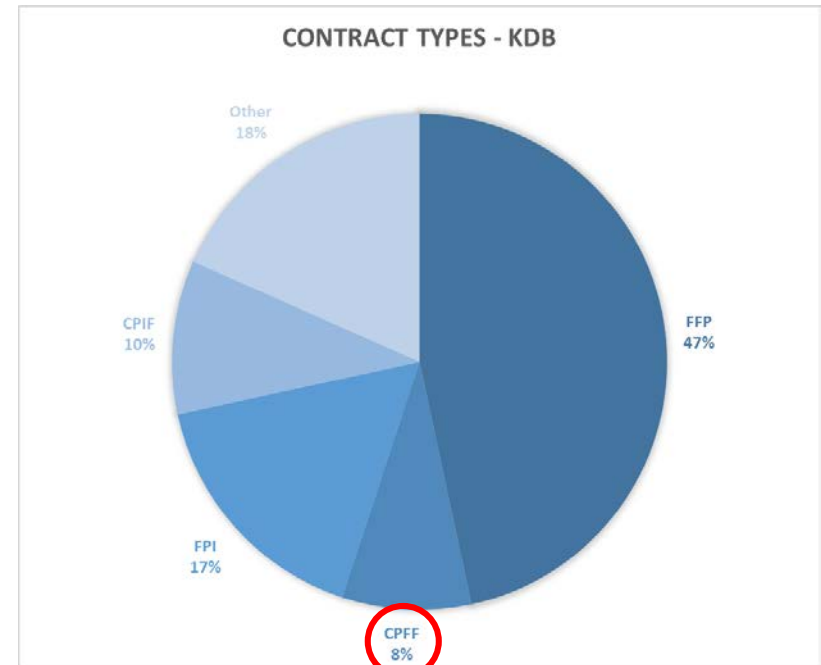

Figure 5. Cost Plus Fixed Fee (CPFF) graph from CIIT

Contract Types from KDB by $$ Total

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Contract Types – Fixed-Price Incentive (FPI)

▪ The contract geometry in FPI adds a break point at the Point of Total Assumption (PTA), where the adjusted price reaches the Ceiling Price

▪ Target Cost is generally a breakpoint as well – we allow different share ratios above (overrun) and below (underrun)
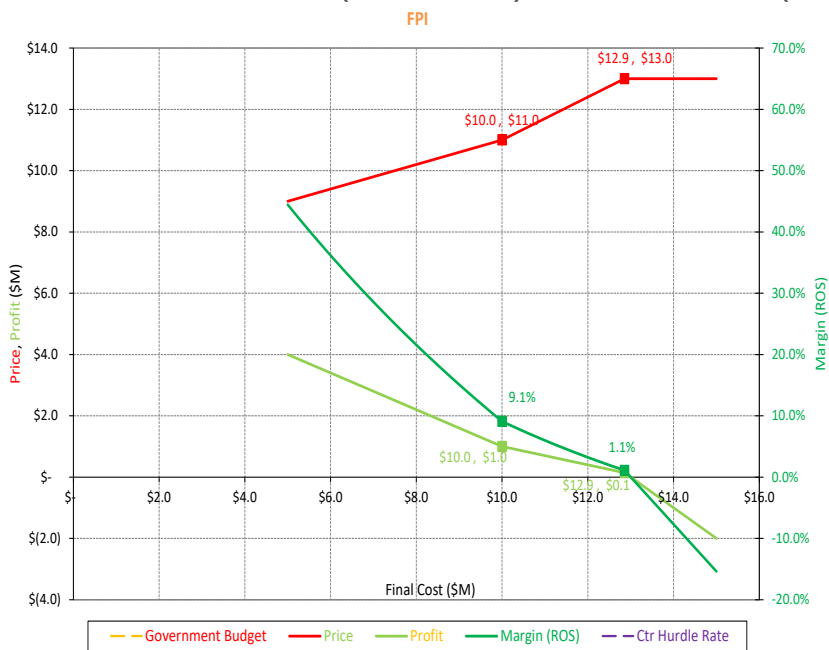
Fixed-Price Incentive (FPI) graph from CIIT
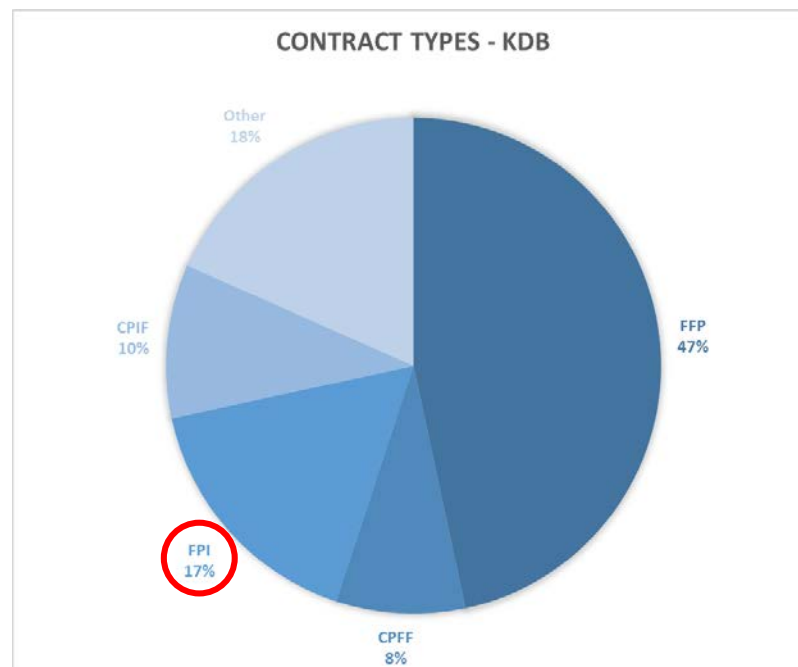
Contract Types from KDB by $$ Total

"Guidance on Using Incentive and Other Contract Types," Director, Defense Procurement and Acquisition Policy (DPAP), 01 Apr 2016 [DPAP]

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Contract Types – Cost Plus Incentive Fee (CPIF)

- CPIF has three breakpoints: Target Cost, and the left and right endpoints of Range of Incentive Effectiveness (RIE)

- Min and Max Fee are usually specified as a percentage of Total Cost, but become fixed dollar amounts

Cost Plus Incentive Fee (CPIF) graph from CIIT

Contract Types from KDB by $$ Total
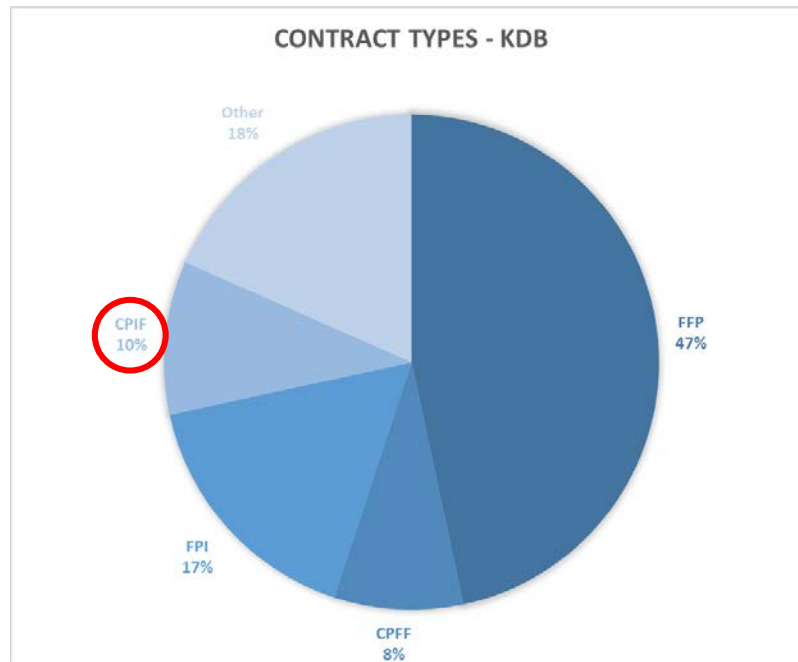
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Contracts Database (KDB)

- A 15-year-old project, Technomics' Contracts Database houses detailed cost information at the Modification and CLIN (Contract Line Item Number) levels about major defense programs from contract data

- The database has grown from the client AFCAA's initial interest in Missile programs to programs across DoD

- KDB tools, found on the Cost Assessment Data Enterprise (CADE) Tools Page, assist with analysis of contract price growth
  - More specifically, KDB tracks contract type at the CLIN level
  - KDB is the source of our pie charts from the previous slides

Contracts

Tool	Data Type	Last Updated	Download Tool	Download User Guide
Contracts Database	Contracts	Jan. 2018	⬇	⬇
Contracts Pivot Tool	Contracts	Jan. 2018	⬇	⬇
Contracts DB Contents and Priorities	Contracts	Jan. 2018	⬇	⬇
Electronic Document Access (EDA)	Contract Documents (BASIC/Mods)	Mar. 2018		
Federal Procurement Data System (FPDS)	Contract Metadata	Mar. 2018		

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http://cade.osd.mil

CADE

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Contracts Database (KDB) – cont'd

- KDB is particularly important for understanding these off-the-shareline or profit-neural mods

- The table below shows the relative prevalence of contract types at the CLIN level within KDB
  - The vast majority of the "Other" category is Fixed Price – Economic Price Adjustments (FP – EPA) and Time and Materials (T&M) contracts

Contract Type	Count	Value	By Count	By Value	Average Size
CPAF	1,316	$ 72,240,314,645.87	1.6%	14.5%	$ 54,893,856.11
CPIF	1,364	$ 49,848,101,332.49	1.7%	10.0%	$ 36,545,528.84
FPIF	1,798	$ 82,104,909,935.05	2.2%	16.5%	$ 45,664,577.27
FFP	58,719	$ 231,715,067,446.07	72.0%	46.6%	$ 3,946,168.49
COST & CPFF	10,210	$ 43,560,605,650.77	12.5%	8.8%	$ 4,266,464.80
Other	8,184	$ 17,411,297,203.31	10.0%	3.5%	$ 2,127,480.11
Total	81,591	$ 496,880,296,213.56	100.0%	100.0%	$ 6,089,891.00

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Firm Fixed-Price (FFP) CLINs

- FFP CLINs are the most common in the database by far
- Take a look at the degree of change that occurs on FFP CLINs
  - $231.7B in contract value from the previous table includes growth relative to a total BASELINE of about $180.9B, or an average growth of about 28.3%
  - The lion's share of this represents TECHNICAL growth
- Unfortunately, unlike Contractor Cost Data Reports (CCDRs), which provide direct insight into profit on FFP contracts, KDB can only provide visibility at the price level
  - This is what is reflected in the original contract documentation (BASIC and mods)

FAR 15.402 Pricing policy. "Contracting officers shall – (b) Price each contract separately and independently "

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Off-the-Shareline Risk

- Previous distributions assume all variation in cost "hits" the shareline, and thus affects Final Price (CPFF), Final Profit (FFP), or both (FPI, CPIF) according to established contract geometry

- In reality, some variation in final contract cost comes in the form of modifications that are adjusted off the shareline
    - New work – ROS-neutral
    - Ts & Cs – profit-neutral

Technical Changes (New Work)

- New work is often added as new CLINs or as changes to existing CLINs

- Work is typically added based on estimated cost plus a commensurate fee/profit

- When fee is the same percentage of target cost as in base work, the mod "moves the goalposts" to readjust target cost/fee

- An example is shown to the right

FAR 16.102 Policies (c) "The cost-plus-a-percentage-of-cost system of contracting shall not be used"

FPI
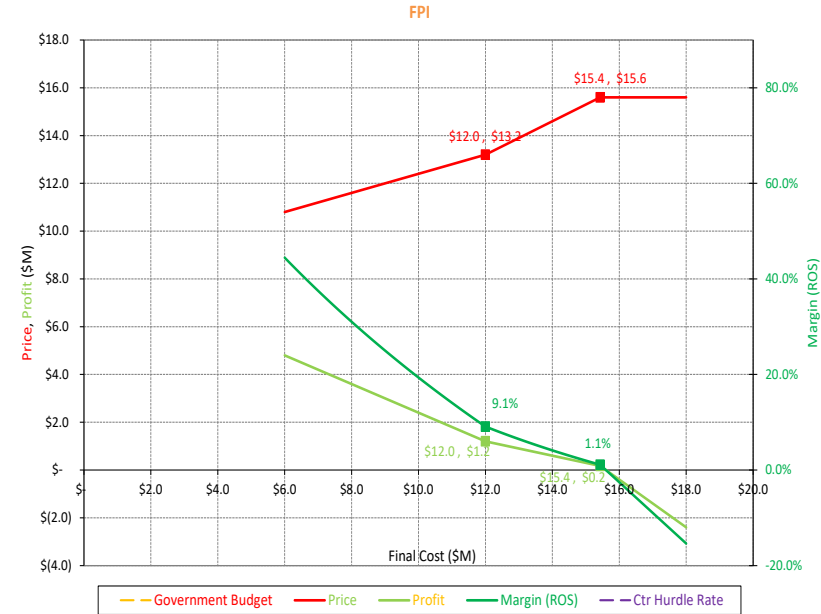
FPI example with ROS-neutral mod

- $2M of new work is added to a base of $10M, yielding new Target Cost of $12M

- 10% profit (at target cost) and 130% ceiling price have been maintained, increasing from $1M to $1.2M and $13M to $15.6M respectively
  - The whole graph shifts up and to the right proportionally

- These changes must represent *new work* to remain within the FAR's prohibition on contract with constant *percent* fee

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Terms and Conditions (Ts & Cs)

- **Other cost adjustments may be dictated by contract Ts & Cs, such as an Economic Price Adjustment (EPA) clause**
- **The effect in this case is more like a CPFF contract type**
  - Costs are adjusted up or down without a commensurate adjustment in fee or profit
  - ROS will change based on the changing denominator (total revenue)
  - These can be designated "Profit-neutral" or "Fee-neutral" mods
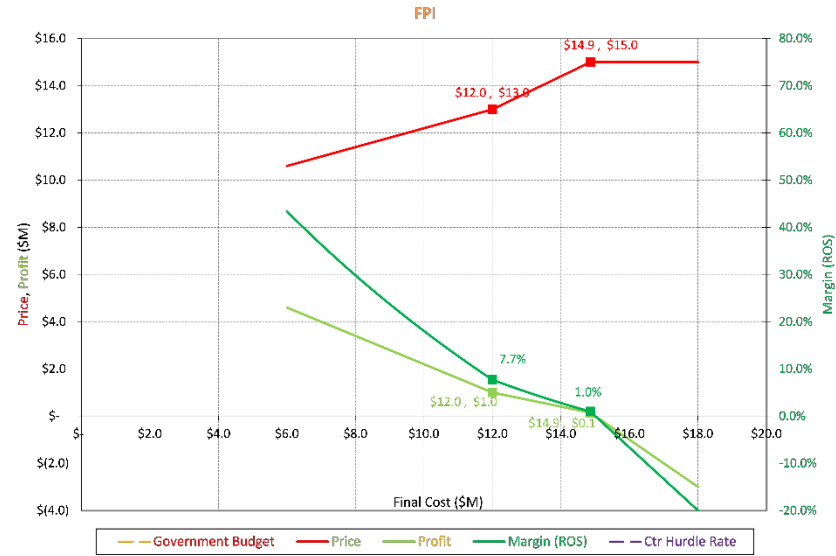
FPI example with Profit-neutral mod

- If in this example the $2M were added "at cost", essentially everything shifts to the right but *not* up
- $12M is again the new target cost, but target profit is still $1M and ceiling price is still $13M above target cost

FAR 15.402 Pricing policy. "Contracting officers shall – (c) Not include in a contract price any amount for a specified contingency to the extent that the contract provides for a price adjustment based upon the occurrence of that contingency. "

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RCPM Approach

- The key to RCPM is to carefully parse sources of risk into how they will manifest relative to the contract structure

- Sound cost and risk analyses are the foundation of RCPM as the Risk-Adjusted Contract Cost component
  - Supporting inputs include Framing Assumptions, Bases of Estimate (BOEs), Risk Register, Independent Technical Assessment (ITA), Independent Cost Estimate (ICE), and Historical Benchmarks

- Most sources of risk are assumed to manifest as on-the-shareline growth
  - Estimators often develop an Engineering Change Order (ECO) factor to estimate **ROS-neutral** work that will be added to the contract
  - **Profit-neutral** work is generally associated with specific Ts & Cs

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RCPM Framework

- The simplest conceptual expansion of Risk-Based ROS is to add a second risk dimension for ROS-neutral changes or Profit-neutral changes

- Instead of a two-dimensional graph with a single contract geometry giving Price and ROS as a function of Final Cost, we have a three-dimensional graph
  - ROS-neutral changes (off-the-shareline cost) axis runs perpendicular to the on-the-shareline cost, creating an infinite family of contract geometry graphs, ever shifting to the right

- Adding both ROS-neutral and Profit-neutral changes simultaneously would essentially take us into four dimensions
  - In a practical sense, there is not limit to the number of component risks involved in a Monte Carlo simulation

RCPM Implementation

- Cost Model vs. Risk Model
  - Ideally, risk and uncertainty are built into the cost model itself
  - RCPM can be implemented directly, with any risk impacts modeled appropriately

- Analytical vs. Monte Carlo
  - Monte Carlo is generally the computational engine of choice
  - Analytical solutions are useful for sensitivity and cross-checks

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RCPM Applications

Goal: Model contract risk with the highest possible fidelity without over-complicating the analysis

- Budgeting
  - RCPM enables decision-makers to budget at desired confidence level by accurately forecasting a range of likely outcomes for total Price to Government
  - Considering ancillary contracts, GFE, and Other Government Costs (OGCs) takes us into the realm of Risk-Adjusted Program Cost

- Source Selection
  - Only include risks allowed by the Request For Proposal (RFP) and inherent in respondents' offers
  - Include both on- and off-the-shareline risk
    - Off-the-shareline risk driven by Ts & Cs
  - RCPM is key enabler of "leveling the playing field" so that all bids are assessed consistently and fairly from a risk perspective

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Future Research

- Analytical Solutions
  - The piecewise nature of the contract geometry for incentive-type contracts makes these solutions a bit of a challenge
  - A library of results for mean Price and ROS might serve as a cross-check for Monte Carlo results
    - May still require the use of the phi function (normal distribution) and other computational techniques

- Improved visualization
  - Convincing senior decision-makers may rely on "killer graphics" to clearly show what is going on
  - Since introduction of off-the-shareline risk takes us into three (or four) dimensions, creating these graphics becomes more and more challenging

- Running the Gamut of Ts & Cs
  - Appropriate modeling of off-the-shareline risk is largely dependent upon knowledge of common Ts & Cs
  - Can be done on an *ad hoc* basis as needed for major procurements
  - Would be helpful to do some preliminary research using KDB

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Thank you

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