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# Practical Application of Principle-Agent and Auction Theory: A Contracting Guide

Griffin, William

Monterey, California. Naval Postgraduate School

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*Integrity - Service - Excellence*

## **Practical Application of Principle-Agent and Auction Theory: A Contracting Guide**



**Maj Adam Ackerman  
Maj Nick Mastronardi  
Maj Travis Thurmond  
Capt Will Griffin  
C1C Ryan Holler  
C1C Jimmy Manuel  
C1C Ryan McVay**

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# Overview

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- **Overview of Environment**
- **Potential Improvements**
  - Risk Sharing (contract type selection)
  - Second Price Sealed Bid
  - Second Score Sealed Bid
- **USAF T-X Program**
- **Contractor Reputation Rating**
- **Summary**



# Introduction

## ■ Statement of the Problem

- The DOD holds an inferior position when bargaining with the private sector (known budget). This creates inefficiencies in procurement leading to excess spending for the quality of product supplied.

## ■ Research Questions

- What mechanisms should the DOD employ to incentivize truth telling and efficiency in performance?





# Risk Sharing

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- **Why discuss principle-agent (government-contractor) risk sharing?**
  - **Tendency to inappropriately skew towards risk sharing extremes (FFP<sub>1</sub> and TM<sub>2</sub>)**
    - FFP<sub>1</sub>
    - TM<sub>2</sub>
  - **The DOD is missing out on the full breadth of tools currently offered.**

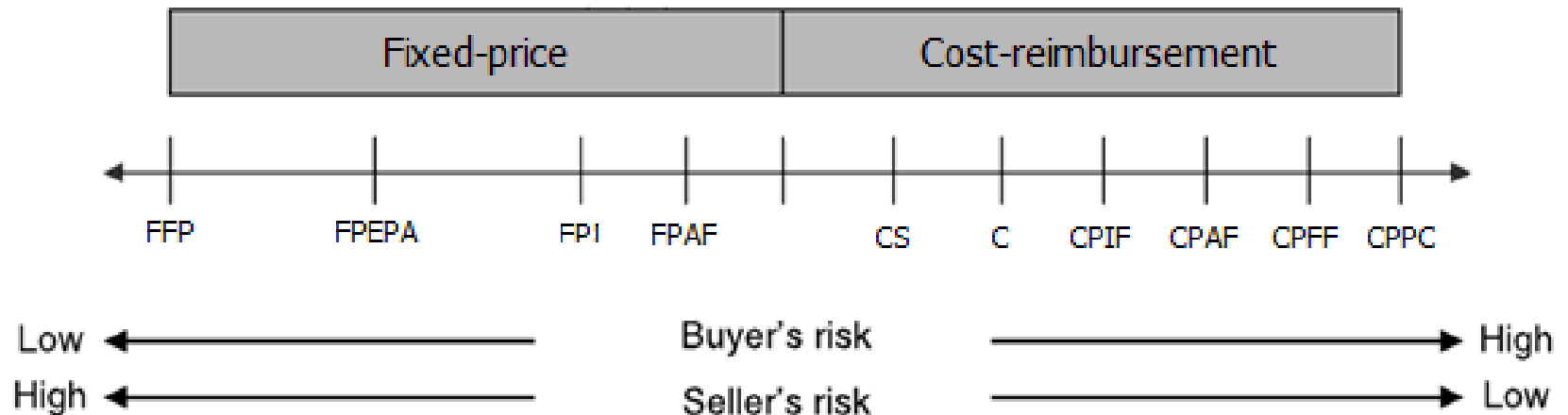
<sup>1</sup>USD (AT&L) Kendall, Frank. Use of Fixed-Price Incentive Firm (FPIF) Contracts in Development and Production. Defense AT&L, Mar-Apr 2013.

<sup>2</sup>USD (AT&L) Kendall, Frank. Appropriate Use of Lowest Priced Technically Acceptable Source Selection Process and Associated Contract Type. 4 March 2015.



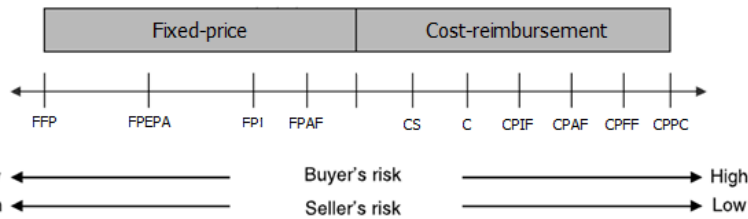
# Risk Sharing

## Types of Contracts



## Types of Contracts by Risk<sub>3</sub>

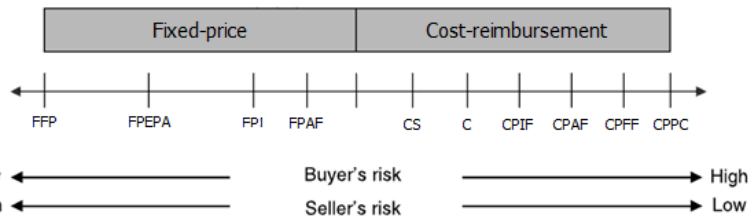
<sub>3</sub>Adapted from Garrett, 2007, World class contracting (4th ed.)



# Risk Sharing

## ■ Contract Types:

- Firm Fixed Price (FFP)
- Fixed Price with Economic Price Adjustment (FPEPA)
- Fixed Price Incentive (FPI)
  - Fixed Price Incentive (Firm Target)
  - Fixed Price Incentive (Successive Targets)
- Fixed Price with Award Fee (FPAF)
- Cost Sharing (CS) / Cost (C)
- Cost Plus Incentive Fee (CPIF)
- Cost Plus Award Fee (CPAF)
- Cost Plus Fixed Fee (CPFF)
- Cost Plus Percentage of Cost (CPPC)

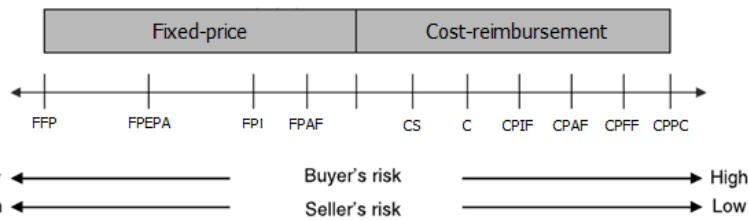


# Risk Sharing

## ■ Contract Types:

- **Firm Fixed Price (FFP)**
- **Fixed Price with Economic Price Adjustment (FPEPA)**
- **Fixed Price Incentive (FPI)**
  - **Fixed Price Incentive (Firm Target)**
  - **Fixed Price Incentive (Successive Targets)**
- **Fixed Price with Award Fee (FPAF)**
- **Cost Sharing (CS) / Cost (C)**
- **Cost Plus Incentive Fee (CPIF)**
- **Cost Plus Award Fee (CPAF)**
- **Cost Plus Fixed Fee (CPFF)**
- **Cost Plus Percentage of Cost (CPPC)**



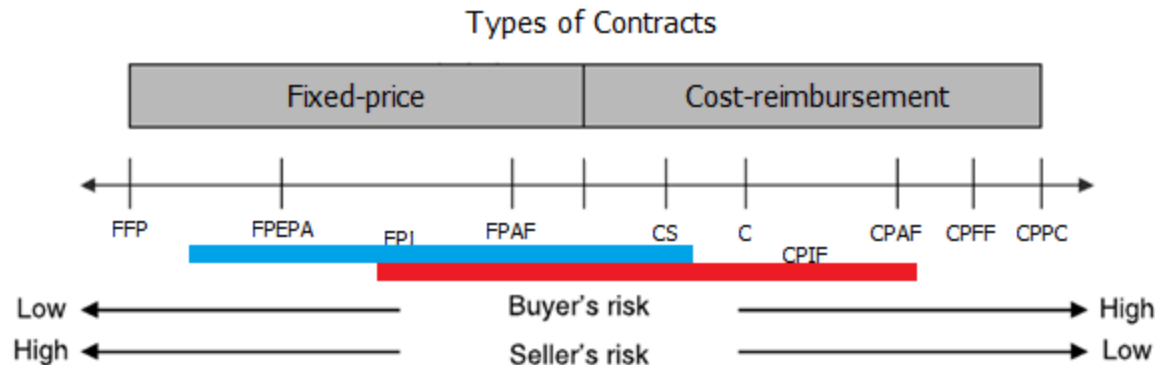


# Risk Sharing

Contract Type	Share Line		Equivalent or Direct Equivalent to:
FPIF	0/100	=	Direct Equivalent of FFP
FPIF	100/0	=	Equivalent of CPFF
CPIF	100/0	=	Direct Equivalent of CPFF
CPIF	0/100	=	No logical direct equivalent



# Risk Sharing



## Proposed scale of cost risk transferred

- **Recommendations:**
  - **Require reporting of share lines and price ceiling percentages**
    - Failing to consider the share line present in an incentive contract risks seriously mischaracterizing implicit contract cost risk
  - **Future research to characterize the difference in risk tradeoffs between FPIF and CPIF**



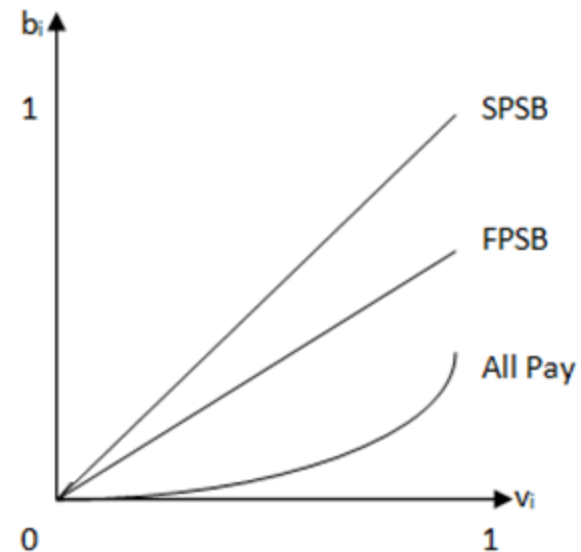
# Second Price Sealed Bid

## Literature:

**Myerson (1981) Revenue Equivalence Theorem**

**Application: limited to single item, pure price discrimination with multiple bidders**

- FFP and FPEPA
- FAR Part 14
- FAR Part 15, LPTA (award without discussions)





# Second Price Sealed Bid

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## Recommendations:

- Utilize Second Price Sealed Bidding for all FAR Part 14 acquisitions
- Utilize Second Price Sealed Bidding for FAR Part 15 LPTA acquisitions that the government is highly confident can be awarded without discussions



# Second Score Sealed Bid

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## Literature:

### Che (1993)

- optimal scoring rule auction under one-dimensional quality

### Asker and Cantillon (2008)

- Scoring rule dominates menu option and beauty contest in procurement auctions

### Bichler (2000)

- Second-price, multi-attribute auctions yield more efficient results than first-price multi-attribute auctions

### Nishimura (2012)

- Optimal scoring rule exists with multi-dimensional quality
- Incremental production cost relationship of attributes



# Second Score Sealed Bid

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## Application: differentiated products/services

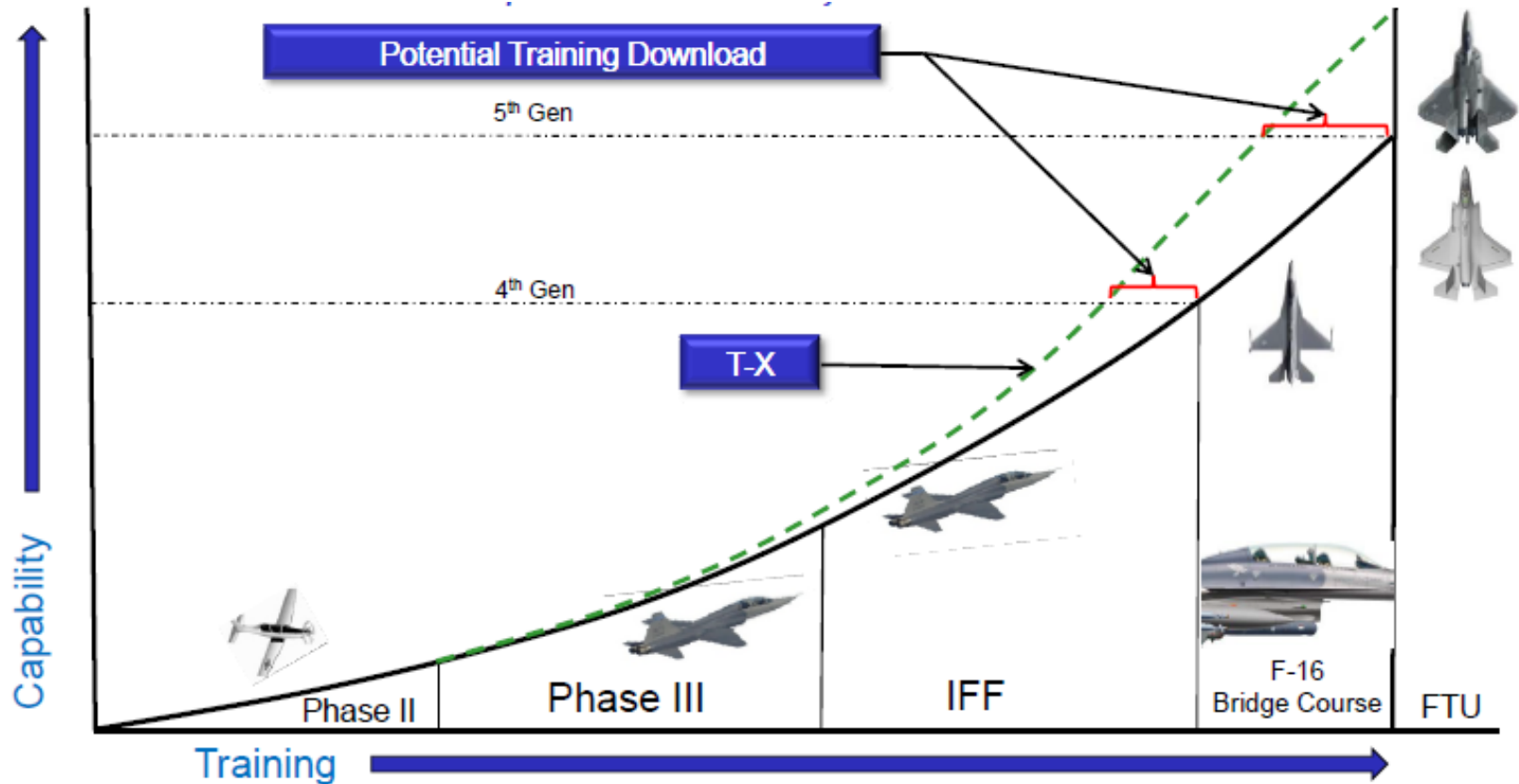
- FAR Part 15 acquisitions
- Requires a publishable scoring rule
- First score bidder graded to the price and score of the second bidder

## Recommendations:

- Extends the efficiencies found in Second Price Sealed Bid to differentiated contracts
- Pilot implementation with a program with well-defined requirements
- A possible pilot implementation...



# T-X Advanced Pilot Trainer



(T-X Industry Day 29-31 Jan 2013)



# T-X Advanced Pilot Trainer

## ■ Recommendation:

### ■ Multi-Attribute Second Score Sealed Bid

- Give suppliers freedom to specialize in areas of expertise
- Greater quality incentivized than price only auction

(Bichler 2000)







# T-X Advanced Pilot Trainer

## ■ Recommendation:

- Account for Complimentary and Substitutionary Attributes
  - e.g. Speed vs. Maneuverability
  - Incentivize suppliers to provide quality in multiple areas
  - Focus on complete plane rather than specific attributes
  - Stop suppliers from “gaming” the scoring equation

(Nishimura 2012)





# T-X Case Study

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## Recommendations:

- Utilize Second Score Sealed “Bidding”
- FAR Part 15, FFP with the intent to award without discussions
- Publish model with trade space explicit, to include substitutionary and complementary aspects defined



# Reputation Attribute

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## Literature:

### ■ Kuwobara

- Reputation Systems
- Opportunity to rate vendor
- Signals: Internet and Rating

### ■ Fernandes

- Trust Management Systems
- Providing rewards is an effective way to get feedback
- Ebay, Amazon





# Reputation Attribute

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## ■ Reputation Attribute

### ■ Non-Monetary Incentive

- Incentivize “truthful bids” and “sticking to contract”
- Implemented in Bidding / Scoring Process

### ■ Provide Continuous Reward or Punishment

- Cost, Schedule, Performance
- Reduce Standard Deviations from Original Contract

### ■ Alternative to CPARS



# Reputation Attribute

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## Assumptions/Criteria

### ■ Effective If:

- Disclosed Score Individually (secretly)
- Multiple Bids
- Later programs likely to incorporate this in future proposal grading



# Summary

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## The DOD should:

- **Collect share line data to complement continuing research into FPIF and CPIF**
- **Conduct further research distinguishing FFP, FPIF, CPIF, and CPFF**
- **Immediately adopt Second Price Sealed Bid for undifferentiated goods likely to receive multiple offers and award without discussions**
- **Pilot the use of Second Score Sealed Bid**
- **Investigate the use of a separate Reputation Attribute to correct CPARS deficiencies**



# Contact Information

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- Estimated publishing: August 2015
- Contact Information:
  - Capt Will Griffin, [william.griffin.14@us.af.mil](mailto:william.griffin.14@us.af.mil)