Risk Analysis (Quantitative) in FPIF Contracting

A review of the two techniques for building FPIF contract geometry as presented by the venerable 1969 DOD AND NASA INCENTIVE CONTRACTING GUIDE, the policy objectives in advocating the now famous 50/50, 120% share line, and how simulation analysis can facilitate better technical evaluation of cost risk and achieve stated policy goals in FPIF Incentive Contracting.

AFLCMC/DAU Midwest 2015 Insight
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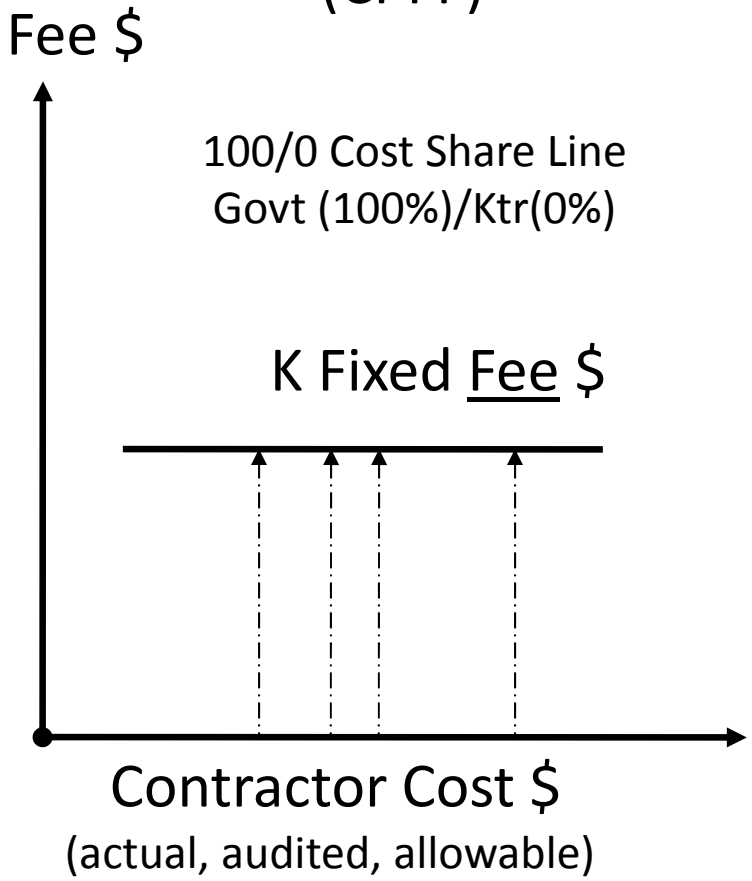
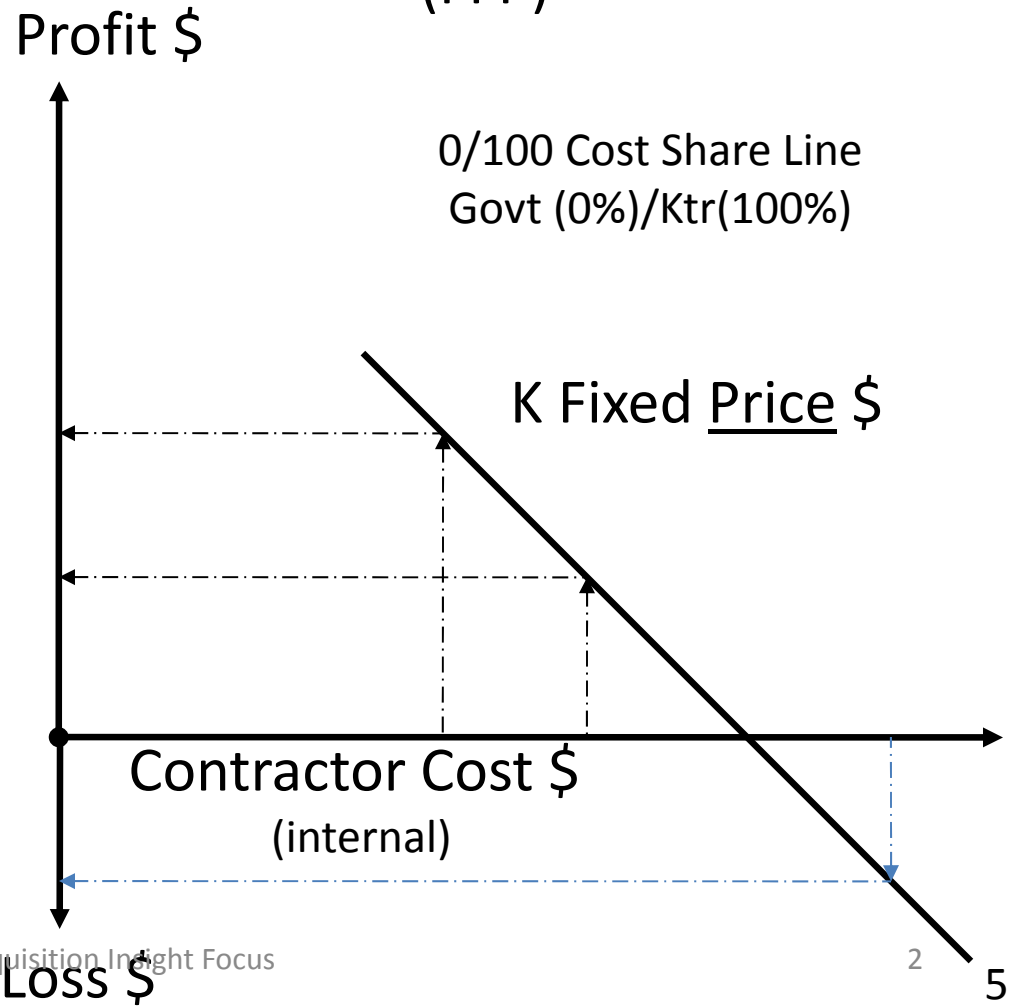
Basic Contract Types Review

Cost Plus Fixed Fee (CPFF)



Firm Fixed Price (FFP)



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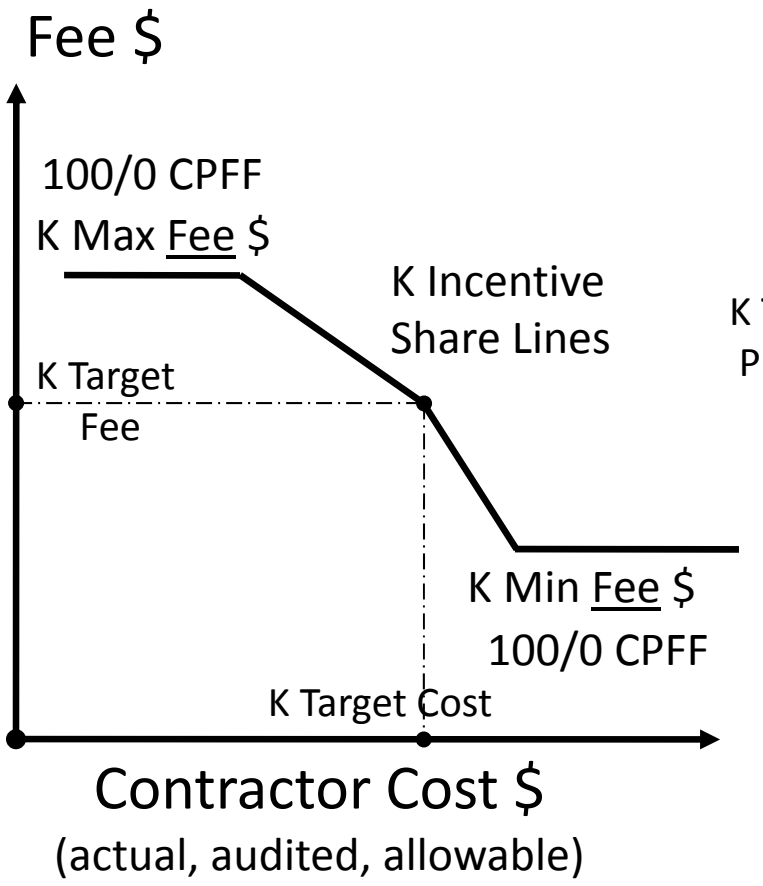
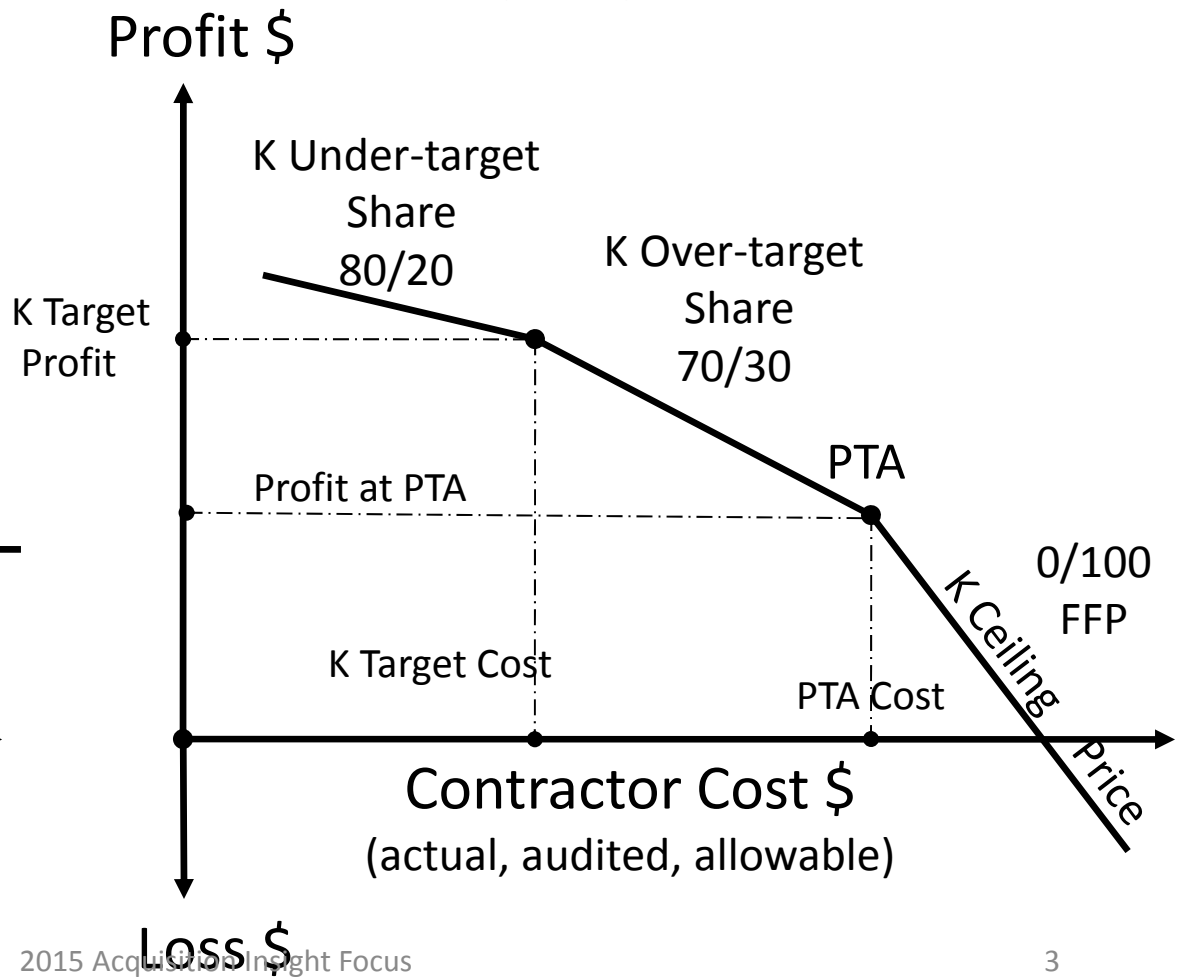
Basic (Cost) Incentive Contract Types Review

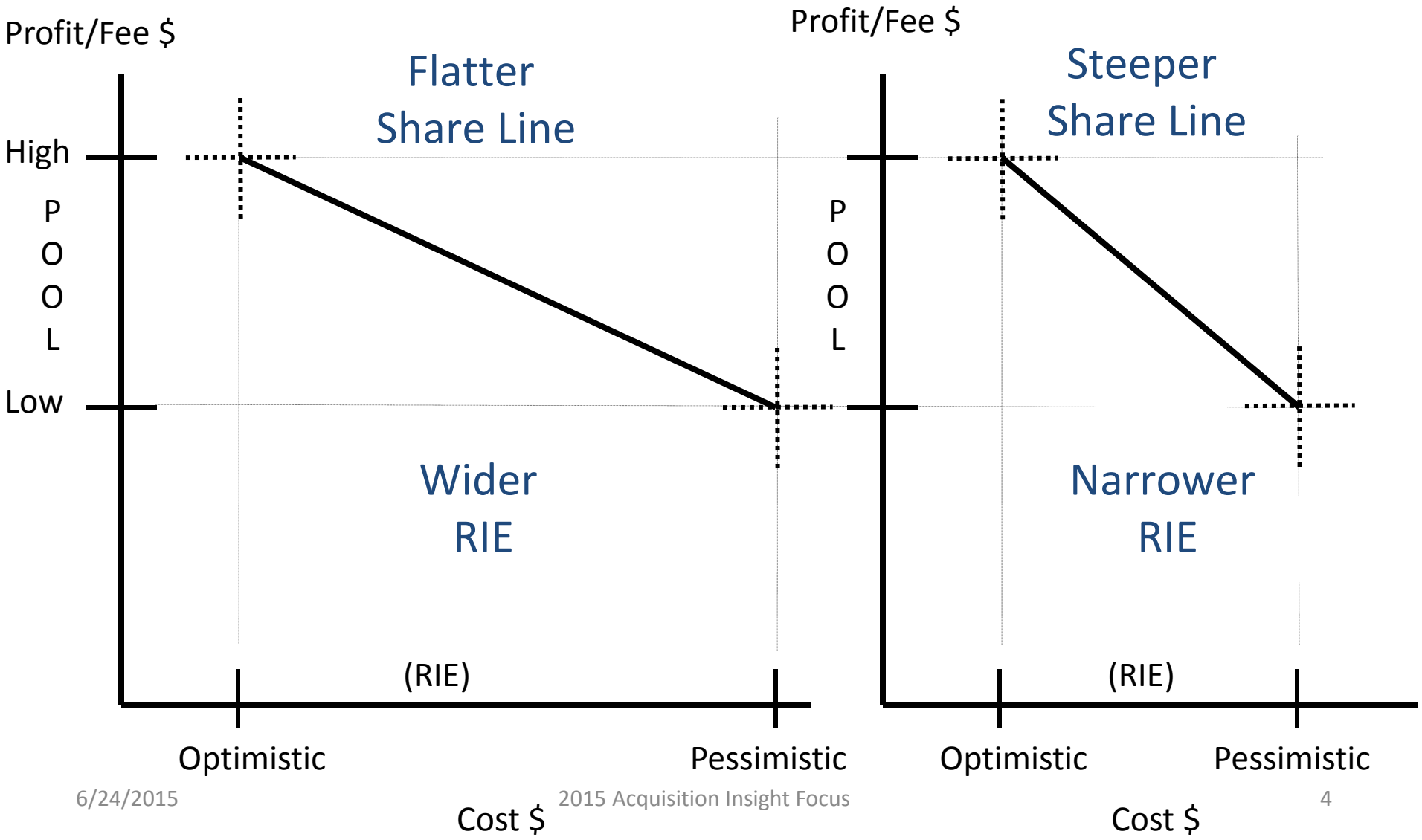
Cost Plus Incentive Fee (CPIF)



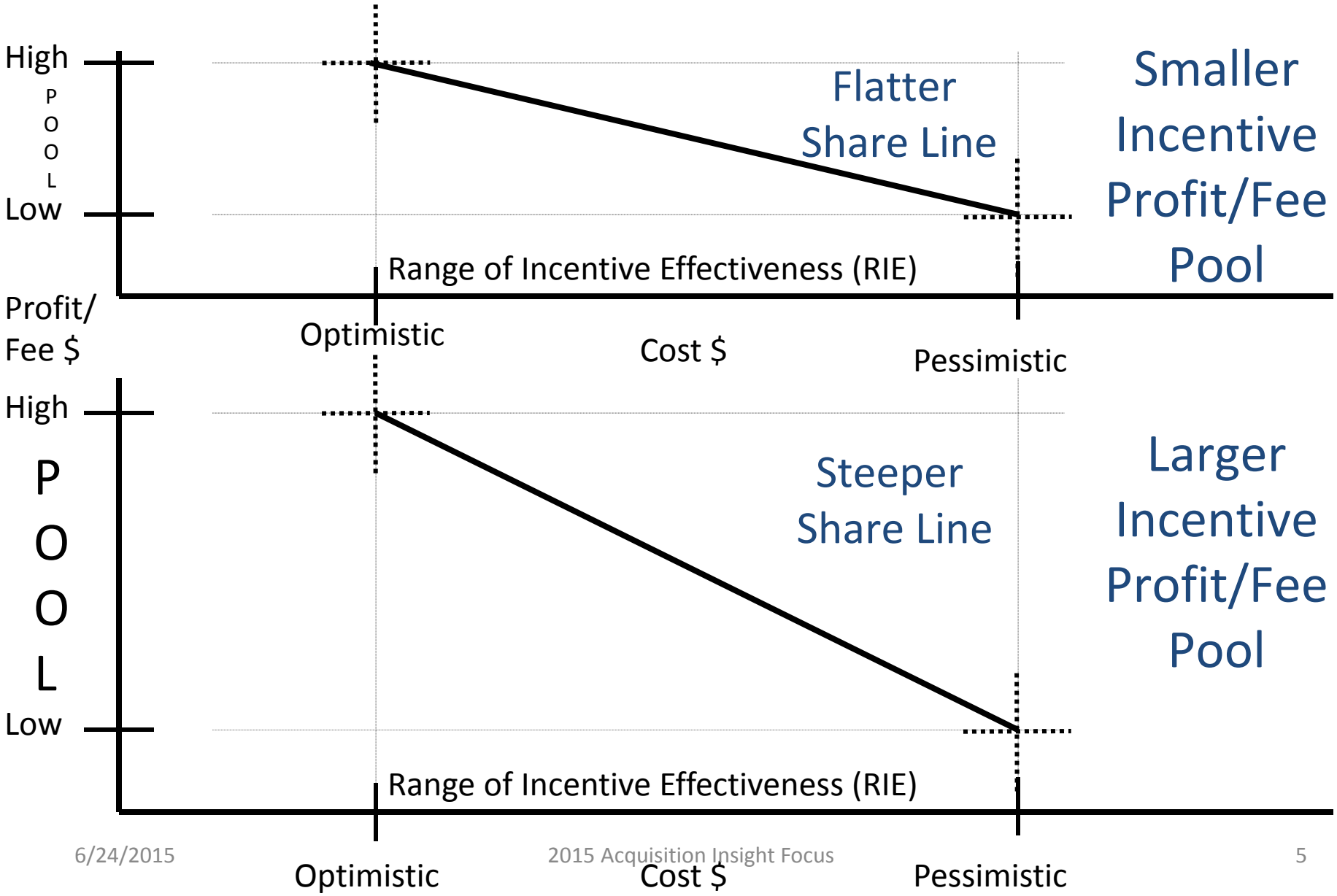
Fixed Price Incentive Firm (FPIF)



Same Profit/Fee Pool
Different Range of Potential Cost Outcomes (Risk)



Same Risk Range – Different Incentive Pools



Reward Pool ÷ Risk Range (RIE or RCS) = Contractor Share % (KS)

RIE of 100, and profit/fee pool is 20

- Contractor Incentive Share % ? 20 ÷ 100 = 20%
- Contract Share line will be? 80/20

RIE of 100 and profit/fee pool is 40

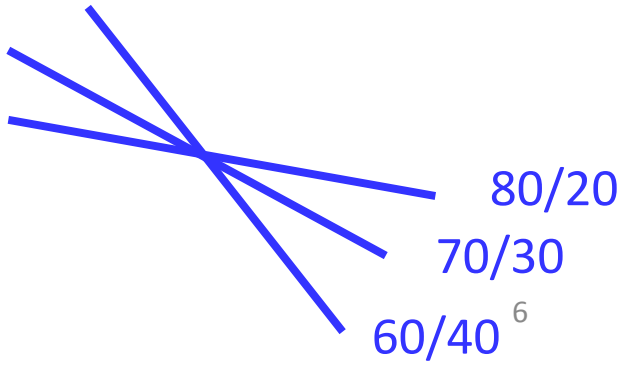
- Contractor Incentive Share % ? 40 ÷ 100 = 40%
- Contract Share line will be? 60/40

RIE of 100 and profit/fee pool is 30 – share ratio is?

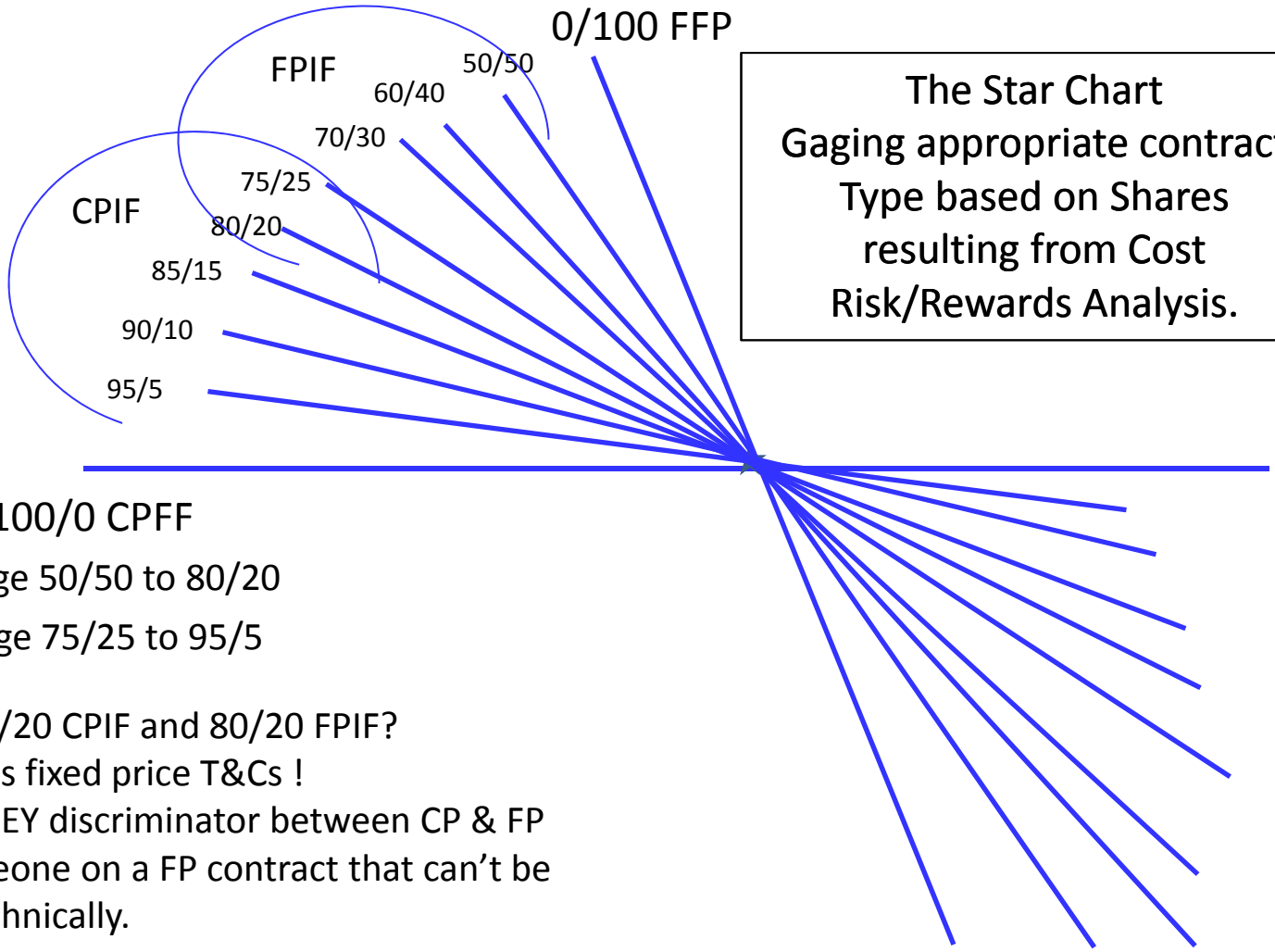
- Contractor Incentive Share % ? 30 ÷ 100 = 30%
- Contract Share line will be? 70/30

Rank order from flatter to steeper:

80/20 70/30 60/40



Risk/Rewards Analysis in Acquisition Planning



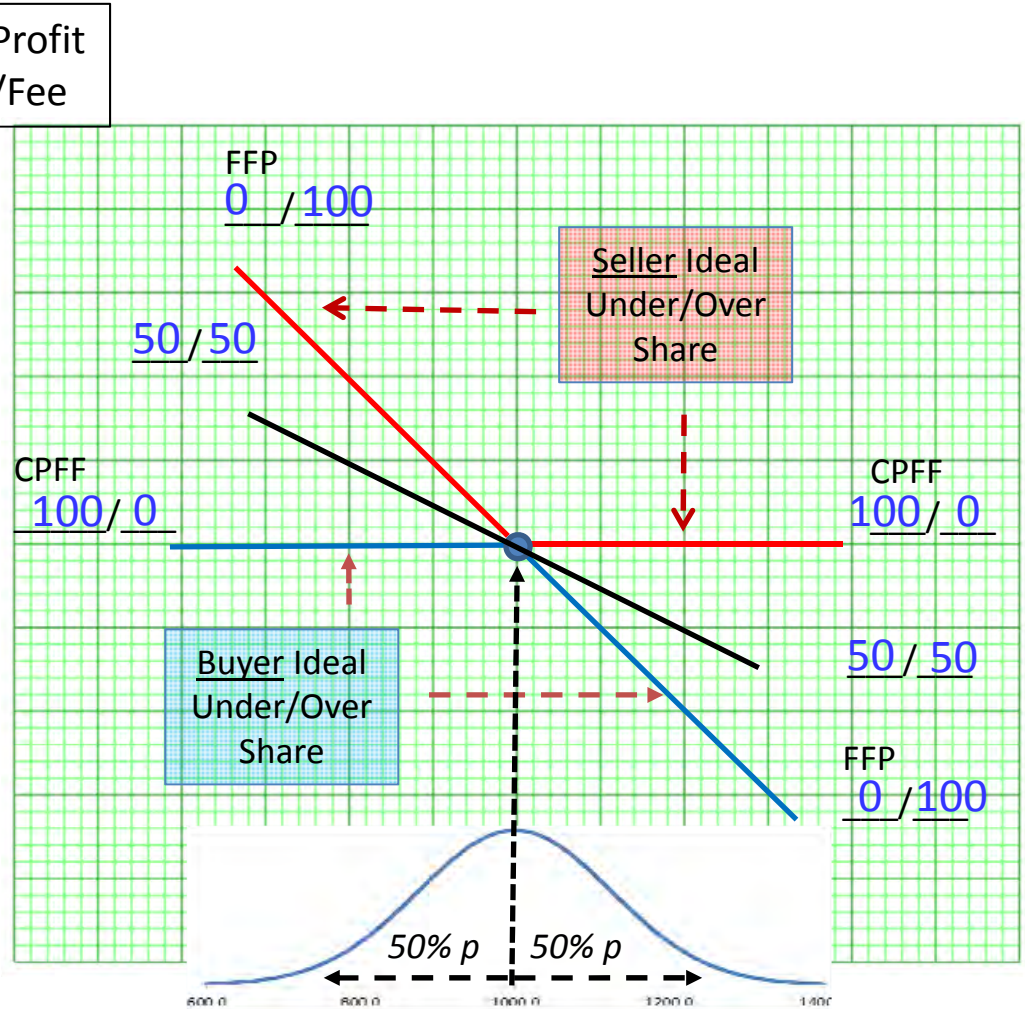
The Star Chart
Gaging appropriate contract Type based on Shares resulting from Cost Risk/Rewards Analysis.

Difference between an 80/20 CPIF and 80/20 FPIF?

- The 80/20 FPIF has fixed price T&Cs !
- **Technical Risk** is KEY discriminator between CP & FP
  Don't put someone on a FP contract that can't be performed, technically.

Why 50/50?
Equal Risk, Equal Sharing

- The share line on a CPFF contract is 100 / 0 where the Government keeps 100% of every underrun dollar and pays 100% of every overrun dollar.
- The share line on a FFP contract is 0 / 100 where the contractor keeps 100% of every underrun dollar and reduces profit 100% for every overrun dollar.
- The Government, in the event of an underrun, would prefer to see a CPFF 100 / 0 share line, but a FFP 0 / 100 share line in an overrun.
- The Contractor, in the event of an underrun would prefer to see a FFP 0 / 100 share line, but a CPFF 100 / 0 share line.in an overrun.
- Thus, a 50 / 50 share line, both in the event of an underrun or overrun.



120% Ceiling with 50/50 Share Ratio - Pronouncements

- BBPI, 14 Sep 2010 - "A 50/50 share line should represent a point where the estimate is deemed equally likely to be too low or too high."

- DFARS 216.403-1 Final Rule, 16 September 2011 - "The reason for specifying the 120 percent ceiling and the 50/50 cost sharing arrangement as the point of departure for establishing the incentive arrangement is to promote cost realism and discourage an incentive arrangement that does not provide adequate incentive to the contractor to control costs. An excessively flat share line approaches a cost-plus-fixed-fee arrangement (100/0), thereby providing almost no incentive to the contractor to control costs." (underline emphasis added)

- PGI 216.403-1, 16 September 2011 - "The first step is establishing a target cost for which the probability of an underrun and overrun are considered equal and therefore, the risks and rewards are shared equally, hence the 50/50 share is the point of departure."

Summary Interpretation – the 1969 DoD/NASA guide advocates a target cost should represent that point with an equal probability of overrun and underrun (repeatedly, pp 67-87); though silent on advocating any specific share line, a 50/50 share line would seem a reasonable extension in following suite to share risks and rewards equally – "hence the 50/50 share."

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

SEP 14 2010

MEMORANDUM FOR ACQUISITION PROFESSIONALS

SUBJECT: Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending

A 50/50 share line suggests that the government and contractor have a common view of the likely contract execution cost. A 50/50 share line should represent a point where the estimate is deemed equally likely to be too low or too high. A flat or steep share line suggests that the government and contractor do not see project cost the same way. These differences in view should be discussed and considered as the basis for adjusting the target cost before an uneven share line is agreed to in contract. This might occur, for example, earlier in a program where the costs are inherently more uncertain.

A ceiling of 120 percent on an FPIF contract sets a 20 percent limit on the government's liability for overrun of the contract target cost. This is reasonable in view of historical experience in program overruns, and also reasonable because programs that overrun more than this amount in an era of relatively flat defense budgets should face review with an eye to cancellation.

A higher proposed ceiling requires explanation to the relevant head of contracting authority. Likewise, a lower ceiling than 120 percent suggests that perhaps a firm fixed-price contract is appropriate.

I am considering whether to issue more formal guidance on this matter, but effective immediately, I will require a justification of contract type for each proposed contract settlement be made to the relevant acquisition executive before negotiations are concluded. The metric for success of this measure would be fewer programs that overrun their cost targets.

agencies on obtaining greater efficiency and productivity in defense spending. In support of this initiative, DoD published a proposed rule in the **Federal Register** on March 2, 2011 (76 FR 11410). The proposed rule required that contracting officers must—

(1) Give particular consideration to the use of fixed-price incentive (firm target) contracts, especially for acquisitions moving from development to production; and

(2) Pay particular attention to share line and ceiling prices for fixed-price incentive (firm target) contracts, with 120 percent ceiling and a 50/50 share ratio as the default arrangement.

The comment period closed on May 2, 2011. DoD received comments from one respondent.

II. Discussion/Analysis

The respondent considered that the incorporation of a broad preference to use a 50/50 share line with a ceiling of 120 percent is a mistake for Government acquisitions for the reasons discussed in the following comments.

Comment: The respondent provided anecdotal evidence that currently acquisition leadership translates this preference as a mandatory requirement.

Response: All of the documentation for this case, and all of the presentations by senior acquisition leaders within DoD, have emphasized that this initiative is to be implemented in a way that makes sense for each individual acquisition. The guidance in the DFARS companion Procedures, Guidance, and Information (PGI) reiterates that each situation must be evaluated in terms of the degree and nature of the risk presented in order to select the proper contract type. The PGI also provides additional guidance on establishing the target cost, share lines, and ceiling price. This regulation is not a "one-size-

Response: The majority of incentive contracts covered by the IDA study were award-fee contracts, not fixed-price incentive (firm target) contracts. Furthermore, DoD is actively taking steps to ensure that incentives are linked to acquisition outcomes and the profits are tied to performance in achieving those outcomes.

Comment: The respondent stated that in order to correct the use of incentives, DoD should mandate that contracting officers use a true pessimistic/optimistic weighted average and ensure that their cost curves do not mirror cost-plus-fixed-fee cost curves.

Response: DoD endorses the respondent's concept that contracting officers should carefully develop a realistic target cost and that an incentive contract should provide adequate incentives. The reason for specifying the 120 percent ceiling and the 50/50 cost sharing arrangement as the point of departure for establishing the incentive arrangement is to promote cost realism and discourage an incentive arrangement that does not provide adequate incentive to the contractor to control costs. An excessively flat share line approaches a cost-plus-fixed-fee arrangement (100/0), thereby providing almost no incentive to the contractor to control costs. A 50/50 share line suggests that the Government and the contractor have a common view of the likely contract execution cost. A 50/50 share line should represent a point where the estimate is deemed equally likely to be too high or too low. However, as already stated, rather than issuing mandates, DoD encourages the evaluation of each situation in terms of the degree and nature of the risk presented in order to select the proper contract type and, if an incentive contract type is selected, the appropriate incentive arrangement.

rule is not a major rule under 5 U.S.C. 804.

IV. Regulatory Flexibility Act

DoD has prepared a final regulatory flexibility analysis (FRFA) consistent with the Regulatory Flexibility Act, 5 U.S.C. 601, *et seq.* The FRFA is summarized as follows:

This rule amends the Defense Federal Acquisition Regulation Supplement to implement the initiative on incentivizing productivity and innovation in industry, as presented by the Under Secretary of Defense for Acquisition, Technology, & Logistics in a memorandum dated November 3, 2010. The objective of the rule is to incentivize contractors to control costs. The legal basis is 41 U.S.C. 1303 and 48 CFR chapter 1.

There were no public comments in response to the initial regulatory flexibility analysis.

The final rule will not have much impact on small entities, because the focus of the rule is on development efforts that are moving into early production. Small entities are more likely to receive awards for commercial products, including commercially available off-the-shelf products, for which firm-fixed-price contracts are appropriate. In Fiscal Year 2010, 93 percent of awards to small businesses were firm-fixed-price contracts, and 99.99 percent of awards to small businesses were other than fixed-price incentive contracts.

The final rule imposes no reporting, recordkeeping, or other information collection requirements.

There are no known alternatives to the rule that would adequately implement the DoD policy. There is no significant economic impact on small entities.

Comment: The respondent stated that in order to correct the use of incentives, DoD should mandate that contracting officers use a true pessimistic/optimistic weighted average and ensure that their cost curves do not mirror cost-plus-fixed-fee cost curves.

Response: DoD endorses the respondent's concept that contracting officers should carefully develop a realistic target cost and that an incentive contract should provide adequate incentives. The reason for specifying the 120 percent ceiling and the 50/50 cost sharing arrangement as the point of departure for establishing the incentive arrangement is to promote cost realism and discourage an incentive arrangement that does not provide adequate incentive to the contractor to control costs. An excessively flat share line approaches a cost-plus-fixed-fee arrangement (100/0), thereby providing almost no incentive to the contractor to control costs. A 50/50 share line suggests that the Government and the contractor have a common view of the likely contract execution cost. A 50/50 share line should represent a point where the estimate is deemed equally likely to be too high or too low. However, as already stated, rather than issuing mandates, DoD encourages the evaluation of each situation in terms of the degree and nature of the risk presented in order to select the proper contract type and, if an incentive contract type is selected, the appropriate incentive arrangement.

The reason for specifying 50/50 Sharing, 120% Ceiling as a point of departure:

- Promote “cost realism” (unrealistic target costs?)
- Discourage arrangements that don’t provide incentive to control cost.
- Flatter share lines provide almost no incentive to the contractor to control costs.
- A 50/50 share line represents a point where the estimated is deemed equally likely to be too high or too low.
- Rather than issuing mandates, DoD encourages the evaluation of each situation in terms of degree of risk.

Much discussion centers on the question "What is a 'good' target?" It has been suggested that, "A good target cost is one about which both parties can agree there is an equal chance of either overrunning or under-running basing their judgment on all complete and current facts available at a point in time."

First, note the emphasis on time. This is recognition of the fact that as experience is gained, cost estimating reliability improves, and the numerical value of a "good target" will change. There is no one good target for the life of a contract.

Second, the definition says that the estimated target cost should be one of equal chance of overrunning or underrunning, not equal magnitude. The idea of symmetry has somehow crept in and people tend to say a target cost is good + or - 20%. This is rarely true. The magnitude of the potential overrun usually will not equal the magnitude of the potential underrun. In the vernacular of the trade, "confidence limits" about a "good target" may be anything, such as + 30% - 3%, + 18% - 10%, + 2% - 30%, and so on. The fact that confidence limits may be far apart (say + 30% - 20%) has nothing to do with whether a target is "good" or "bad."

Third, the sharing arrangement on an incentive contract should reflect the confidence limits. Where the magnitude of the overrun or underrun is

small, for a given fee swing, the share line should be steeper. Where the magnitude of the overrun or underrun is great, the share line should be relatively shallow. Note that the confidence limits establish a range of possible actual costs. The target is only one point in that range. Whether the target cost is at the upper end of the range (sometimes we say loose) or at the lower end of the range (we might say tight) will affect the share lines. Neither a tight target nor a loose target is necessarily a good or bad target. Again, we go back to the definition - equal probability of overrun and underrun makes a "good target."

Excerpts from '69 GUIDE, Chapter 3

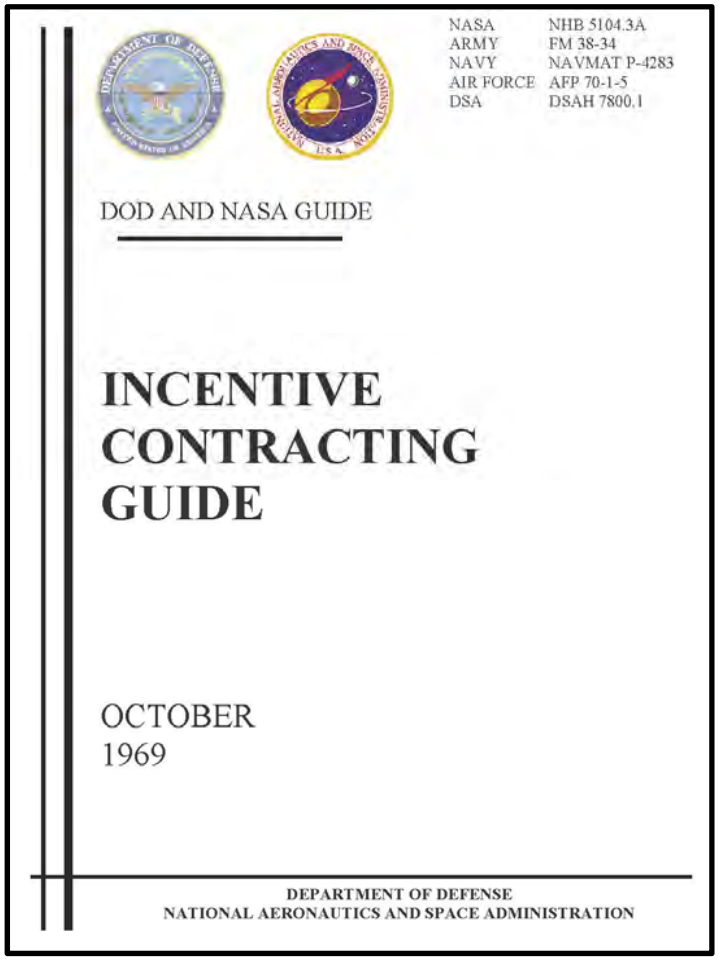
Fifth, there is a tendency to confuse target cost with actual cost and assume that they are directly comparable. People who follow this logic would say that a "good" target cost is equal to or less than the actual cost, this logic is fallacious. We expect variance, in individual cases, between target cost and actual cost.

Sixth, sight should not be lost of the function of target cost. It has two main purposes: (1) It serves as the basis of obligation of funds to the contract, and to company management in establishing a goal. There is usually direct correlation between negotiated target costs and internal corporate budgets. Hopefully, the company goal will be less than target cost. When a close relationship does not exist, there was not a real meeting of the minds that a "good" target cost had been established. (2) The target cost usually sets the profit level and effects the slope of the sharing arrangement. The impact on level arises from the fact that profit is established as a percentage of estimated (target cost). Obviously, this level will change based on our "confidence" in the negotiated target cost.

In summary, there is considerable misunderstanding about the meaning of target cost. Care should be taken to establish the most realistic target cost possible and nothing said here should imply otherwise. However, it is important to recognize: (i) That a good target cost represents a good estimate at a point in time. It will change with time. (ii) That a target cost is not absolute, but is a point in a range of possible actual costs. (iii) Where the target cost falls in the range of probable costs it will be reflected in the slope of the share lines. (iv) That target cost and actual cost are not comparable on individual cases for purposes of determining good or bad target cost. (v) That the main functions of target cost are (a) to provide a goal for internal management, (b) to establish the profit level (with target profit) of the sharing arrangement, and (c) to provide a basis for funding the contract. It should also be clearly recognized that very often a target cost is established on the basis of the relative strengths or weaknesses of the negotiating parties and not on the basis of that point which represents an equal chance of either overrunning or underrunning a cost.

Excerpts from '69 GUIDE, Chapter 3

In the past there have been two (2) negotiation techniques widely used in structuring FPI contracts as documented in the venerable 1969 GUIDE .

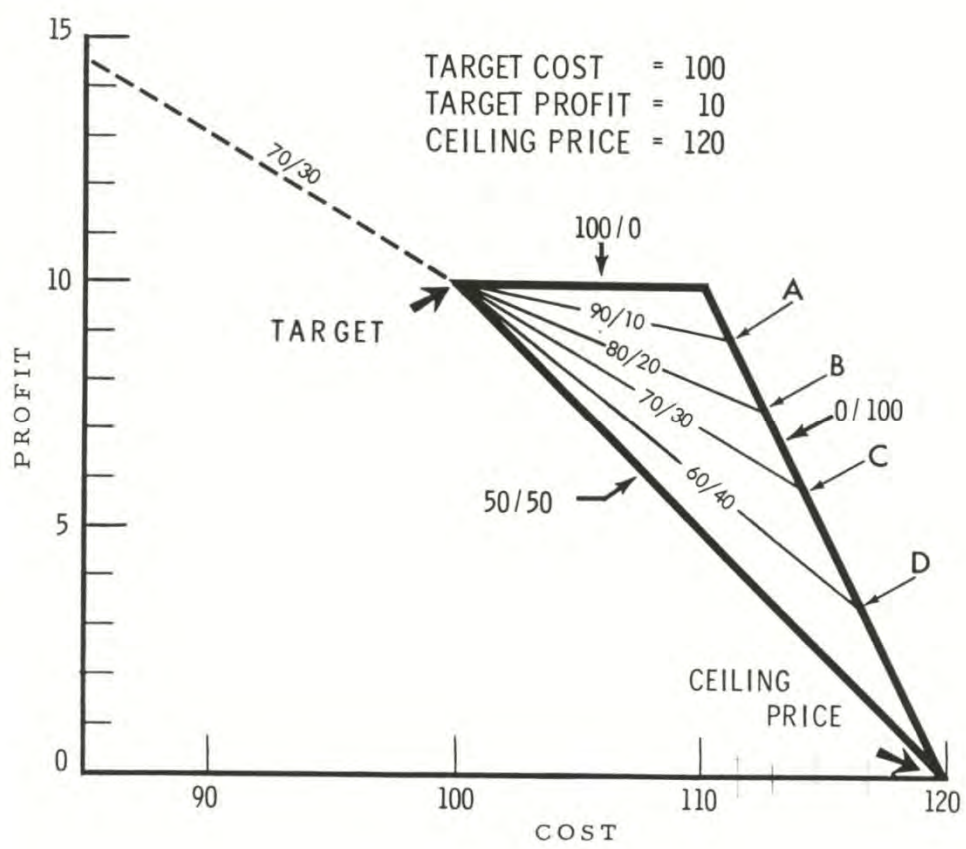


1) Establishing a reasonable profit dollar amount for both target cost and the point of total assumption (or the upper limit of the range of incentive effectiveness). This technique automatically establishes both the sharing arrangement and the ceiling price. While this approach may have drawbacks it does have the distinction of providing a rationale for all of the significant ingredients of the arrangement and does not over-rely on arbitrary percentage factors in selecting sharing ratios (e.g. 80/20, 70/30, etc.) or ceiling price (115% or 120% of target cost).

2) The other technique often used is to negotiate target cost, target profit, ceiling price and share ratio individually but base final negotiation upon simultaneous agreement of all elements of the price. When all of the elements are properly evaluated and combined this is an excellent procedure. However, too heavy a reliance on the negotiation for target price may dictate the results of the other ingredients if there is an over-reliance upon percentage factors rather than price and value considerations.

(2) "Structuring Technique #2

. . . too heavy a reliance on the negotiation for target price may dictate the results of the other ingredients if there is an over-reliance upon percentage factors rather than price and value considerations. For example, in the past there appeared to be a clustering of target profit, ceiling price and share ratio percentages without regard to the product being procured or the stage of its development. This clustering of percentage factors could imply that proper value considerations had not been expressed in the contract -- i.e. evaluation of what profit the contractor should receive at target performance and at a given level of cost performance."



FIXED-PRICE INCENTIVE

PROFIT MATRIX

Figure 2

- Ceiling price line (0/100) simply placed at 120% of Target Cost
- Share lines projected from Target Price (Target Cost + Target Profit) at various percentages (starting at 50/50 through 100/0) to ceiling price line.

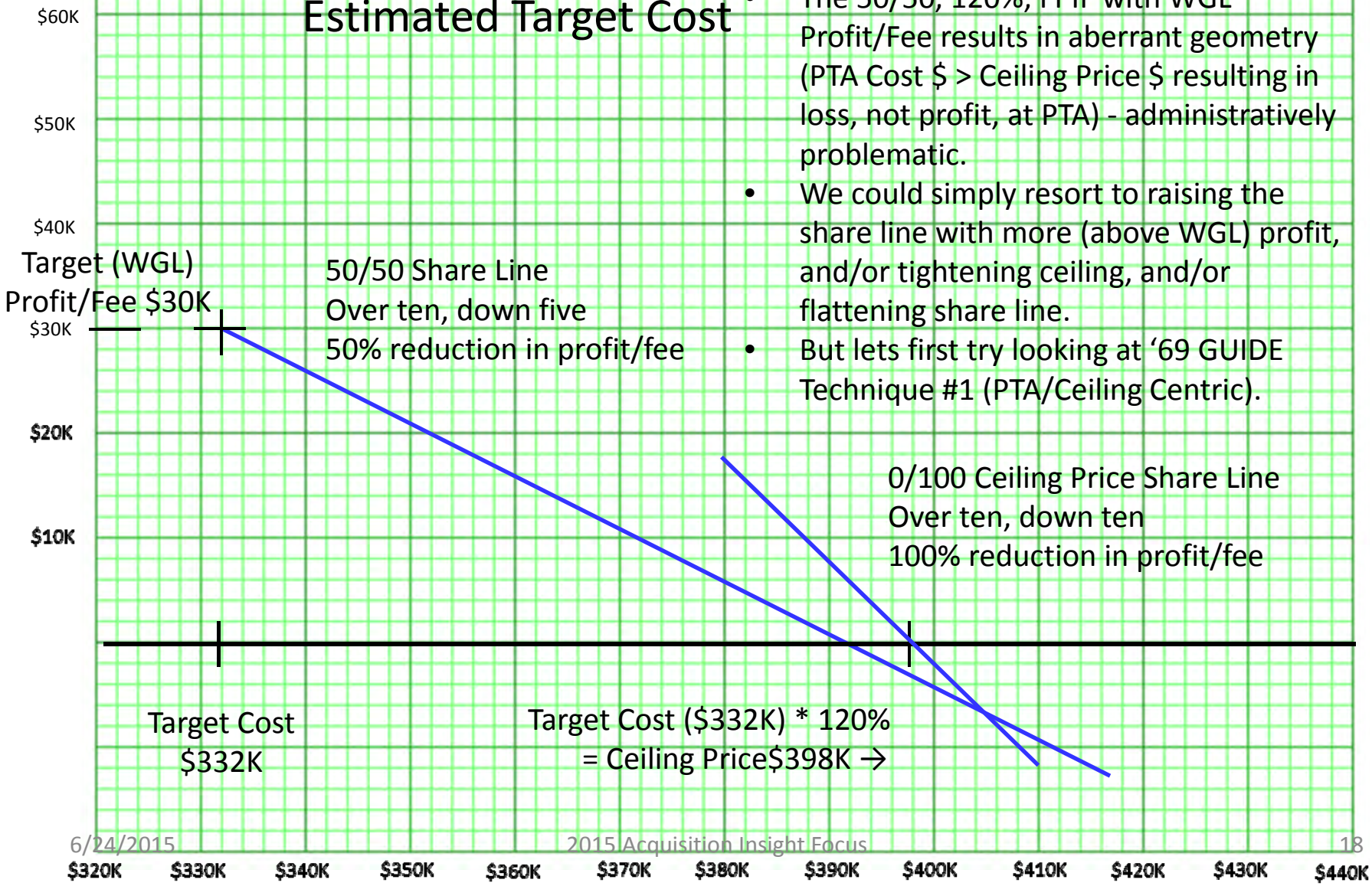
(Termed the "Target Centric" in CON 270 – share & ceiling heuristic percentages projected from target.)

	Likely
Parts	$12,900
Subcontracts	39,600
Direct Labor	34,000
Engineering	50,300
Overhead & G&A	195,200
Total Costs	$332,000
Assume then profit/fee should be:	30,000 [1]
Price	$362,000

[1] Determined by the technique of profit analysis required by the department or agency.

Excerpt from '69 GUIDE, Chapter 3

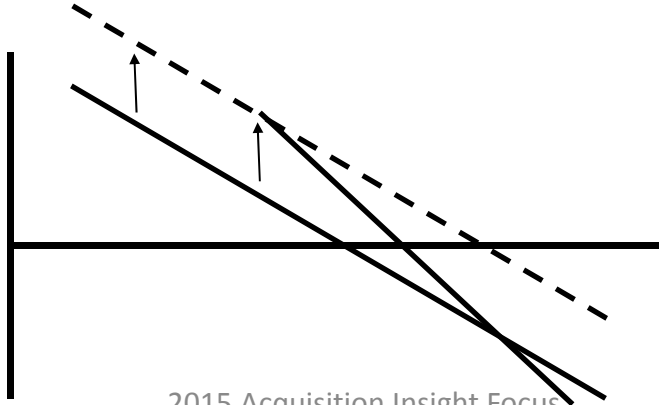
‘69 GUIDE Technique #2 (Target Centric)
FPIF, 50/50, 120% Ceiling
Applied to Single Point
Estimated Target Cost



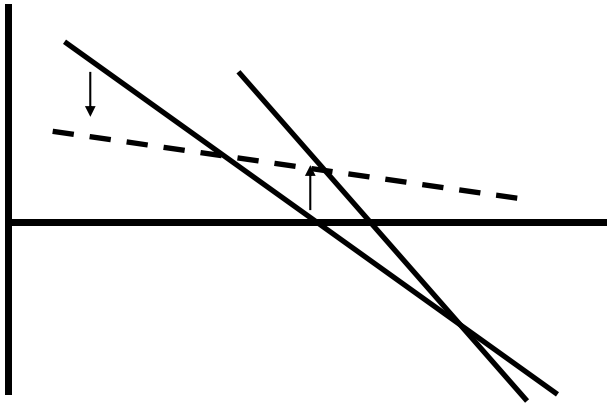
- The 50/50, 120%, FPIF with WGL Profit/Fee results in aberrant geometry (PTA Cost $ > Ceiling Price $ resulting in loss, not profit, at PTA) - administratively problematic.
- We could simply resort to raising the share line with more (above WGL) profit, and/or tightening ceiling, and/or flattening share line.
- But lets first try looking at ‘69 GUIDE Technique #1 (PTA/Ceiling Centric).

Aberrant FPI Geometry
(Problem, Conditions, and Cures)

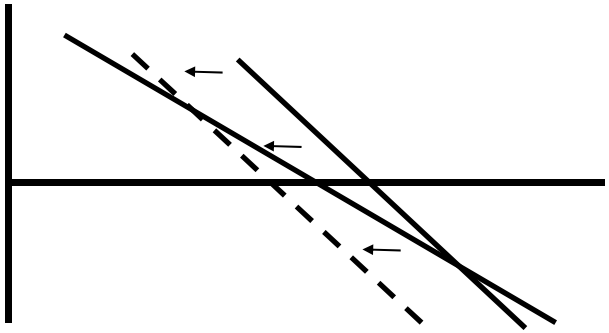
- Aberrant Geometry may result from any combination of the following (**conditions**):
  - A contract share line with insufficient elevation because of lower target profit,
  - A relatively steep share line providing higher contractor shares (e.g. 50/50 vs. 70/30), and/or
  - A relatively more generous ceiling price percentage with respect to target cost (e.g. 120% vs. 115%) providing greater contractor ceiling relief.
- Possible adjustments (**cures**) to avoid aberrant geometry:
  - Elevation of share line, (providing the contractor more target profit as demonstrated in Target Centric Example #2 to raise the share line).



– Slope of share line (flatten, rotate, the share line by reducing contractor share).



– Tighten the ceiling price line relative to target cost, shifting the ceiling price line to the left closer to target.



- Technique #1 simultaneously determines line position (horizontal/vertical) and shares.
  – Requires (can't avoid) quantitative cost risk analysis to determine PTA.
  – Includes some profit at PTA to determine ceiling - aberrance is avoided by design.
  – Will likely (unnecessarily, with improper mathematics) result in overly generous ceilings, and less contractor incentive in calculating the share line.

1969 DOD AND NASA INCENTIVE CONTRACTING GUIDE Technique #1. pp. 71-72

Establishing a reasonable profit dollar amount for both target cost and the point of total assumption (or the upper limit of the range of incentive effectiveness). This technique automatically establishes both the sharing arrangement and the ceiling price. For example: Assume that the negotiation results in agreement that the following are reasonable

Target Cost: $10.0 million
Target Profit: $1,050,000

Assume also that the evaluation indicates a reasonable upper cost level of $11.5 million and the negotiator believes the contractor is entitled to $500,000 profit at this point. A ceiling price is automatically set at $12.0 million ($11.5 maximum cost plus $500,000 profit). Further, the sharing ratio is set at 63/37.

The following formula is used to calculate the contractor's share:

$$\text{Contractor's Share} = \frac{\text{Profit Pool}}{\text{Range of Incentive Effectiveness (Cost Sharing Range)}}$$

1969 DOD AND NASA INCENTIVE CONTRACTING GUIDE
Technique #1. pp. 71-72

Cost at - PTA	$11.5 million	
Cost at - Target	$10.0 million	
Cost Range	$1.5 million	
Profit-Target		$1,050,000
Profit at PTA		$ 500,000
Profit Pool		$ 500,000 (typo here: $550,000)

Contractor's Share = $550,000 / $1,500,000 = .37

1,500,000/550,000 or

Sharing Ratio -- 63/37

The only question remaining is whether the 63/37 sharing arrangement should also apply to cost under target. Generally it could apply equally well to either over or below target cost. If a different sharing ratio was desired for cost below target the same procedure as above target would be used.

‘69 DOD AND NASA INCENTIVE CONTRACTING GUIDE p. 83

	Low	Likely	High
Parts	$12,000	$12,900	$13,000
Subcontracts	35,800	39,600	40,500
Direct Labor	28,000	34,000	58,000
Engineering	43,000	50,300	75,500
Overhead & G&A	174,000	195,200	230,000
Total Costs	$292,800	$332,000	$417,000
Assume then profit/fee should be:	38,000 [2]	30,000 [1]	18,000 [2]
Price	$330,800	$362,000	$435,000

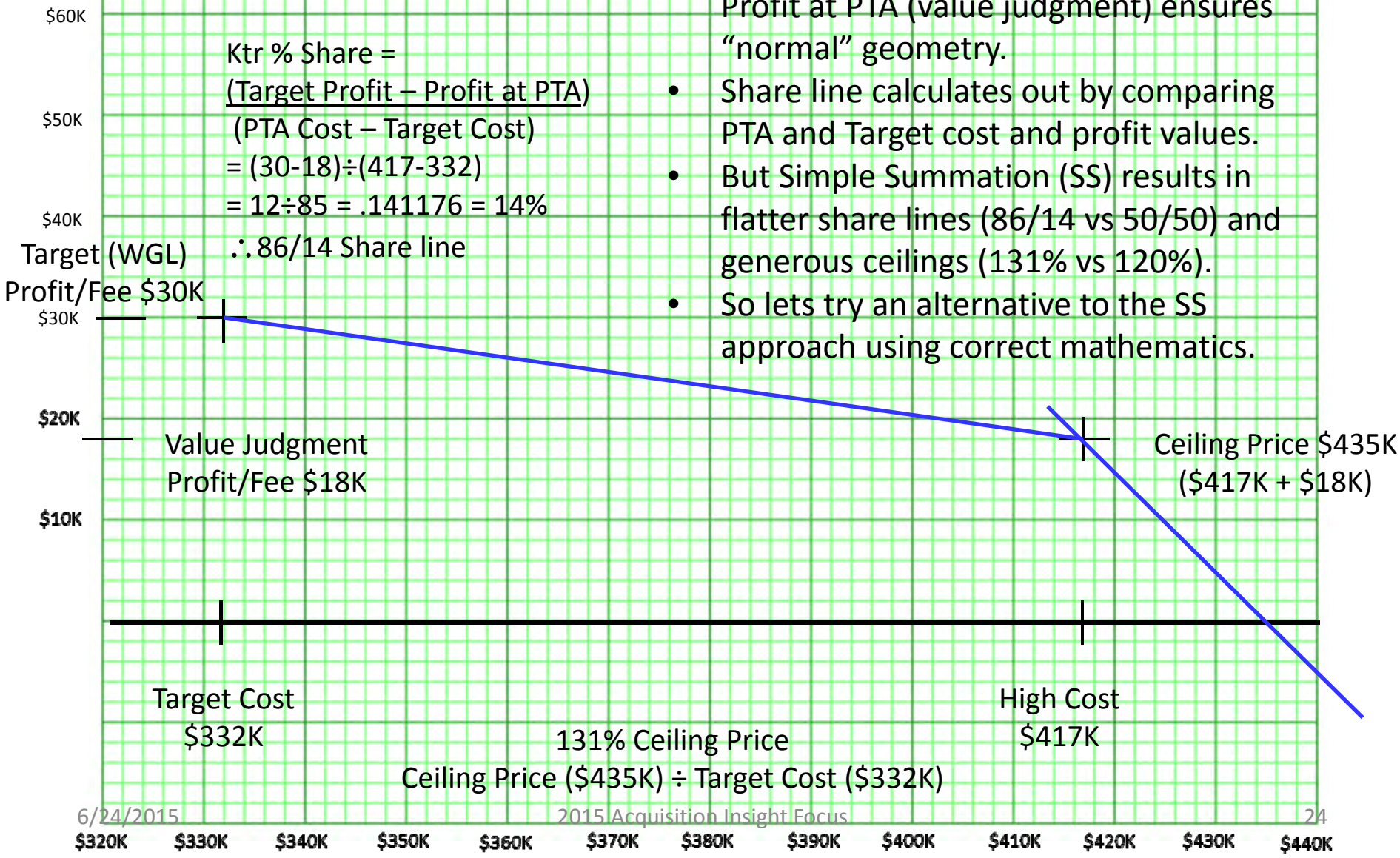
[1] Determined by the technique of profit analysis required by the department or agency.

[2] Value judgment - the dollars you would be willing to pay at that cost level.

‘69 GUIDE Technique #1 (PTA/Ceiling Centric)
Simple Summation (LOW, LIKELY, HIGH)

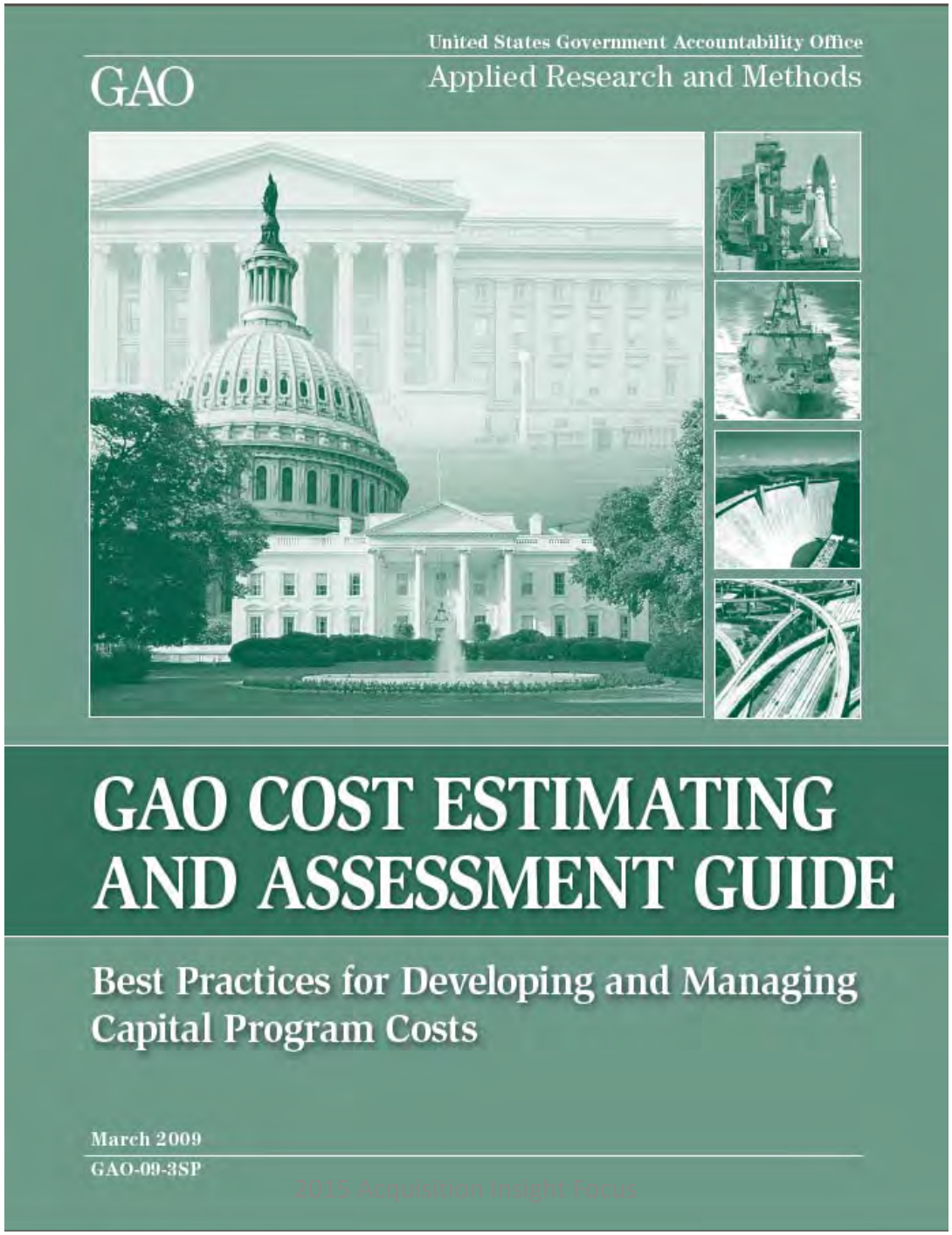
- Affirmative determination of Positive Profit at PTA (value judgment) ensures “normal” geometry.
- Share line calculates out by comparing PTA and Target cost and profit values.
- But Simple Summation (SS) results in flatter share lines (86/14 vs 50/50) and generous ceilings (131% vs 120%).
- So lets try an alternative to the SS approach using correct mathematics.

Ktr % Share =
(Target Profit – Profit at PTA)
(PTA Cost – Target Cost)
= (30-18)÷(417-332)
= 12÷85 = .141176 = 14%
∴ 86/14 Share line



Limitations with technique #1

- “While the approach may have its drawbacks . . .” - ‘69 GUIDE
- Adding individual LOW, LIKELY, and HIGH values to obtain total distribution values?
- Of the moments that describe distributions, only the mean and variance may be summed to describe a total distribution.
- The GAO has made note of this err while devoting an entire chapter to Cost Risk in their Cost Estimating Guide.
- Technique #1 application in constructing FPI geometry, with mistaken mathematics, has the effect to: 1) understate target cost, 2) inflate ceiling prices, and also calculate flat share lines not providing as much incentive for contractor’s to control cost and/or assume more risk for cost overruns.


United States Government Accountability Office
GAO
Applied Research and Methods
GAO COST ESTIMATING AND ASSESSMENT GUIDE
Best Practices for Developing and Managing Capital Program Costs
March 2009
GAO-09-3SP

CHAPTER 14

Cost Risk and Uncertainty

In chapter 13, we discussed sensitivity analysis and how it is useful for performing what-if analysis, determining how sensitive the point estimate is to changes in the cost drivers, and developing ranges of potential costs. A drawback of sensitivity analysis is that it looks only at the effects of changing one parameter at a time. In reality, many parameters can change at the same time. Therefore, in addition to a sensitivity analysis, an uncertainty analysis should be performed to capture the cumulative effect of additional risks.

Because cost estimates predict future program costs, uncertainty is always associated with them. For example, data from the past may not always be relevant in the future, because new manufacturing processes may change a learning curve slope or new composite materials may change the relationship between weight and cost. Moreover, a cost estimate is usually composed of many lower-level WBS elements, each of which comes with its own source of error. Once these elements are added together, the resulting cost estimate can contain a great deal of uncertainty.

The Difference Between Risk and Uncertainty

Risk and uncertainty refer to the fact that because a cost estimate is a forecast, there is always a chance that the actual cost will differ from the estimate. Moreover, lack of knowledge about the future is only one possible reason for the difference. Another equally important reason is the error resulting from historical data inconsistencies, assumptions, cost estimating equations, and factors typically used to develop an estimate.

In addition, biases are often found in estimating program costs and developing program schedules. The biases may be cognitive—often based on estimators' inexperience—or motivational, where management intentionally reduces the estimate or shortens the schedule to make the project look good to stakeholders. Recognizing the potential for error and deciding how best to quantify it is the purpose of risk and uncertainty analysis.[51]

It is inaccurate to add up the most likely WBS elements to derive a program cost estimate, since their sum is not usually the most likely estimate for the total program, even if they are estimated without bias.[52] Yet summing costs estimated at the detailed level to derive a point estimate is the most common approach to

[51] Many good references outline the cost risk and uncertainty modeling process. The Air Force Cost Analysis Agency's recent *Cost Risk and Analysis Handbook* is one example (see Alfred Smith and others, *Air Force Cost Analysis Agency (AFCAA) Cost Risk Analysis Handbook (CRH)*, prepared for Stephen Tracy, Air Force Cost Analysis Agency (Goleta, Calif.: Tecolote Research, Inc., October 2006).

[52] See Stephen A. Book, "Do Not Sum 'Most Likely' Costs," presentation to American Society of Military Comptrollers, Los Angeles, Calif., April 30, 2002.

Quantitative Risk Analysis
Simple Summation and Distribution Summation

	Low	Likely	High	Triangular Distributions Mean	Variance
Parts	$ 12,000	$ 12,900	$ 13,000	$ 12,633	5.06E+04
Subcontracts	$ 35,800	$ 39,600	$ 40,500	$ 38,633	1.04E+06
Direct Labor	$ 28,000	$ 34,000	$ 58,000	$ 40,000	4.20E+07
Engineering	$ 43,000	$ 50,300	$ 75,500	$ 56,267	4.85E+07
Overhead/G&A	$ 174,000	$ 195,200	$ 230,000	$ 199,733	1.33E+08
Total Cost	$ 292,800	$ 332,000	$ 417,000	$ 347,267	√ 2.25E+08
			$69,733		$14,993
			4.65	Std deviations???!!!	Std dev

WIKI Math References

Triangular Distributions
http://en.wikipedia.org/wiki/Triangular_distribution

Cumulant Moments (mean and variance)
http://en.wikipedia.org/wiki/Moment_(mathematics)

68-95-99.7 rule
http://en.wikipedia.org/wiki/68%E2%80%9395%E2%80%9399.7_rule

Mean	$	347,267	68-95-99.7 rule
plus	$	14,993	1 Std dev (68%)
	$	362,259	
plus	$	29,986	2 Std dev (95%)
	$	377,252	
plus	$	44,978	3 Std dev (99.7%)
	$	392,245	

Shouldn't 3 Std. Devs. covering 99.7% be sufficient for PTA/Ceiling? Shouldn't the mean representing 50/50 probability of over/under run be the Target? At least for figuring share %? Does Target matter on price line?

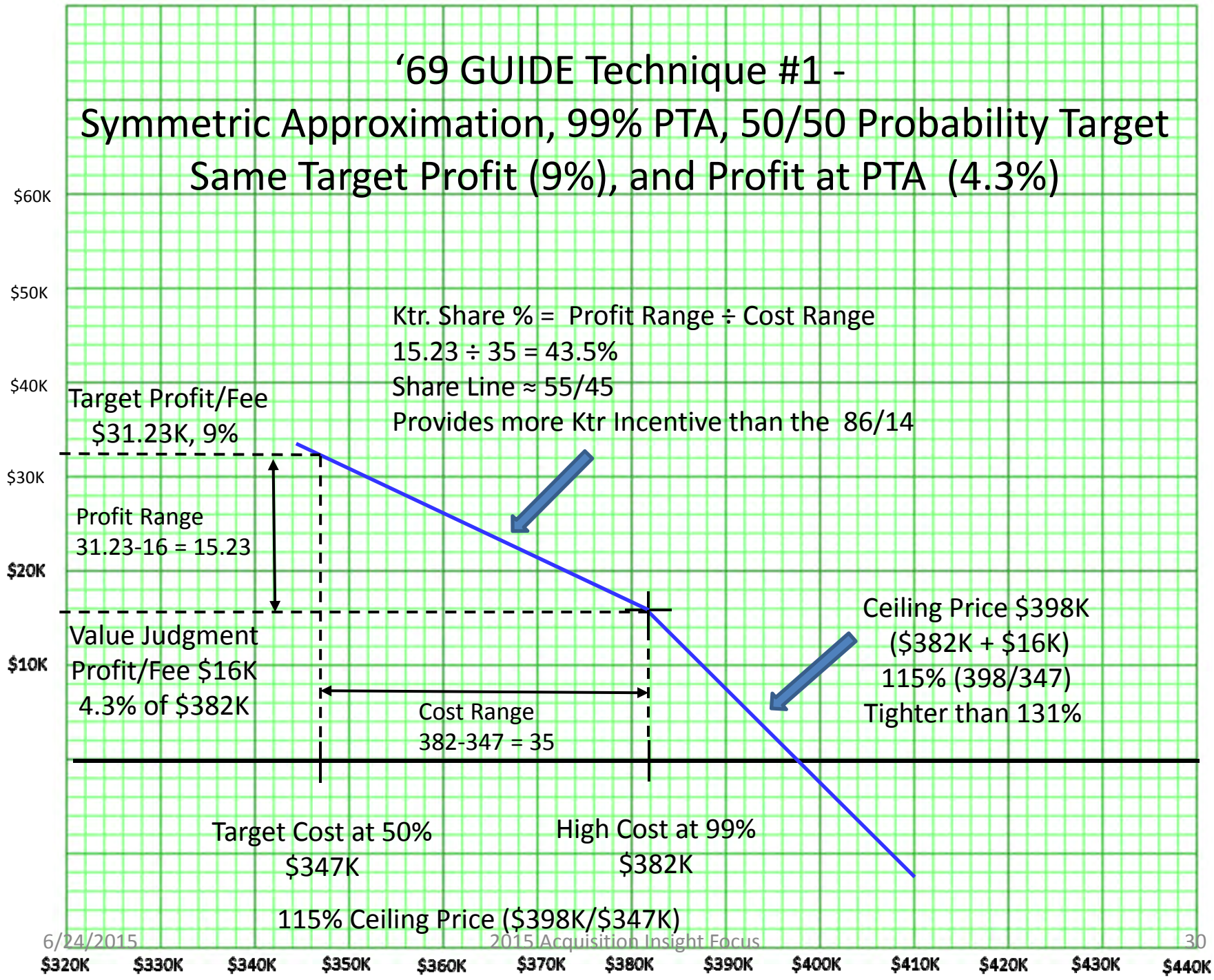
Lets enter the '69 GUIDE example in the CON 270 Risk Template

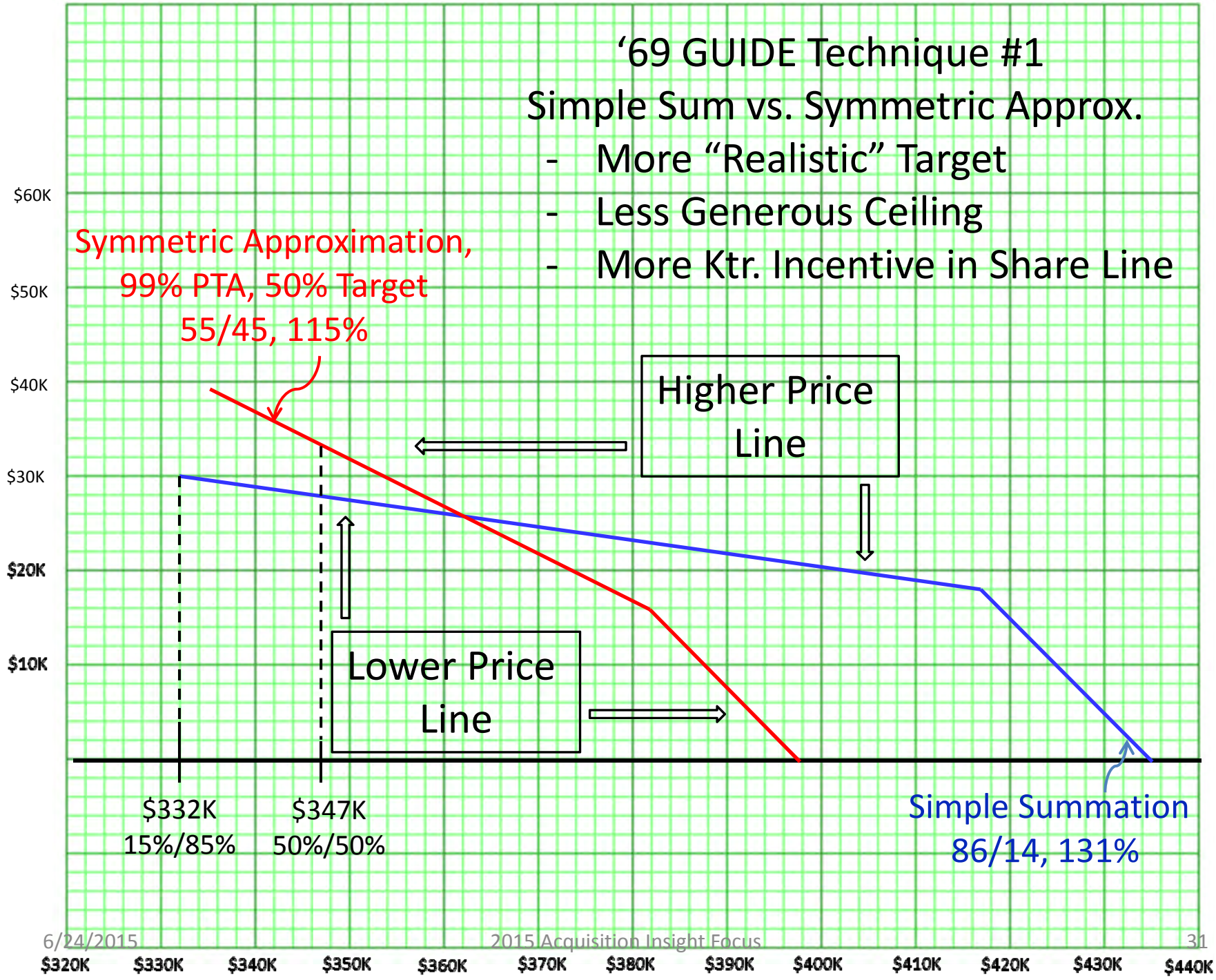
Symmetric Approximation

	Triangular, Right Beta, Uniform			
Cost Element	**Low**	**Most Likely**	**High**	**Shape**
Parts	12000	12900	13000	T
Subcontracts	35800	39600	40500	T
Direct Labor	28000	34000	58000	T
Engineering	43000	50300	75500	T
Overhead & G&A	174000	195200	230000	T

- Assess the probability of overrun/underrun at the "simple" sum of the most likely, $332,000
- Determine that cost truly at the equal probability of overrun and underrun, i.e. the 50th percentile, to use as target.
- Determine the cost that covers 99% of the risk to use as our PTA to compute Ceiling Price.

Position to be Evaluated:	332000		
Probability of Underrun:	15.43%		
Probability of Overrun:	84.57%		
Left Prob:	50.00%	**Left Value:**	347267
Right Prob:	99.00%	**Right Value:**	382145


'69 GUIDE Technique #1 -
Symmetric Approximation, 99% PTA, 50/50 Probability Target
Same Target Profit (9%), and Profit at PTA (4.3%)
$60K
$50K
$40K
$30K
$20K
$10K
Ktr. Share % = Profit Range ÷ Cost Range
15.23 ÷ 35 = 43.5%
Share Line ≈ 55/45
Provides more Ktr Incentive than the 86/14
Target Profit/Fee
$31.23K, 9%
Profit Range
31.23-16 = 15.23
Value Judgment
Profit/Fee $16K
4.3% of $382K
Cost Range
382-347 = 35
Ceiling Price $398K
($382K + $16K)
115% (398/347)
Tighter than 131%
Target Cost at 50%
$347K
High Cost at 99%
$382K
115% Ceiling Price ($398K/$347K)
$320K
$330K
$340K
$350K
$360K
$370K
$380K
$390K
$400K
$410K
$420K
$430K
$440K


'69 GUIDE Technique #1
Simple Sum vs. Symmetric Approx.
- More "Realistic" Target
- Less Generous Ceiling
- More Ktr. Incentive in Share Line
Symmetric Approximation,
99% PTA, 50% Target
55/45, 115%
Higher Price Line
Lower Price Line
$332K
15%/85%
$347K
50%/50%
Simple Summation
86/14, 131%
$60K
$50K
$40K
$30K
$20K
$10K
$320K
$330K
$340K
$350K
$360K
$370K
$380K
$390K
$400K
$410K
$420K
$430K
$440K

Symmetric Approximation – Some Notes

- The math for calculating means and variances (the only sum-able distribution moments) has been known for years.
- The summed Total Distribution assumes:
  - That it is a Normal distribution (which may not be true), and
  - Either NO correlation (0) between individual cost elements, or
  - Perfect (+1) correlation between cost element; in which case you sum the individual standard deviations instead of variances.
- Requires total dollars ($) for individual cost elements, when in reality these $ are the products of resources (hrs.) and rates which will have different distributions.
- The Template displayed was developed for CON 270 classroom use only and, unlike other tools, is not available for practitioner download at the DAU Pricing COP.
  - Though simulation software is not difficult to use, it is software and there is insufficient time in class to insert the 3rd party software of choice (@Risk or Crystal Ball) used by DoD practitioners engaged in quantitative risk analysis.
  - There exist other DAU courses, e.g. BCF 206, where the simulation software is taught but the curriculum is within the context of the Cost Estimating career field having to comply with WSARA in preparation of the POEs to Congress.

Lets Examine Technique #1 through a Case Study

- First by using the typical construction used, historically and currently, to follow the ‘69 GUIDE, Technique #1.

- Then by incorporating simulation, now available for desktop computers, as part of our quantitative risk analysis.

You have just received all your inputs to prepare the negotiation objective for a FFP contract.

- After review of the contractor's proposed point estimates, your technical evaluation arrived to provide the requested point estimates to build your FFP negotiation objective as follows:

  - Design (Engineering) Hours: 110,000
  - Test (Engineering) Hours: 30,000
  - Fabrication (Mfg.) Hours: 22,540
  - Assembly (Mfg.) Hours: 6,565

- CBAR reports DCMA has a current FPRA as follows:

	Direct	Indirect
Engineering	$30.00/hr	110.00%
Manufacturing	$17.00/hr	198.00%
G&A (TCI)		12.00%

- The auditors at DCAA have scrubbed the bill of material for current quotes and purchase orders;
  - they find $5,350,000 to be a current, complete and accurate amount for materials and subcontracts.

- Assembling these inputs you determined Government cost objective to be $17,521,794.

	FFP Objective
Design Eng Hours	110,000
Test Eng Hours	30,000
Total Eng Hours	140,000
Eng Wage Rate	$ 30.00
Direct Eng $	$ 4,200,000
Eng OH Rate	110%
Eng OH $	$ 4,620,000
Subtotal Eng	$ 8,820,000
Fab Hours	22,540
Assembly Hours	6,565
Total Mfg Hours	29,105
Mfg Wage Rate	$ 17.00
Direct Mfg $	$ 494,785
Mfg OH Rate	198%
Mfg OH $	$ 979,674
Subtotal Mfg	$ 1,474,459
Material	$ 5,350,000
Sub-Total Cost	$ 15,644,459
G&A Rate	12%
G&A $	$ 1,877,335
Total Cost	17,521,794

- You were just getting ready to run the WGL to develop the profit objective on your FFP contract when . . . .
- You are advised to immediately switch to a FPIF contract.
- Per the PGI, and venerable 1969 DOD/NASA guide, this is going to require a quantitative risk analysis, and that by element of cost.

- You recall there were delays with some evaluators getting their technical evaluation positions done.
  - Some were trying to discuss with you some of the boundaries and situations as they were grappling with trying to come up with “a” number.
  - But you were running out of time and had demanded,

    “_____ IT . . . just give me a number.”

- You recall a risk presentation involving a Telework study.
  - Three (3) individuals reported the same commuting time (30 minutes) on the survey you sent out.
  - But when you investigated by interviewing them, each had a different story behind their number.
  - While the single point numbers were the same, was the character behind each estimate really the same?

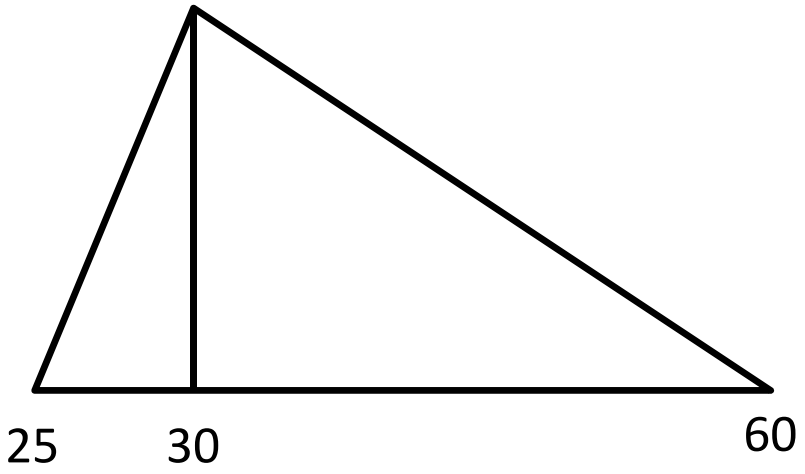
The Story Behind the Estimate - TELEWORK

(an illustration created by Professor Steve Malashevitz, DAU Midwest)

Agency reviewing their Telework policy – you are asked to research commuting times.

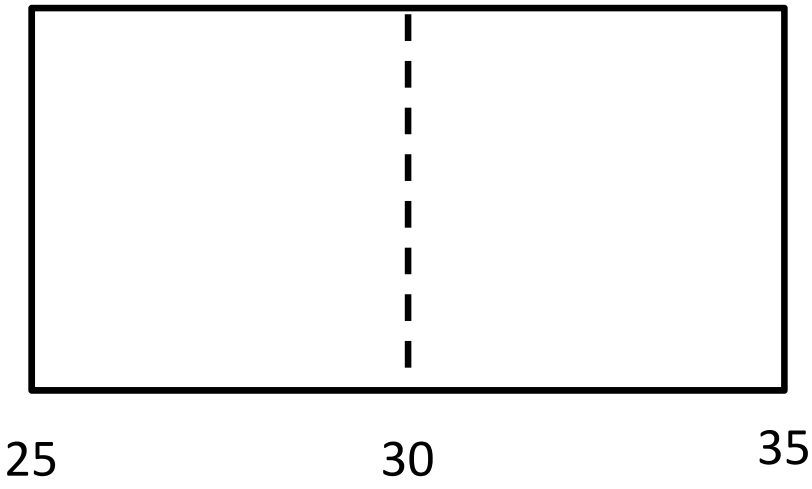
- The first person reported it takes 30 minutes to get to work, usually, . . . :
  - most days it takes 30 minutes by highway, but
  - on a good day they can make it in as little as 25 minutes, however
  - can take as long as 60 minutes with construction and/or heavy traffic.

- Lets translate with a common distribution, a triangular[1] distribution; where 30 minutes is most likely (mode), along with a low of 25 and a high of 60.



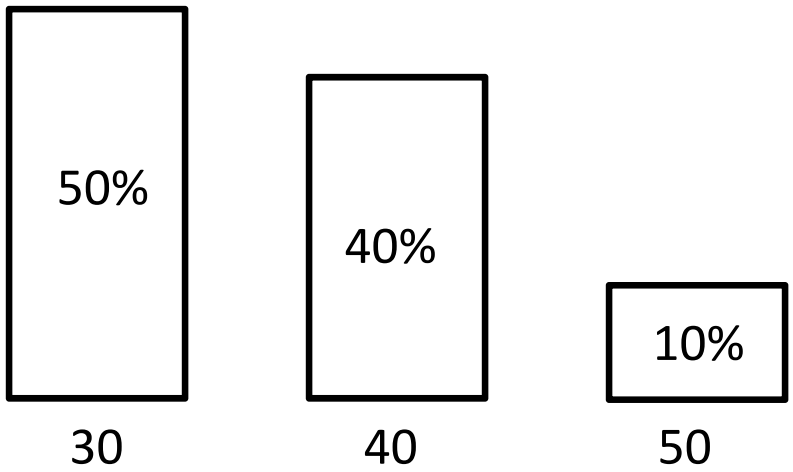
[1]Other distributions (e.g. variations of the Beta) could also be defined with these three (3) parameters, but will place less probability in the tails of a skewed distribution should the event be highly improbable.

- The second person also says it takes them 30 minutes. Hmmm? . . .
  - 25 minutes if all the lights are green on their surface street route,
  - 35 minutes if all the lights are red; and any point in between is just as likely.
  - Your survey required a point estimate, so they split the difference at 30.
- Let's translate this as a uniform distribution; defined with a low of 25 minutes and a high of 35 minutes.[1]

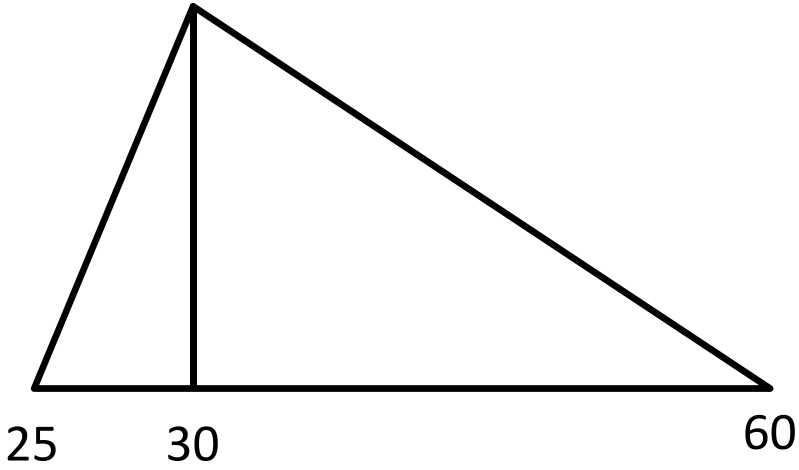


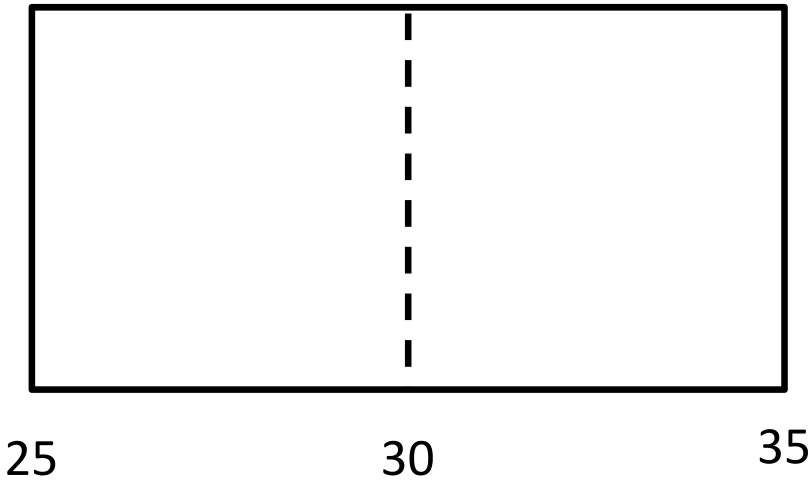
[1] The graphic above portrays the original point estimate at 30 just for reference with the narrative of the illustration; the low and the high (alone) define a uniform distribution.

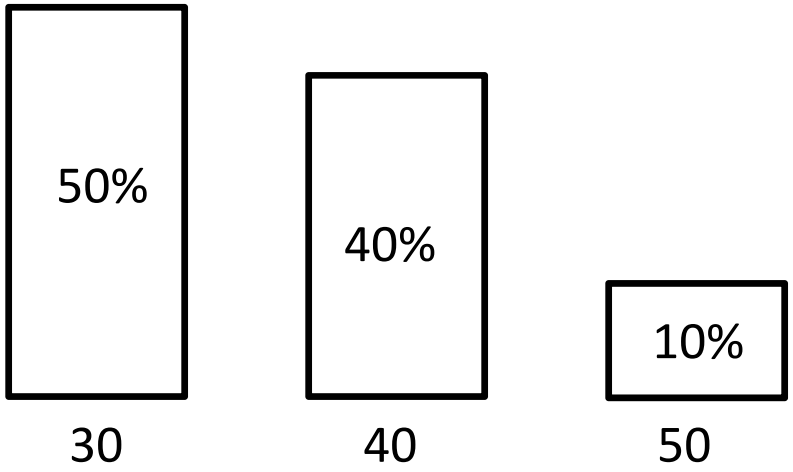
- Interestingly enough, another person also reported 30 minutes. On average, for every two week, 10 day, period they:
  - take the bus one day (1/10th of the time), which takes 50 minutes;
  - carpool twice a week (4/10^{ths} of the time), which takes 40 minutes;
  - and drive the rest (5/10^{ths} of the time), which takes 30 minutes (the most likely commute reported on their survey).
- Let's translate this as a discrete distribution, graphically portrayed below.



- Each of three (3) different people reported on your initial survey that they are most likely to experience a 30 minute commute time.







- Although the same point estimate (30 minutes), your investigation found they were not the same estimate – the character of each was different.

- You had only solicited and received single point estimates to support your firm-fixed-price negotiation objective.

- Considering some of the lessons behind the TELEWORK illustration, you decide to go get the story behind the estimates you received.

- But you will also have to try and put those stories in the paradigm/template of the three-column analysis presented in the ’69 DOD AND NASA INCENTIVE CONTRACTING GUIDE.

- Indeed, you may also be working in an organization where the three-column technique is THE template that must be used when presenting FPIF objective contract geometry.

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template.

- Design Engineering Hours (the story behind the 110,000 hours estimate)
  - Government engineers considered 110,000 hours to be achievable.
  - However, they had also considered they could be as low as 100,000.
  - Or as high as 165,000 hours, depending on . . .
  - how much of the existing design needs to be modified.

- Design Engineering Hours (bucketed into the three column template).

ELEMENT	LOW	LIKELY	HIGH
Design Eng. Hrs.	100,000	110,000	165,000

- Great! This is going to be a snap! We are on our way!

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template, continues.

- Test Engineering Hours (the story behind the 30,000 hours estimate)
  - Some uncertainty regarding the probability of range, vs. simulation testing
  - 10% likely to only require simulation? If so, then 20,000 hours.
  - Remaining probability split between a mixture, or all (100%) range
  - If a mixture of simulation/range testing, then test hours likely to be 30,000.
  - If 100% range testing were to be required, test hours could reach 50,175.

- Design Engineering Hours (bucketed into the three column template).

ELEMENT	LOW	LIKELY	HIGH
Test Eng. Hrs.	20,000 (10% p)	30,000 (45% p)	50,175 (45% p)

- Ok, although an equal probability between a mixture of simulation/range testing (30,000) vs. all range testing (50,175) – we put the 30,000 in the likely column. That was their recommendation and we needed a middle number in the template. We still don't have all day, and we need to move on!

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template, continues.

- Fabrication Hours (the story behind the 22,540 hours estimate).
  - Contractor had proposed 22,540 hours with improved tooling.
  - DCMA IE considered that overly conservative, and 17,500 more likely.
  - IE in program office considered anywhere between 17,500 and 23,500 to be equally likely; so concurred with the 22,540 hours proposed.

- Fabrication Hours (bucketed into the three column template).

ELEMENT	LOW	LIKELY	HIGH
Fabrication Hrs.	17,500	22,540	23,500

- Ok, everything between 17,500 and 23,540 is equally probable. But my template requires three numbers, and I have three numbers. If that means the proposed of 22,540 ends up being the most LIKELY, and therefore the low and the high are treated as less likely, then so be it.

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template, continues.

- Assembly Hours (the story behind the 6,565 hours estimate).
  - The government engineers believe 6,565 hours the most likely outcome.
  - But they could be as low as 6,000 hours,
  - or as high as 7,500 hours.

- Assembly Hours (bucketed into the three column template).

ELEMENT	LOW	LIKELY	HIGH
Assembly Hrs.	6,000	6,565	7,500

- Finally!!! Another reality that cleanly aligns with the paradigm/template! Odds were that it had to happen sooner or later.

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template, continues.

- Engineering Direct Labor Rate (the story behind the $30/hr. FPRA).
  - The DACO based their negotiation on a historical average rate with a $1.25 standard deviation.

- Engineering Direct Labor Rate (bucketed into the three column template).

ELEMENT	LOW	LIKELY	HIGH
Eng. DL Rate	$30/hr.	$30/hr.	$30/hr.

- Since it's a FPRA, I guess I better use in in all my position? (That would be quite handy since I'm otherwise not sure how I would develop a low and high position based on this standard deviation information - would/should I take the average rate to then add and subtract one, two, or three standard deviations.)

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template, continues.

- Manufacturing Direct Labor Rate (the story behind the $17/hr. FPRA).
  - The DACO reluctantly accepted the $17/hr. rate as the current average rate under the existing union contract up for negotiations this year.
  - Should the company's two-tier wage plan be accepted the rate would drop to $15/hr., but there is a 70% probability the union will defeat this plan.

- Manufacturing Direct Labor Rate (bucketed into the three column template).

ELEMENT	LOW	LIKELY	HIGH
Mfg. DL Rate	$15/hr.	$17/hr.	$17/hr.

- At least here I have some rates, instead of standard deviations. I'll go ahead and use the FPRA in the LIKELY and HIGH positions since there is a 70% probability this is going to be the rate. But I'll consider the $15/hr. rate in the low position.
- Not sure the effect this will have, but I need to multiply those hours by something to get the LOW, LIKELY, and HIGH dollars used in the paradigm/template.

Your investigation of the story behind the estimate by element of cost, and your attempt to bucket it into the three column paradigm, or template, continues.

- Indirect Rates, Overheads and G&A (the story behind the FPRAs).
  - The DACO based their negotiations using the company's projections of business activity reflected in the base [rate % =pool($) ÷ base ($)]
  - They constrained their base to only current contracts; with no consideration for winning contracts they're bidding where they have a 50% chance.
  - Should the company win additional contracts (10% of the current base), those rates will drop during your contract performance.
- Indirect Rates, Overheads and G&A (bucketed into three column template).

ELEMENT	LOW	LIKELY	HIGH
Eng. OH Rate	100%	110% FPRA	110% FPRA
Mfg. OH Rate	180%	198% FPRA	198% FPRA
G&A Rate	10.91%	12% FPRA	12% FPRA

- The paradigm/template requires three positions on indirect cost calculated from your direct costs; so you use the FPRAs in both the LIKELY and HIGH positions, but recognize the 50% probability of the lower rate position to obtain overhead and G&A only in the LOW column. (You will face a hailstorm of objections if you don't recognize the FPRAs.)

			Results of Risk Investigation Interview		
			Forcing the honest stories into three traditional bucket		
	FFP Objective		**Low**	**Likely/Middle?**	**High**
Design Eng Hours	110,000		100,000	110,000	165,000
Test Eng Hours	30,000		20,000	30,000	50,175
			10%	45%	45%
Total Eng Hours	140,000		120,000	140,000	215,175
Eng Wage Rate	$ 30.00		$ 30.00	$ 30.00	$ 30.00
Direct Eng $	$ 4,200,000		$ 3,600,000.00	$ 4,200,000.00	$ 6,455,250.00
Eng OH Rate	110%		100%	110%	110%
Eng OH $	$ 4,620,000		$ 3,600,000.00	$ 4,620,000.00	$ 7,100,775.00
Subtotal Eng	$ 8,820,000		$ 7,200,000.00	$ 8,820,000.00	$ 13,556,025.00
Fab Hours	22,540		17,500	22,540	23,500
Assembly Hours	6,565		6,000	6,565	7,500
Total Mfg Hours	29,105		23,500	29,105	31,000
Mfg Wage Rate	$ 17.00		$ 15.00	$ 17.00	$ 17.00
Direct Mfg $	$ 494,785		$ 352,500.00	$ 494,785.00	$ 527,000.00
Mfg OH Rate	198%		180%	198%	198%
Mfg OH $	$ 979,674		$ 634,500.00	$ 979,674.30	$ 1,043,460.00
Subtotal Mfg	$ 1,474,459		$ 987,000.00	$ 1,474,459.30	$ 1,570,460.00
Material	$ 5,350,000		$ 5,350,000.00	$ 5,350,000.00	$ 5,350,000.00
Sub-Total Cost	$ 15,644,459		$ 13,537,000	$ 15,644,459	$ 20,476,485
G&A Rate	12%		10.91%	12.00%	12.00%
G&A $	$ 1,877,335		$ 1,476,887	$ 1,877,335	$ 2,457,178
Total Cost	17,521,794		15,013,887	17,521,794	22,933,663

‘69 GUIDE Technique #1 Application

	Likely - Target	High - PTA	
Cost:	$ 17,521,794	$ 22,933,663	
(WGL) Target Profit		PTA (Value)	Profit
9.50%	$ 1,664,570	$ 458,673	2.00%
Target Price	$ 19,186,365	$ 23,392,336	Ceiling Price
			134%

Change in Profit	$ 1,205,897
Change in Cost	$ 5,411,869

Contractor Share 22.28%

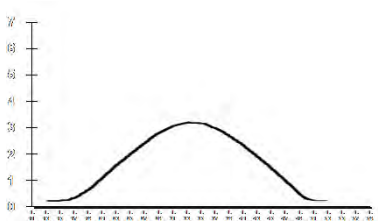
Share Line 78/22 - 80/20

‘69 GUIDE Technique #1, But With Simulation

- Previous construction still forced us into a “template” or paradigm, but now with three values . . . even after trying to get the “true” story behind the number.
- Simulation allows direct translation of the stories into custom distribution selection in the software – can improve communication, and build trust between the technical evaluation and cost/price analysis function.
- Macro driven random number generation samples are from taken from each distribution to build a total cost distribution.
- Probabilities are read directly form the output.
- We’ll use Technique #1, but with Target Cost at 50/50 probability of underrun-overrun and PTA at (say) 99th percentile.

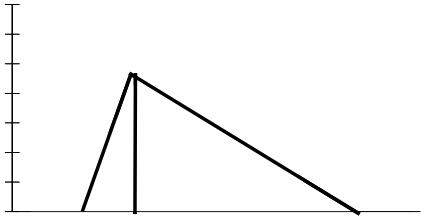
Distributions

Normal

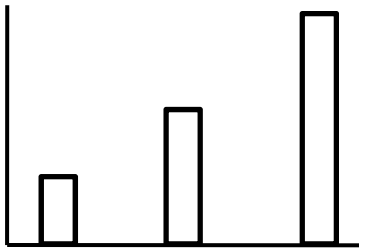


Uniform

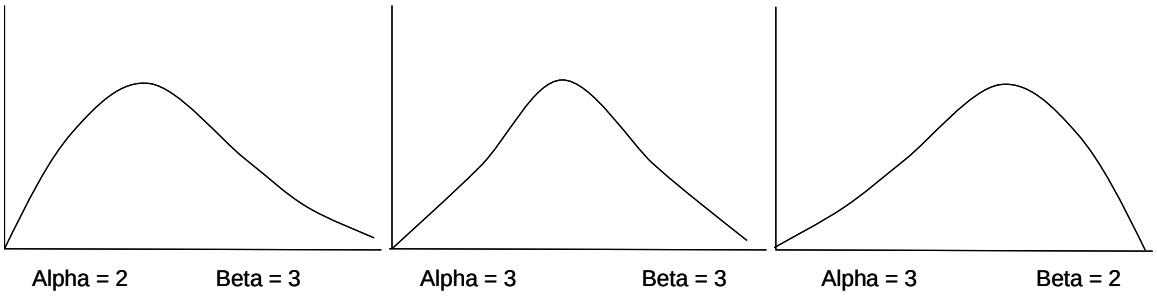
Triangular



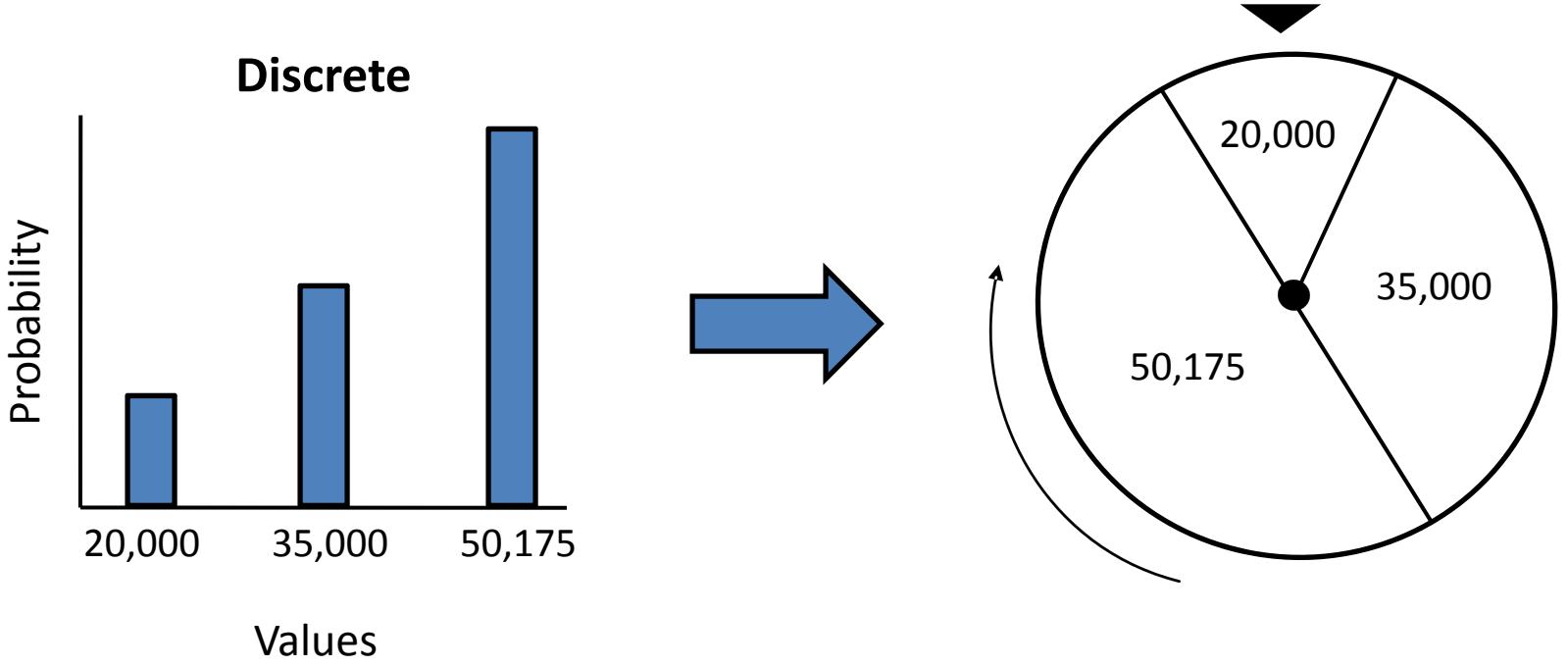
Discrete



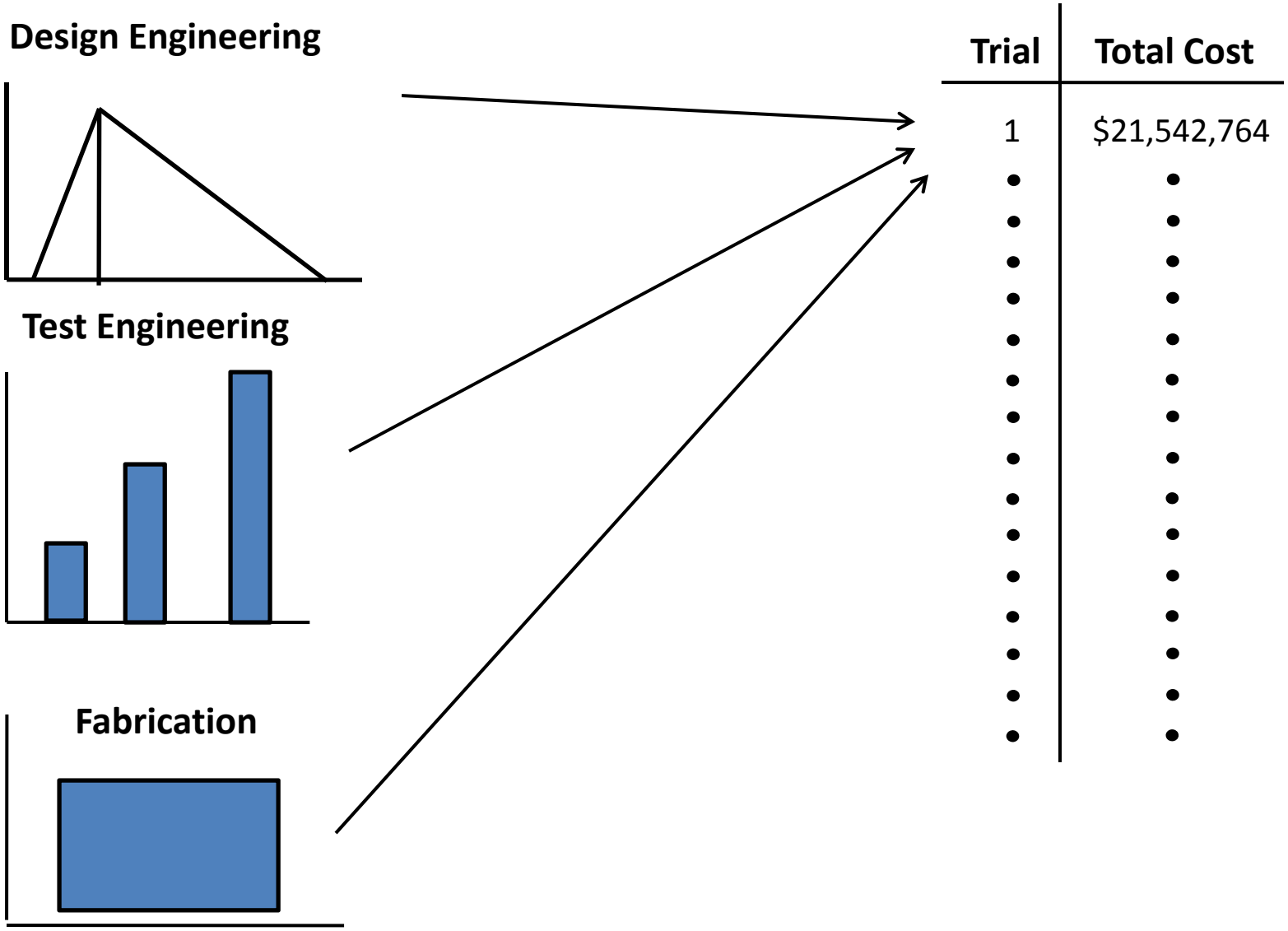
Beta



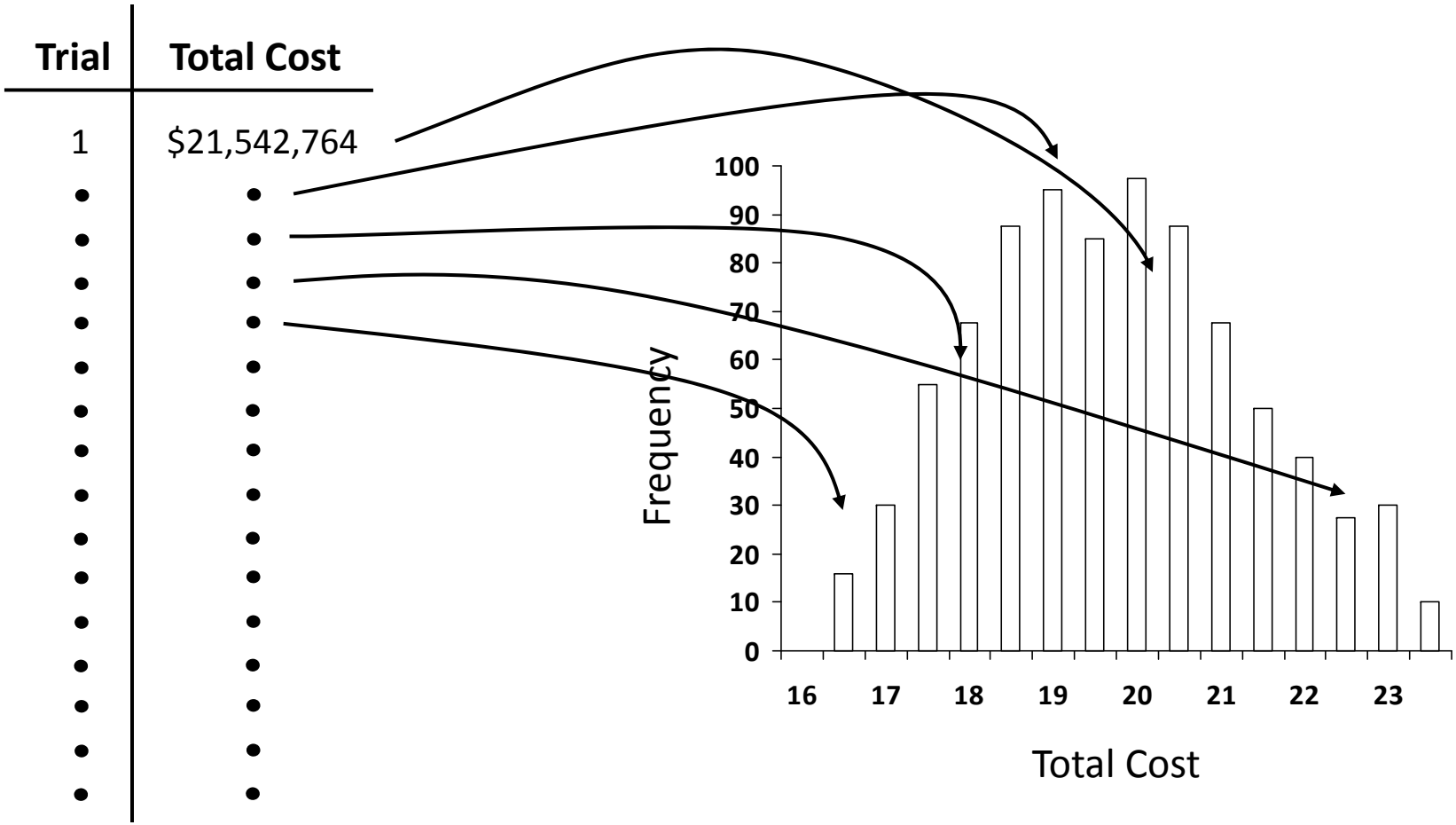
Random Sampling

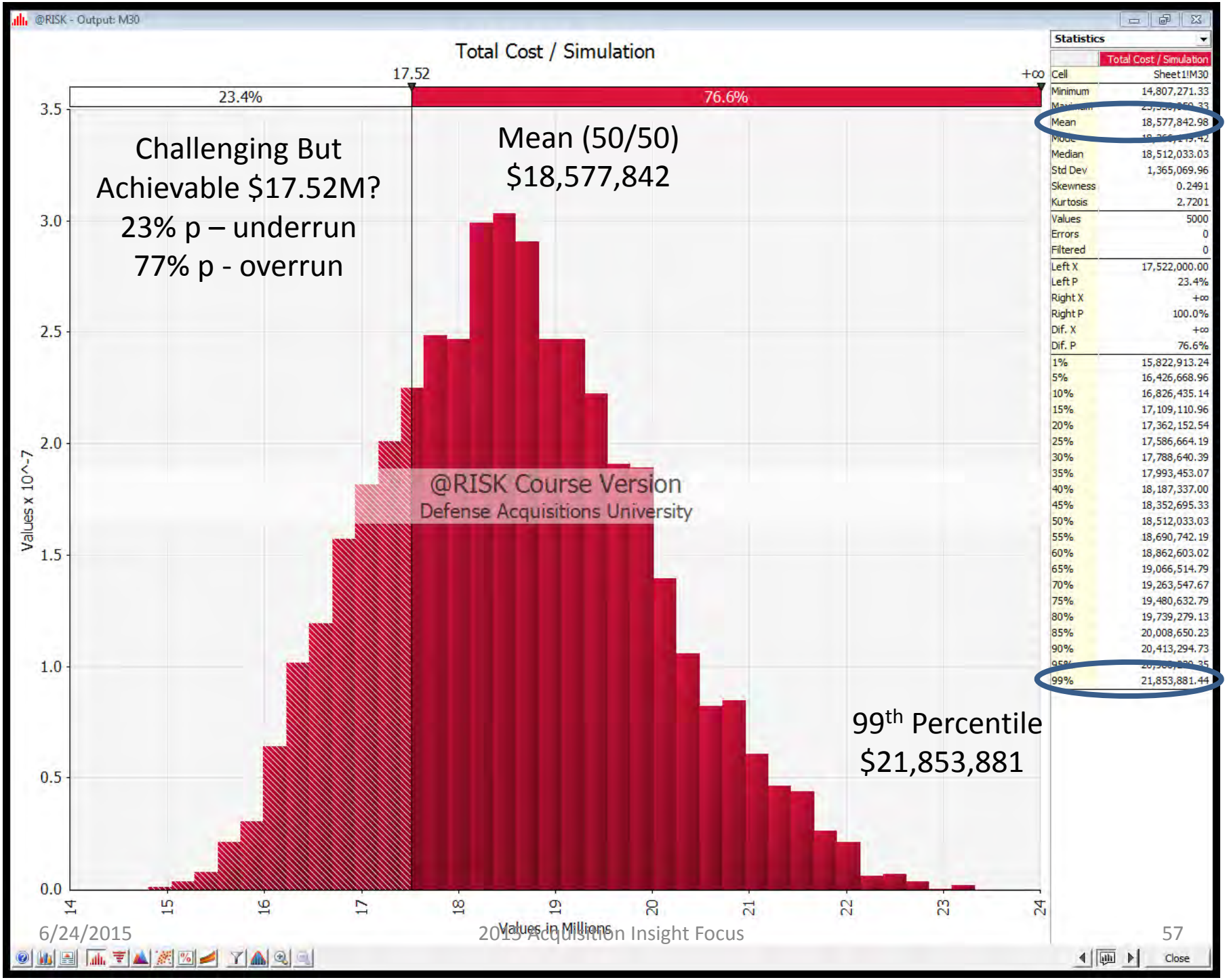


Iterations in Monte Carlo Simulation



Creating the Total Cost Distribution




@RISK - Output: M30
Total Cost / Simulation
17.52
+∞
23.4%
76.6%
Challenging But Achievable $17.52M?
23% p – underrun
77% p - overrun
Mean (50/50)
$18,577,842
@RISK Course Version
Defense Acquisitions University
99th Percentile
$21,853,881
Values x 10^-7
Values in Millions
Statistics
Total Cost / Simulation
Cell Sheet1!M30
Minimum 14,807,271.33
Mean 18,577,842.98
Median 18,512,033.03
Std Dev 1,365,069.96
Skewness 0.2491
Kurtosis 2.7201
Values 5000
Errors 0
Filtered 0
Left X 17,522,000.00
Left P 23.4%
Right X +∞
Right P 100.0%
Dif. X +∞
Dif. P 76.6%
1% 15,822,913.24
5% 16,426,668.96
10% 16,826,435.14
15% 17,109,110.96
20% 17,362,152.54
25% 17,586,664.19
30% 17,788,640.39
35% 17,993,453.07
40% 18,187,337.00
45% 18,352,695.33
50% 18,512,033.03
55% 18,690,742.19
60% 18,862,603.02
65% 19,066,514.79
70% 19,263,547.67
75% 19,480,632.79
80% 19,739,279.13
85% 20,008,650.23
90% 20,413,294.73
99% 21,853,881.44
Close

‘69 GUIDE Technique #1 FPIF Geometry Construction - Simulation Mean at Target, 99th Percentile at PTA -Same Target Profit Percentage (9.5%) and Profit at PTA (2%)

	Target (Mean)		PTA (99%)	
Cost	$ 18,577,843		$ 21,853,881	
Profit	$ 1,764,895	9.50%	$ 437,078	2.00%
	$ 20,342,738		$ 22,290,959	Ceiling Price
			120%	Ceiling Percent
Change in Profit	$ 1,327,817			
Change in Cost	$ 3,276,038			
	40.53%			
	40%	60/40		

CBA Target & Simulation PTA/Ceiling Hybrid? (Sum "LIKELY" Target; but 99th percentile PTA)

	Target Challenging, but Achievable		PTA 99th Percentile Risk Adjusted	
Cost	$ 17,521,794		$ 21,853,881	
Profit	$ 1,664,570	9.50%	$ 437,078	2.00%
Target Price	$ 19,186,365		$ 22,290,959	Ceiling Price
			127%	
Calculated Share				
Change in Profit	$ 1,227,493			
Change in Cost	$ 4,332,087			
Ktr Share %	28.33%			
Share Line	70/30			

50/50 Target w/WGL & 99th Percentile PTA to construct ceiling price and share line (60/40); but walked up and applied to CBA "Target Cost" Offer

"Achievable" TC Offer		17,521,794			
Target Profit	$	1,764,895	9.50% WGL Profit on 50/50 target		
Incentive Profit	$	422,419	Running up the 60/40 developed from 50/50 target		
Total (above WGL) Profit	$	2,187,315			
		12.48%		$	22,290,959
"Target Price" Offered		19,709,109		127%	Ceiling Price

- "Above WGL" Profit recognized as needed by the presenter is calculated as incentive profit by walking it up the steeper share line (60/40) from 50/50 target.
- Should contractor accept this position, it will yield the same FPIF final price curve (geometry) as that constructed using 50/50 target.
- Only reservation is to make provision for administrative reservation of funding at the higher target price reflecting cost "most likely" to come in at 50/50 cost point.

FPIF Grapher CBA Target 20150623 - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

F32

=IF(F30="","",IF(IF(F30<F5,ROUND(F7-(O64*(F5-F30)),0),ROUND(F7+(O65*(F30-F5)),0))>F8,F8,IF(F30<F5,ROUND(F7-(O64*(F5-F30)),0),ROUND(F7+(O65*(F30-F5)),

FPIF with: Target Cost $18,577,843; Target Profit $1,764,895; Target Price $20,342,738; Ceiling Price $22,290,959. Share 60/40 Under & 60/40 Over.

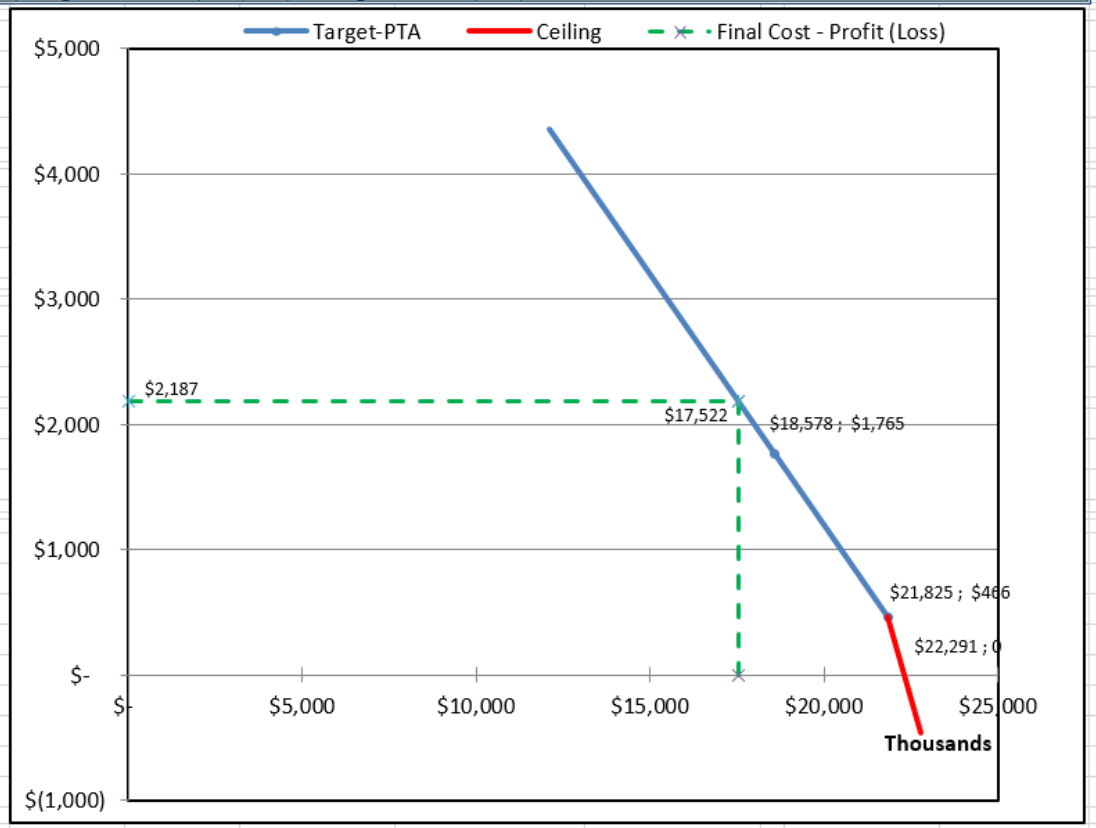
Target Cost		$ 18,577,843
Target Profit %/$	9.50%	$ 1,764,895
Target Price		$ 20,342,738
Ceiling %/$	119.99%	$ 22,290,959

Assigned Shares	Govt	/ Ktr
Under Target	60.0%	/ 40.0%
Over Target	60.0%	/ 40.0%

Calculated Shares	Cost	Profit
Optimistic		
Pessimistic		

	Govt	/ Ktr
Under Target		/
Over Target		/

Point of Total Assumption (PTA)	$ 21,824,878
Final Actual Audited Allowable Cost:	$ 17,521,794
Final Contract Price:	$ 19,709,109
Final Contractor Profit (Loss):	$ 2,187,315
Final Contractor Profit (Loss) %:	12.48%



Using the risk evaluated 50/50 target to construct 60/40 share line with WGL profit of 9.5%, but calculating "above WGL profit" for a "Challenging but Achievable" cost using the simple sum of the "LIKELY" cost elements. Difference between the 9.5% WGL profit and 12.48% effective profit at CBA is the 40% incentive in effect. Should contractor accept CBA Target Cost $17,521,794, 12.48% Target Profit, 60/40 Over/Under, 127% Ceiling - its the same deal line using 50/50 Target. Only precaution would be to ensure administrative funding reserves of 50/50 Target Price of $22,290,959 instead of Target Prce of $19,709,109 based on CBA Target.

Analyst Notes

FPIF - Protected | FPIF - Unprotected | 50-50 Target | CBA Target

READY 130%

FPIF Grapher CBA Target 20150623 - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

C5 Target Cost

FPIF with: Target Cost $18,577,843; Target Profit $1,764,895; Target Price $20,342,738; Ceiling Price $22,290,959. Share 60/40 Under & 60/40 Over.

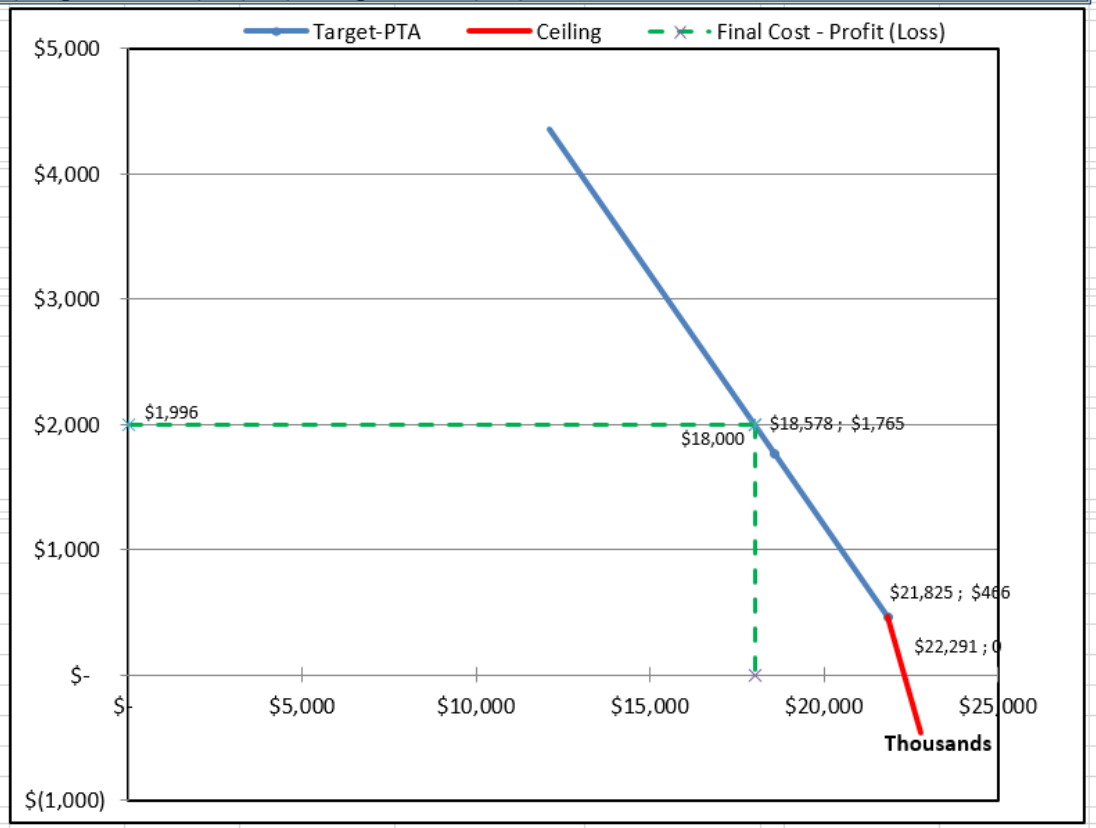
Target Cost		$	18,577,843
Target Profit %/$	9.50%	$	1,764,895
Target Price		$	20,342,738
Ceiling %/$	119.99%	$	22,290,959

Assigned Shares	Govt	/ Ktr
Under Target	60.0%	/ 40.0%
Over Target	60.0%	/ 40.0%

Calculated Shares	Cost	Profit
Optimistic		
Pessimistic		

	Govt	/ Ktr
Under Target		/
Over Target		/

Point of Total Assumption (PTA)	$	21,824,878
Final Actual Audited Allowable Cost:	$	18,000,000
Final Contract Price:	$	19,996,032
Final Contractor Profit (Loss):	$	1,996,032
Final Contractor Profit (Loss) %:		11.09%



Going on contract with the 50/50 Target Cost, 9.5% WGL Target Profit, and 99th Percentile PTA used to construct Ceiling Price and 60/40 Share Line - If actual, audited, allowable cost were to come in at $18M, Final Contrat price would be $19,996,032.

Analyst Notes

FPIF - Protected | FPIF - Unprotected | 50-50 Target | CBA Target

READY 130%

FPIF Grapher CBA Target 20150623 - Excel

FILE HOME INSERT PAGE LAYOUT FORMULAS DATA REVIEW VIEW

C5 Target Cost

FPIF with: Target Cost $17,521,794; Target Profit $2,186,720; Target Price $19,708,514; Ceiling Price $22,290,959. Share 60/40 Under & 60/40 Over.

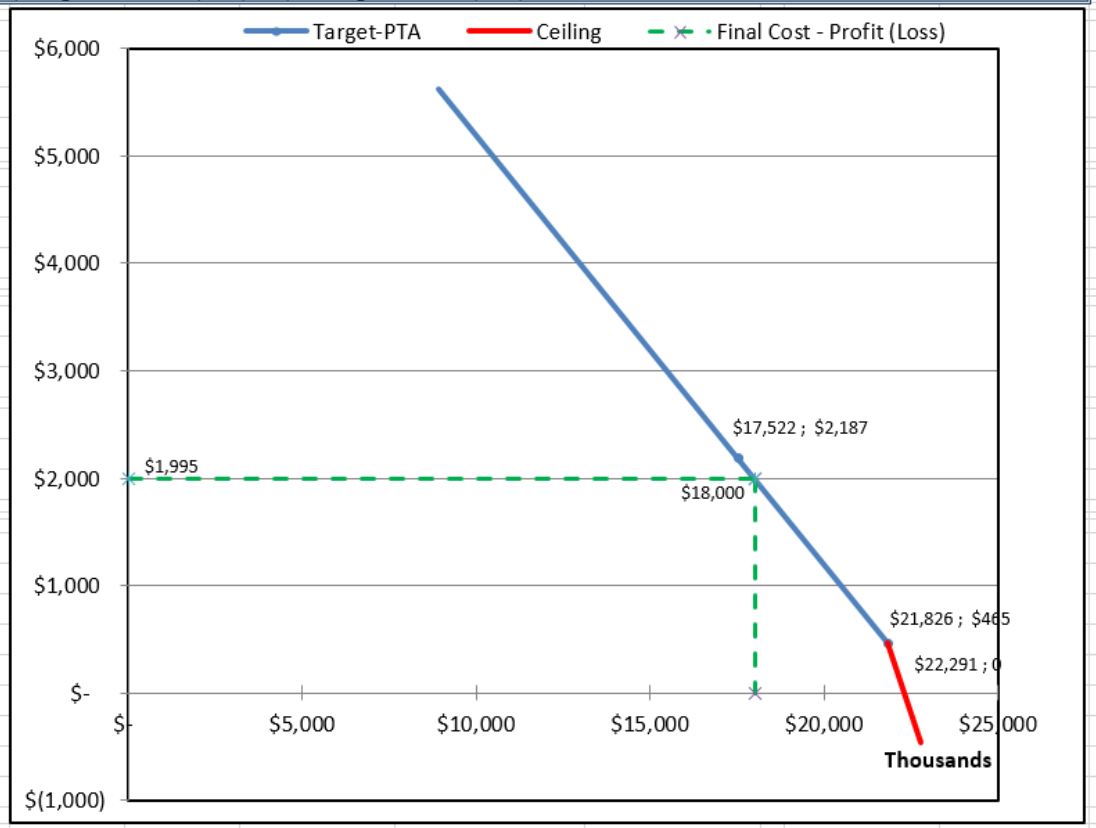
Target Cost		$ 17,521,794
Target Profit %/$	12.48%	$ 2,186,720
Target Price		$ 19,708,514
Ceiling %/$	127.22%	$ 22,290,959

Assigned Shares	Govt	/ Ktr
Under Target	60.0%	/ 40.0%
Over Target	60.0%	/ 40.0%

Calculated Shares	Cost	Profit
Optimistic		
Pessimistic		

	Govt	/ Ktr
Under Target		/
Over Target		/

Point of Total Assumption (PTA)	$ 21,825,869
Final Actual Audited Allowable Cost:	$ 18,000,000
Final Contract Price:	$ 19,995,438
Final Contractor Profit (Loss):	$ 1,995,438
Final Contractor Profit (Loss) %:	11.09%



Going on contract with Challenging But Achievable (CBA) Target Cost (simple sum of the LIKELYs), but with Target Profit of 12.48% (9.5% from WGL on 50/50 Target Cost and balance from 40% share on underrun from the 50/50 Target Cost), same 60/40 Share Line and same Ceiling Price (now 127.22%) - If actual, audited, allowable cost were to come in at $18M, Final Contrat price would be $19,995,438 instead of $19,996,032 ($594 difference). The CBA Target Cost with Target Profit (above WGL) quantified with Share Line constructed from 50/50 target is the SAME deal, its the SAME line.

Analyst Notes

FPIF - Protected | FPIF - Unprotected | 50-50 Target | CBA Target

READY 130%

Policy Goals/Objectives and Case Results

- Policy Goals/Objectives
  - 50/50 shares, 120% ceiling not a mandate but a point of departure
  - More realistic targets
  - More contractor incentive (steeper) shares
- '69 GUIDE Technique #1 – straight three column
  - Probability of under/over running target cost: 23/77
  - Share line 80/20; contractor share of cost risk 20%
  - Contractor ceiling price relief: $23,392,336 (134%)
- '69 GUIDE Technique #1 – simulation
  - Probability of under/over running target cost: 50/50
  - Share line 60/40; contractor share of cost risk 40%
    - Not 50%; but documented with quantitative risk analysis.
    - Doubled contractor share of cost risk; from 20% to 40%
  - Contractor ceiling price relief reduced: $22,290,959 (120%)

Technique #1 vs. #2

- Technique #1 (basic paradigm/template without risk adjustment)
  - Noted by GAO to improperly sum values that mathematically don't sum.
  - Establishes unrealistic (understated) targets[1], with
  - Generous (overstated) ceilings, and
  - Less meaningful (flatter) share lines to motivate contractor cost reductions.
- Technique #2
  - Also establishes unrealistic (understated) targets[1] around a point estimate,
  - But with less generous ceilings and more meaningful (steeper) share lines,
  - Requires heuristics (e.g. 50/50 share, 120% ceiling) may appear arbitrary.
  - Negotiations may yield to less risky (flatter) shares, and/or (higher) ceilings with Government anchored (perhaps) at a too optimistic target price with unrealistic target cost (e.g. 23/77 p under/over?) and WGL target profit.

[1] Right skew estimate distributions can be expected - historically borne out with program overruns. Zero bounds optimistic estimates, while there is no absolute bound on pessimistic estimates. GAO noting you simply can't add any point estimate, including the "LIKELY" cost of individual estimates, this sum will be less than the mean representing 50% chance of overrun.

Comparing Risk Adjustment Techniques

- Symmetric Approximation
  - The “poor man’s” simulation it can be reduced to an Excel template
  - May come close to an actual simulation considering the underlying assumptions of the technique (either complete independence or dependence between elements, and total distribution is indeed normal).
  - Requires more mature estimators to somehow factor both resources’ distributions (e.g. engineering, manufacturing and materials) and rates’ distributions (both direct and indirect) into a single cost element distribution in terms of consolidated dollars.

- Simulation
  - Requires purchased software which integrates into Excel ($1,000 - $1,500)
  - Sophistication interpreted as more difficult to use; even though, like all software, there are startup videos, instructions and templates included.
  - Sharing distribution gallery with subject matter experts has been known to better communicate with technical community the risk actually present (or not). Engineers of few words can say much more, better, with drawings.
  - Perceptions persist in some organizations that it is not favored at the Pentagon, even though WSARA requires it on all services’ POEs.