

HQ U.S. Air Force Academy

Integrity - Service - Excellence

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



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Report Documentation Page

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Overview

- **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

- **Why discuss principle-agent (government-contractor) risk sharing?**
 - **Tendency to inappropriately skew towards risk sharing extremes (FFP₁ and TM₂)**
 - FFP₁
 - TM₂
 - **The DOD is missing out on the full breadth of tools currently offered.**

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

²USD (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 Risk₃

₃Adapted from Garrett, 2007, World class contracting (4th ed.)

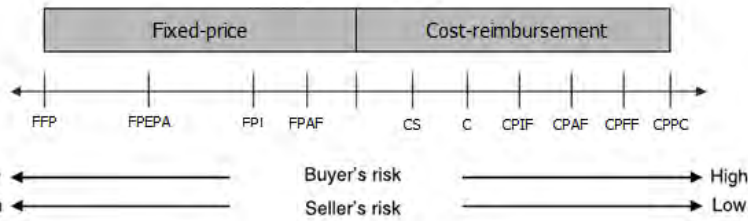
Risk Sharing



■ 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)**
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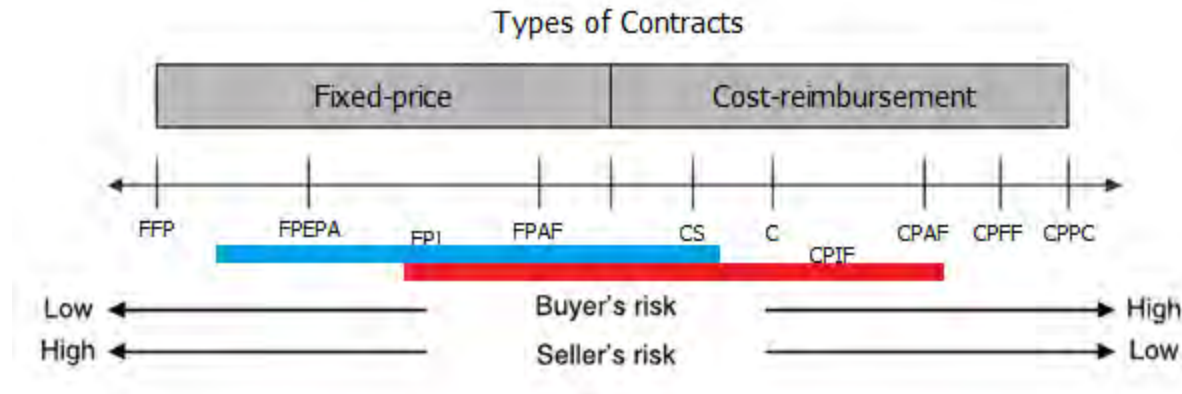
Risk Sharing



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**



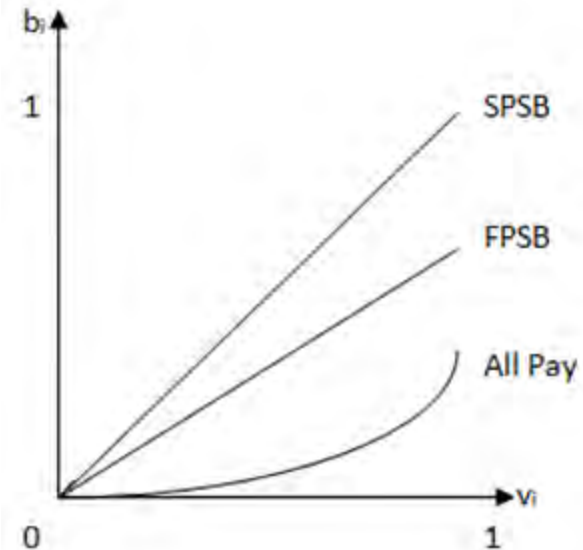
Second Price Sealed Bid

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

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

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

Application: differentiated products/services

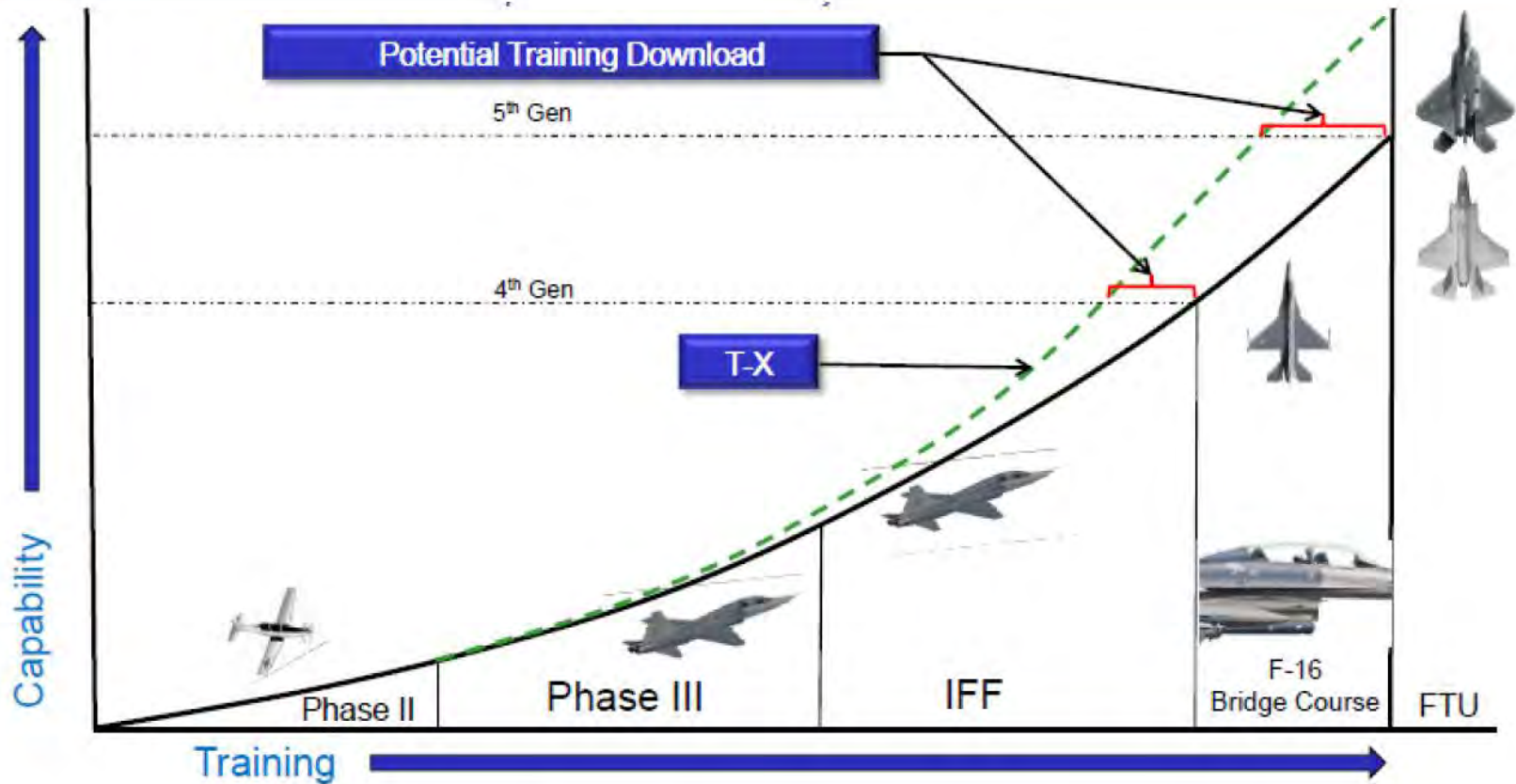
- FAR Part 15 acquisitions
- Requires a publishable scoring rule
- First score bidder graded to the price and score of the second bidder

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

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

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

■ 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

Assumptions/Criteria

■ Effective If:

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



Summary

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**



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