



Cost Risk for Firm Fixed-Price Contracts

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Introduction

- **The terms “cost risk” and “firm fixed-price contracts” may seem contradictory**
- **Firm Fixed Price (FFP) contracts are intended to place the onus of the risk of cost growth onto the performing contractor**
- **Interpreted that the contractor bears all financial risk**
- **However, sometimes the government pays for cost overruns on FFP contracts**
- **If government adds requirements cost can overrun the agreed to amount, leading to a request for equitable adjustment (REA)**



Contract Types

- **Two main types of contracts the government uses are fixed-price and cost-reimbursement**
- **Per the Federal Acquisition Regulation (FAR) 16.2 & 16.3:**
 - Fixed-price types of contracts provide for a firm price or an adjustable price
 - Cost-reimbursement types of contracts provide for payment of allowable incurred costs



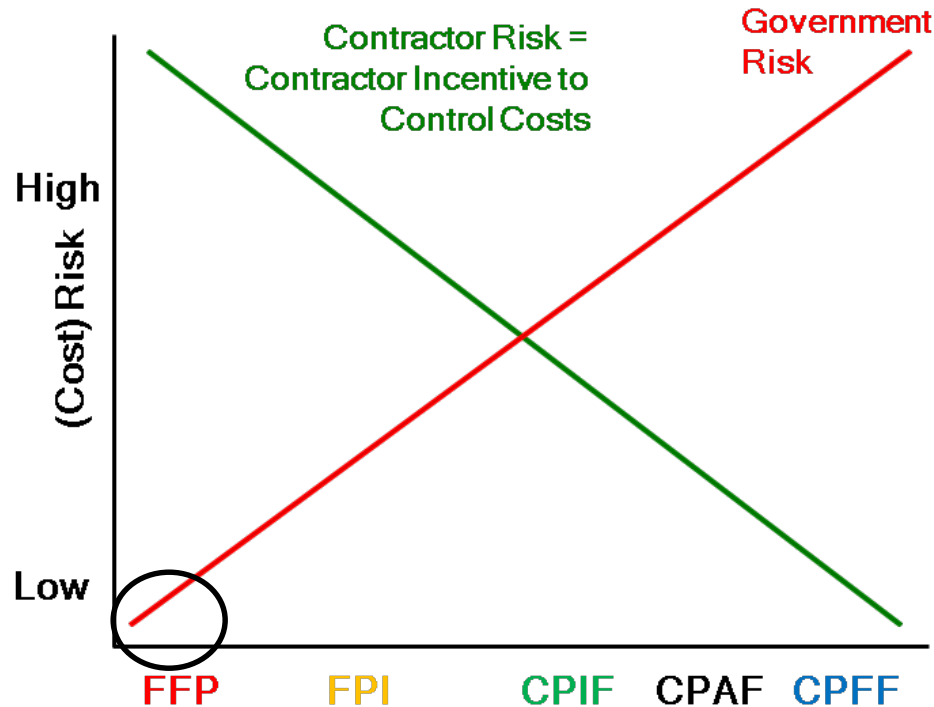
Firm-Fixed-Price Contracts

- A subset of fixed-price contracts is the firm-fixed-price contract
- **FAR 16.202.1:** A firm-fixed-price (FFP) contract provides for a price that is *not subject to any adjustment* on the basis of the contractor's cost experience in performing the contract
- This contract type places upon the contractor maximum risk and *full responsibility for all costs* and resulting profit or loss



Comparison of Contract Types

- Implied intercept of 0 or that FFP carries no government cost risk



- Source: CEBok 1.2



Data Analysis

- Analyzed 1,729 FFP contracts at the Missile Defense Agency
- 12% of the contracts experienced cost growth
- The vast majority of FFP contracts do not increase
 - One in eight FFP contracts increase in cost
- Average growth is approximately 6%
- When an overrun is experienced the average growth was 50%



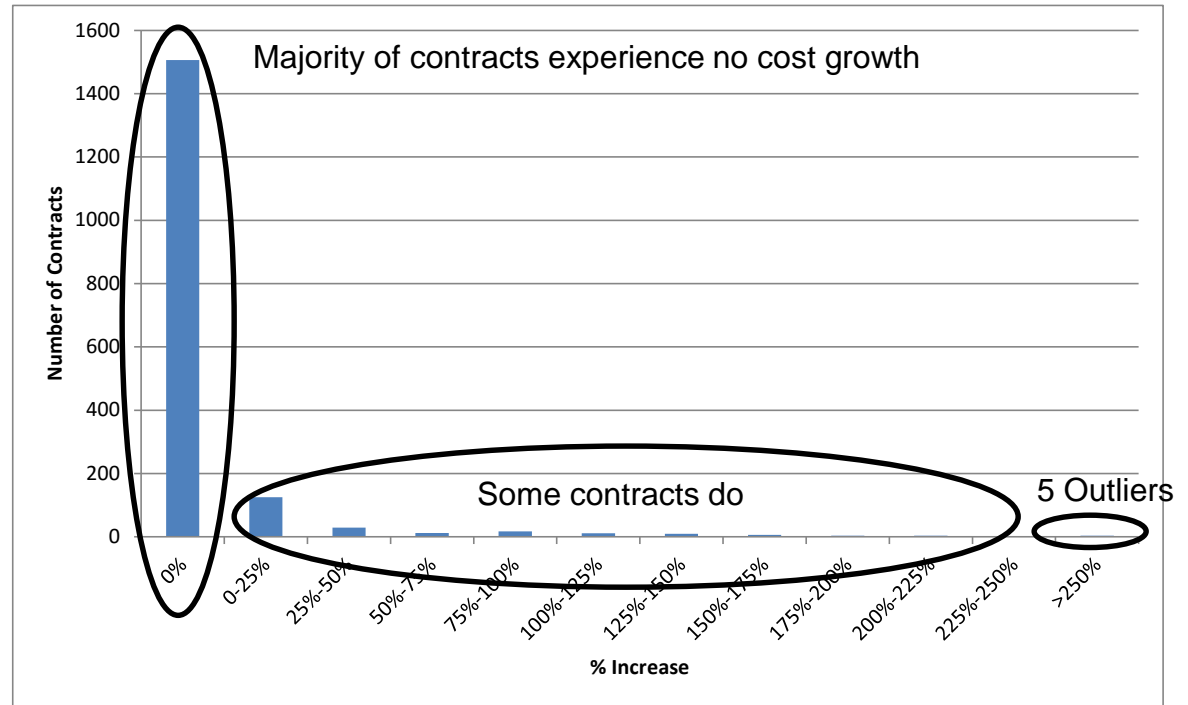
What Do the Data Say?

Survey of 1729 MDA Fixed Price Contracts

% Growth	Number of Contracts	% of Total
0% Growth	1530	88%
1-10% Growth	63	4%
11-20% Growth	24	1%
>20% Growth	112	6%
Total	1729	

Total Change in Value of MDA Firm Fixed Price Contracts

Total of initial value	\$5,911,374,537
Total of final value	\$7,737,065,887
Change in Value	\$1,825,691,350
% Change in Value	30.884%

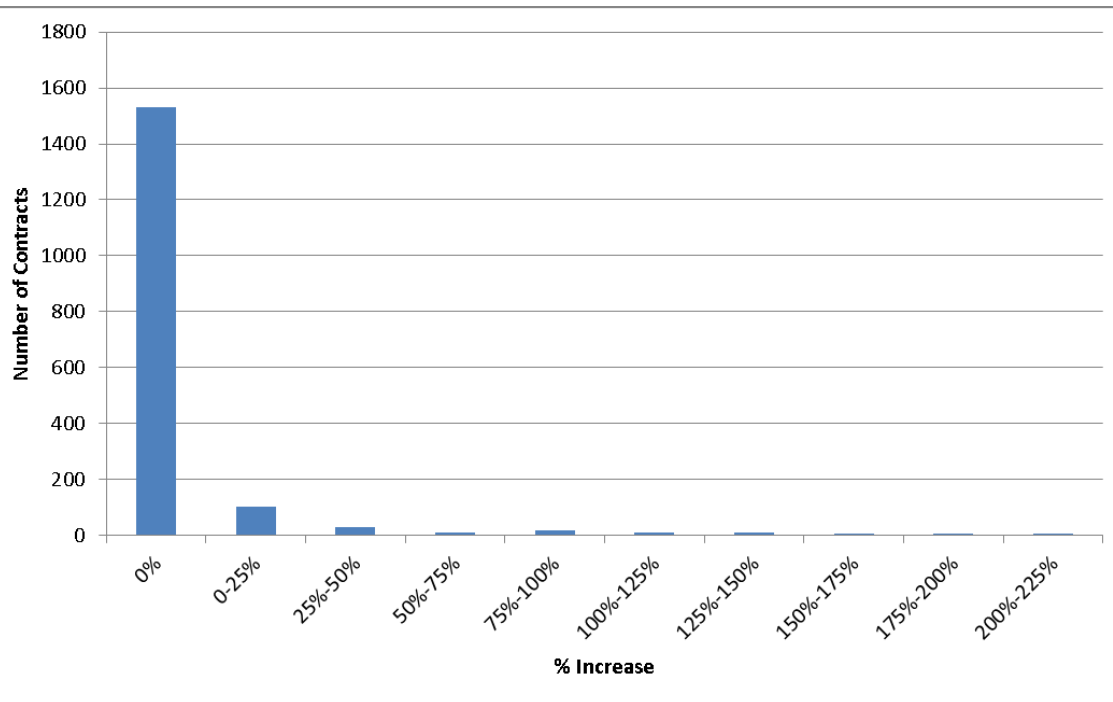


Summary of cost growth data for 1729 MDA Firm Fixed Price Contracts



Outlier Adjustments

- **Adjustments made to outliers:**
 - Contract awarded prior to final negotiations due to time sensitivity
 - Award of pre-negotiated options
- **Results of adjusted data are summarized below:**



Descriptive statistics from Firm Fixed Price dataset

Mean	0.058903
Standard Deviation	0.252613
Kurtosis	32.8695
Skewness	5.489287



Reasons for changes

- **Other growth due to:**
 - Request for Equitable Adjustment (REA)
 - Addition of work to the contract
 - Deletion of work from the contract
 - Substitution or replacement of one item of work for another (i.e., an addition with a related deletion)

 - Requirements Creep
 - Examples
 - Increased quantity
 - Decrease quantity purchased
 - Add additional safety constraints
 - Add additional cybersecurity constraints
 - Most drive cost uppers at best no cost change

 - Administrative Changes



Fitting a distribution (Crystal Ball)

- The cost growth data were fit to a variety of standard probability distributions using Crystal Ball
- The top 3 results are summarized below:

Distribution	Kolmogorov-Smirnov	Chi-Square
Critical Value ($\alpha = .05$)	0.0327	74.22
Normal	0.4737	49203.0086
Student's t	0.4764	47200.5147
Lognormal	0.5099	48477.0896

- All three reject H_0 that the data fit the distribution



Fitting a distribution (Beta Methodology)

- **Beta distributions**

- Unique ability to be able to be reshaped to fit
- Vary parameters Alpha, Beta, Min, and Max
- Used Excel add in “solver” to reduce the squared deviation between the data set and the beta distribution

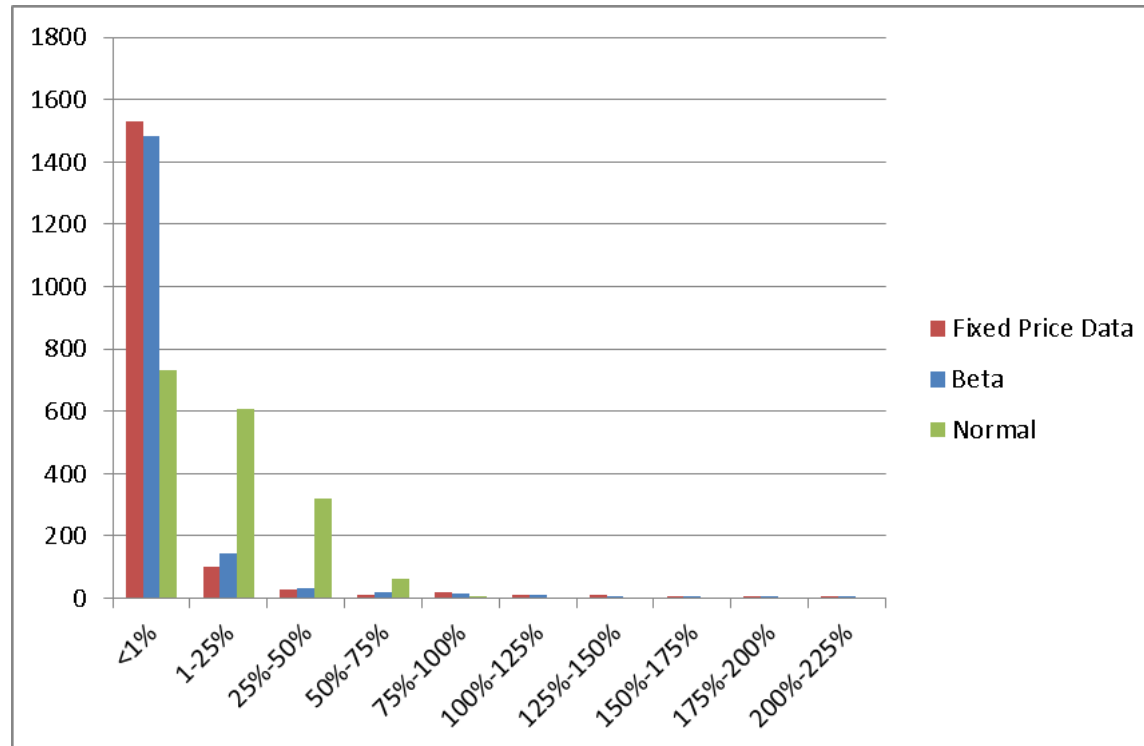
- **Parameters from Beta Distribution are summarized below:**

Alpha	0.02875
Beta	1.046737
Min	0
Max	2.225



Fitting a distribution to the data – testing the fit (1)

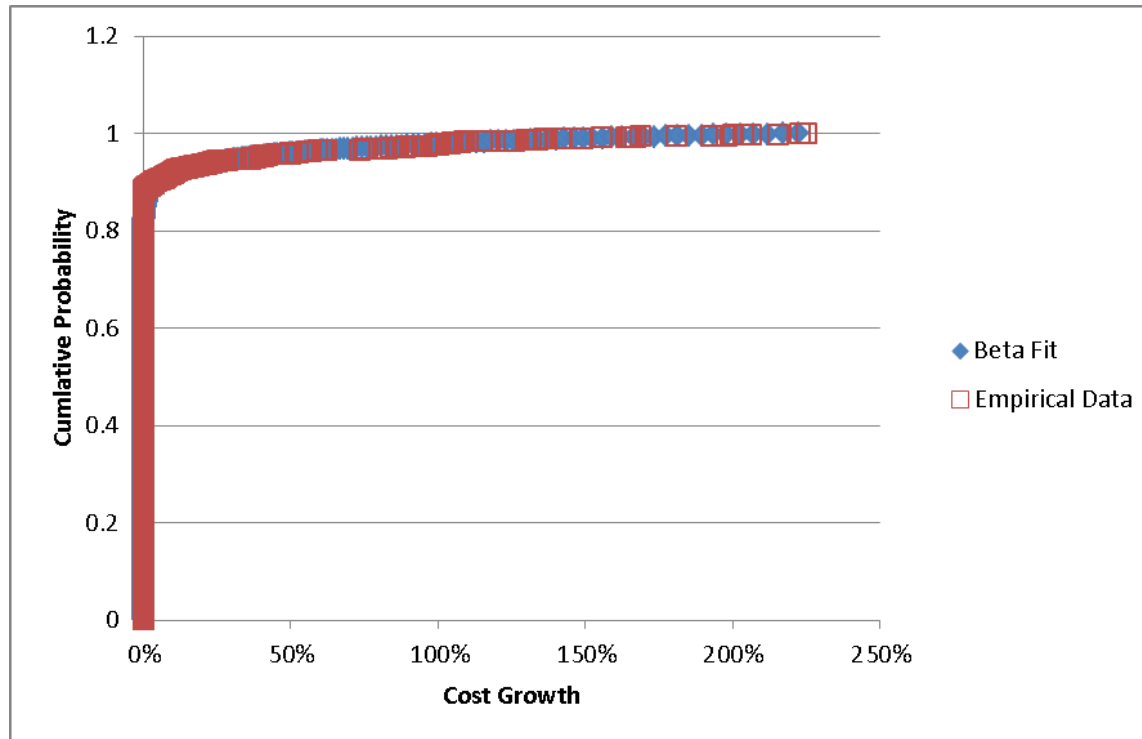
- Plotting the fitted Beta distribution and the Normal distribution on the histogram visually confirms that the Beta is a good fit and the Normal is not





Fitting a distribution to the data – testing the fit (2)

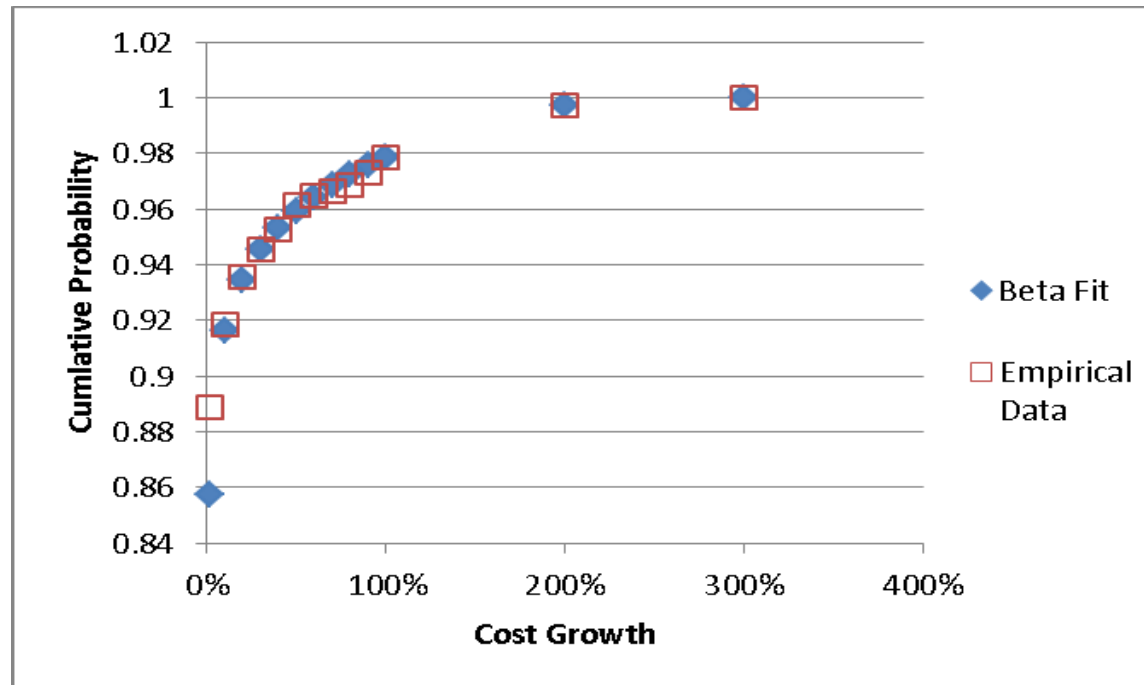
- Graphical comparison of the Beta distribution vs Empirical data





Fitting a distribution to the data – testing the fit (3)

- **Graphical comparison Beta distribution vs Empirical data**
 - Filtered out the bulk of the data to add clarity
 - Distribution excels in the right tail and comes extremely close on the left tail
 - 14% predicted probability of overrun vs. 12% actual





Fitting a distribution to the data – testing the fit (4)

- Kolmogorov-Smirnov and Chi-Square Hypothesis tests results:

Distribution	Kolmogorov-Smirnov	Chi-Square
Critical Value ($\alpha = .05$)	.0327	74.22
Beta	0.027616	1

- Fail to reject H_0
 - H_0 empirical data is described by the fitted Beta distribution
 - Indicates the Beta distribution is a good fit



Conclusion

- **There is strong evidence that cost overruns (that the government pays) occur on firm fixed-price contracts about 12% of the time, and that the average overrun is 50%**
- **We need to model this risk when estimating costs for FFP contracts**
- **We have provided a beta distribution whose parameters can be used as a default cost risk distribution around FFP contract values in the absence of any additional insight**