



Acquisition Research Program:
Creating Synergy for Informed Change

Applying Insights from Transaction Cost Economics (TCE) to Improve DoD Cost Estimation

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OUTLINE

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- IV. DoD COST ESTIMATION
- V. WHAT TCE IS
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I. BACKGROUND: Starting Points

- Entering Argument: Cost drivers are more complex than current methodology considers.
- $\text{Cost} = f(\text{"Production" Costs, Transaction Costs})$
 - Production Costs = $g(\text{WBS, systems integration})$
 - Transaction Costs = Coordination + Motivation Costs
- Can a more complete view of costs improve cost estimation methodology?



II. CURRENT ACCURACY OF COST ESTIMATES

Strong Evidence of Systematic Bias and General Inaccuracy in Initial Cost Estimates for New Weapon Systems:

- **FROM PECK & SCHERER TO RAND (2006)**
- **OVERRUNS CONTINUE (GAO, 2006)**
 - **F-22, 200%**
 - **F-35, 25%**
 - **FUTURE COMBAT SYSTEMS, >50%**
 - **“PROGRAMS CONSISTENTLY MOVE FORWARD WITH UNREALISTIC COST ESTIMATES.”**



III. WHY? SOME HYPOTHESES

- BAD INCENTIVES
 - ADVOCATES’ (SINCERE) OPTIMISM
 - DISINGENUOUS “BUY-IN”
- INADEQUATE METHODOLOGY
 - SOMETHING MIGHT BE MISSING
- IF BAD INCENTIVES WERE THE ONLY CAUSE, THEN INDEPENDENT COST ESTIMATES WOULD LIKELY HAVE SOLVED THE PROBLEM.

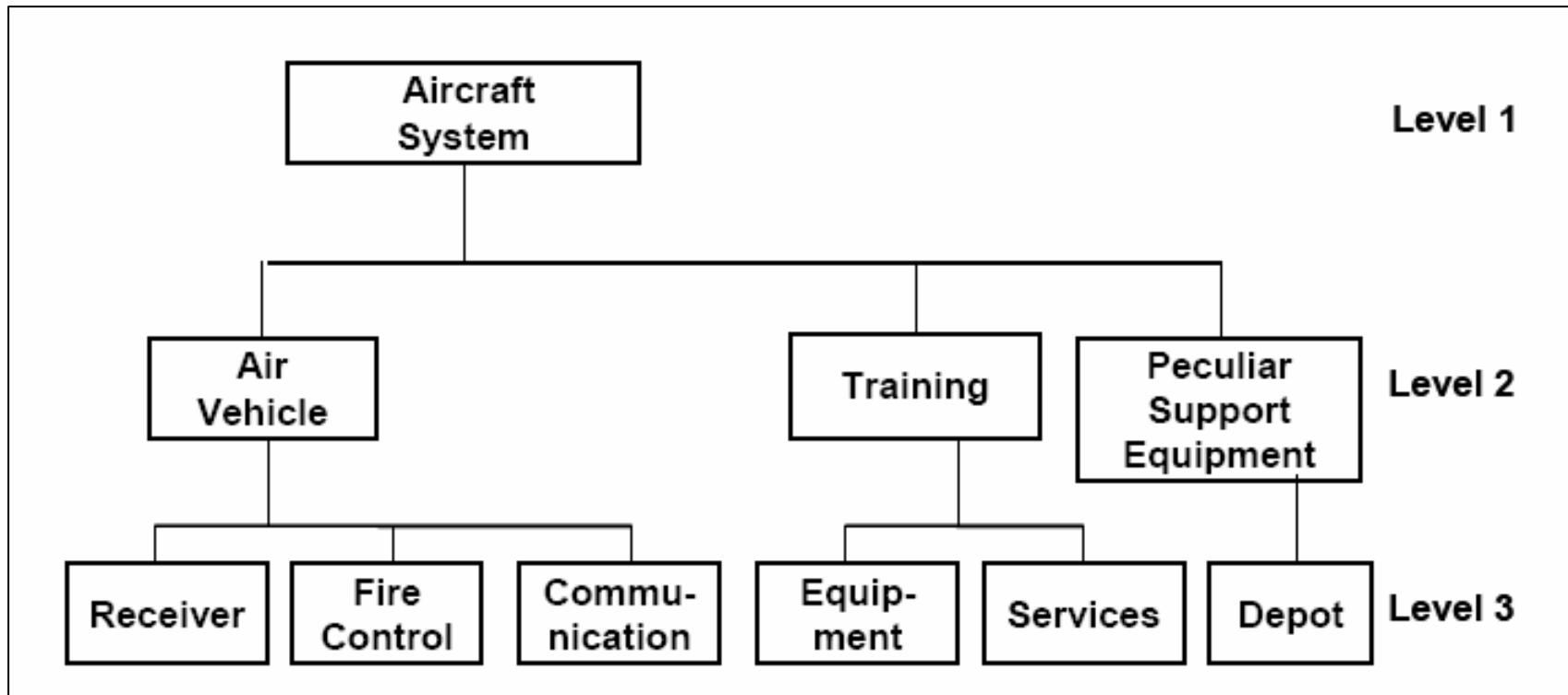


IV. Cost Estimating Methodology in DoD

- **Understand the system**
 - **Cost Analysis Requirements Description (CARD)**
- **Establish a framework for the estimate**
 - **Work Breakdown Structure (WBS)**
 - **Cost Element Structure**
- **Develop cost estimate**
 - **Methodology depends on available information and system maturity**



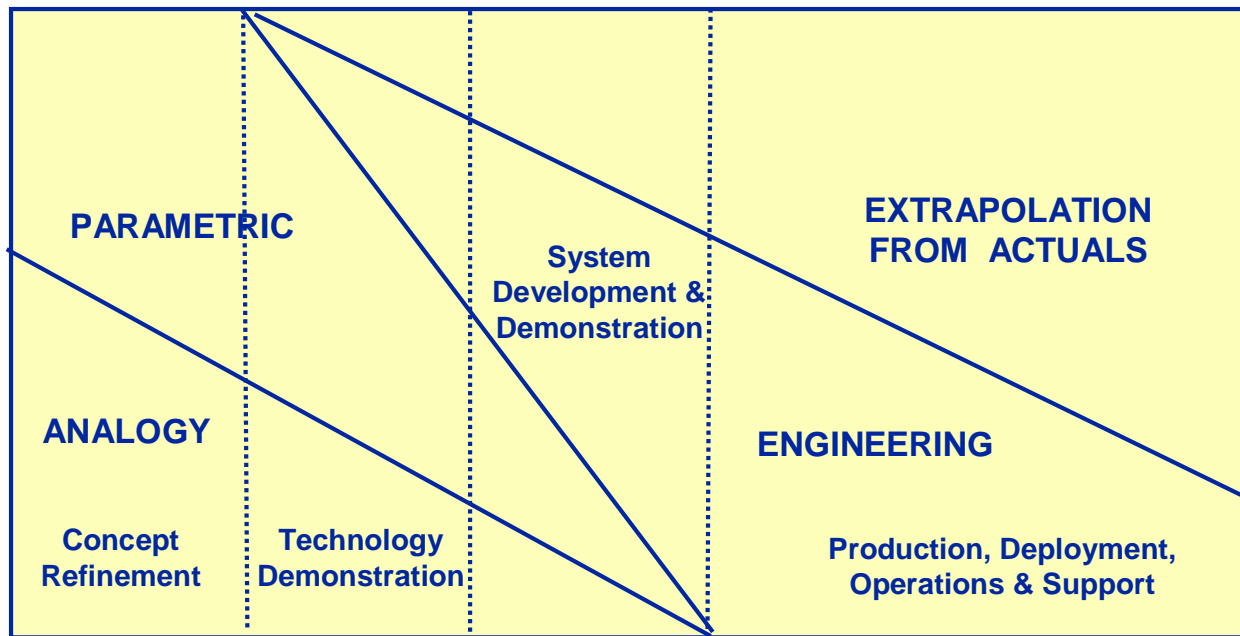
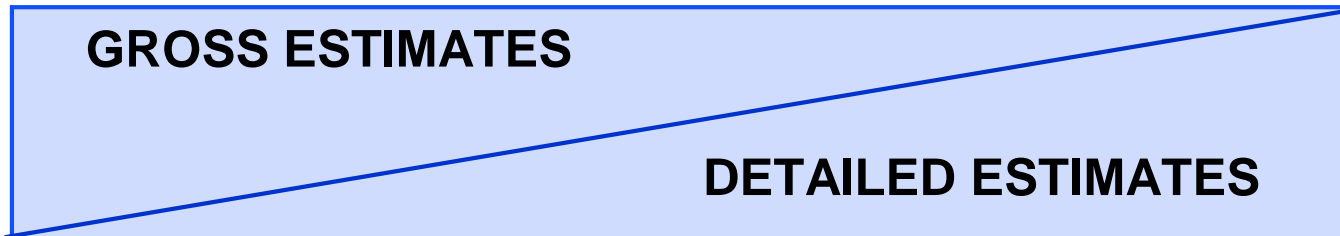
Typical Program WBS



(DoD, 2005)



Cost-Estimating Techniques Versus Acquisition Phases



Some Issues with DoD Cost Estimates

- **Structure of WBS assumes cost elements are independent**
 - Lack of independence between cost elements can significantly increase variability of estimate
- **Program WBS is product oriented, not relationship oriented**
 - Can therefore omit transaction costs



TRANSACTIONS COST ECONOMICS (TCE): Some Basics

- STUDY OF “VERTICAL” FIRM BOUNDARIES
- KEY PARTS OF WORLD VIEW
 - MARKETPLACE IS NOT A FRICTIONLESS, COSTLESS MEDIUM
 - ENTERPRISES ARE A NETWORK OF CONTRACTUAL RELATIONSHIPS (TRANSACTIONS)
 - THE NATURE OF THE TRANSACTIONS DETERMINES THE VERTICAL BOUNDARIES (INDICATES WHETHER TO MAKE OR BUY)
- A WELL-DEVELOPED FIELD OF STUDY



POTENTIAL APPLICATIONS TO DOD ACQUISITION PRACTICES

- COMPETITIVE SOURCING DECISIONS, E.G., A-76 COMPETITIONS (Franck & Melese, 2005)
- INCENTIVE STRUCTURES, E.G., CONTRACT TYPES (Dillard, Franck & Melese, 2006)
- PROGRAM MANAGEMENT: OPTIMAL GOVERNANCE STRUCTURE DEPENDS ON NATURE OF RELATIONSHIP



Type of Contracts Won by the Top 10 Contractors 1998 to 2003 (Makison, 2004)

Category	<u>Cost-plus (C+)</u>	<u>Fixed-price (FP)</u>	Time & Materials
1. Lockheed Martin	50%	47%	2%
2. Boeing Co.	27%	70%	2%
3. Raytheon Co.	38%	58%	3%
4. Northrop Grumman	42%	50%	2%
5. General Dynamics	39%	60%	0%
6. SAIC	52%	21%	15%
7. Carlyle Group	44%	46%	9%
8. Newport News Ship	78%	22%	0%
9. TRW	71%	23%	2%
10. Computer Sciences	41%	26%	24%



VI. How TCE Might Help Improve DoD Cost Estimation: Our Hypotheses

- Cost misestimates are significant.**
- One systemic cause for misestimates is inadequate consideration of scope for opportunistic behavior***
 - Incorporating TCE factors would improve cost estimates**

*** “self-interest seeking with guile”**



CASE FOR NULL HYPOTHESIS: TCE Factors Will Not Improve Estimates.

- Difficult to behave opportunistically against a sovereign entity.
- Transaction Costs fairly constant across major DoD acquisition projects (as a %).
- Existing rules of thumb for management budgets deal reasonably well to deal with scope for opportunistic behavior (into diminishing returns).
- Factors already included (e.g., complexity, risk) are good proxies for TCE factors (highly correlated).
- Opportunistic behavior hard to find, by definition.





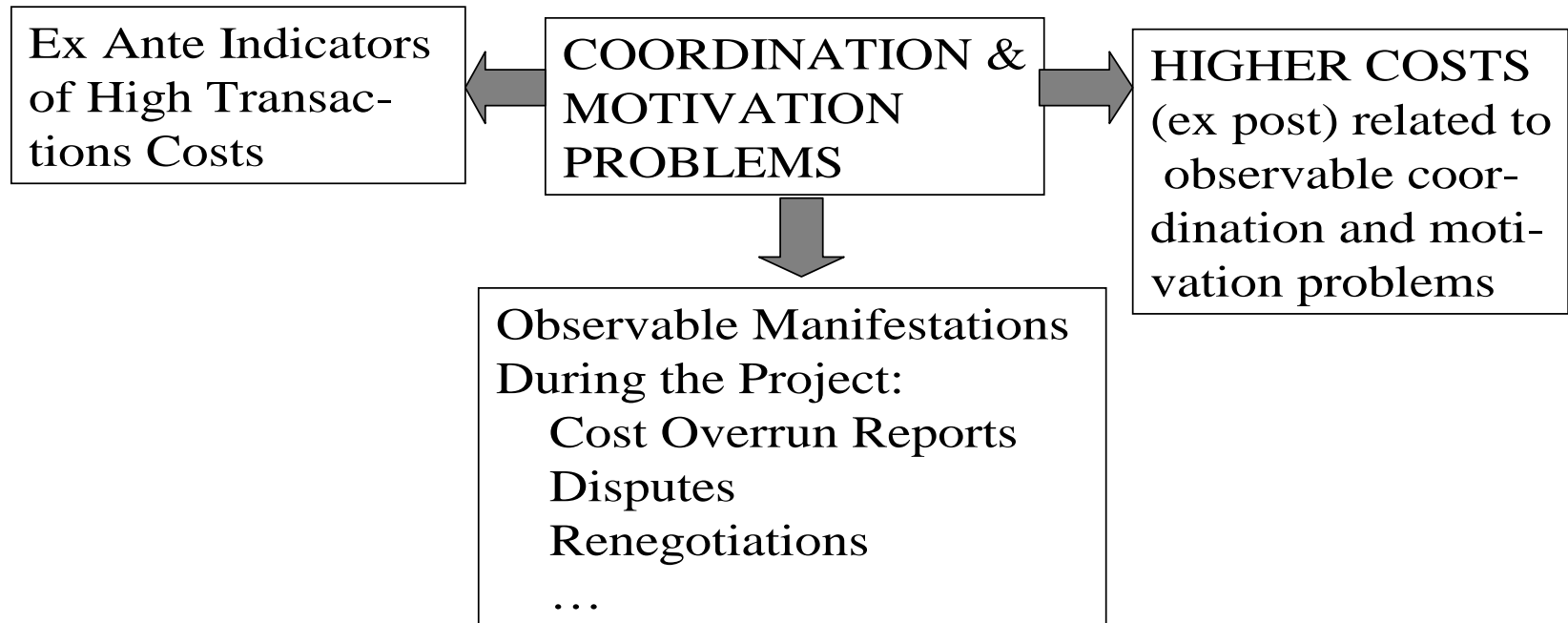
VII. Two Defense Acquisition Case Studies with TCE Perspectives



- Can TCE factors indicate a cost overrun about to happen?
- **Army Tactical Missile System: 1986-1991**
 - DARPA's "*Assault Breaker*" - Mature Technologies
 - FFP, 48 months development
 - Specific Assets (Launcher Prime)
 - Production options
- **Javelin Anti-Armor Missile System: 1989-1994**
 - DARPA's "*Tank Breaker*" - Immature Technologies
 - CPIF, 36 months development after 27 months tech development
 - Specific Assets (FPA Prime) and "Buy-in"
 - Joint Venture to Split for Competitive Production



TCE Issues in Acquisition Projects and Hypothesized Cost Manifestations



Comparison of Programs With Different Contract Types and Technology Readiness Levels

Key Program Characteristics - First Increment of Capability

<u>Program Aspects</u>	<u>ATACMS</u>	<u>JAVELIN</u>
DARPA Predecessor	Assault Breaker 1977-82	Tank Breaker 1981-82
Ultimate Capability	"Deep Attack"	"Fire & Forget"
<u>Critical Technologies & Readiness Levels:</u>		
Munition	9 - Lance M74 Bomblet	5 - Tandem Shaped Charges
Propulsion	9 - Solid Rocket Motor	5 - Two-Stage Solid Rocket Motor
Flight Control	9 - Fin surfaces	6 - Fins + Thrust Vector Control Vanes
Guidance and Control	9 - Inertial	4 - Tracker Software Algorithm
Safe/Arm Fusing	7 - Mechanical	4 - Electronic
Software Function (Target Acquisition, Fire Control, etc.)	6 - Various	6 - Various
Sensor	N/A	5 - Focal Plane Array
Capability Leap Area	Range	Range, Lethality, Survivability
Cost of development	~\$700M	~\$700M
Contract Type	Fixed Price	Cost Reimbursable
Tech Development Phase	0 Months	27 Months
Advanced Development Phase - Planned	48 Months	36 Months
Advanced Development Phase - Actual	51 Months	54 Months
Total Time in Development	51 Months	81 Months
Advanced Development Phase Contract Cost Growth	0%	>150%



Ex-ante Assessment of ATACMS Development Program

<u>TCE Indicator</u>	<u>Assessment</u>	<u>Comments</u>
Asset Specificity	RED	Pre-existing condition. Contractor's previous experience with launch vehicle. Production option proved a hedge for the contractor.
Complexity	GREEN	Technology generally mature
Length of Relationship	GREEN	Advanced Development Phase only.
Time Sensitivity	YELLOW	Green after end of Cold War
Operational Significance	YELLOW	Green after end of Cold War



Ex-ante Assessment of Javelin Development Program

<u>TCE Indicator</u>	<u>Assessment</u>	<u>Comments</u>
Asset Specificity	YELLOW	TI's in-sourcing of FPA production. Mitigated by planned dual-source production, and steps to diversify FPA sources.
Complexity	RED	Fire-and-forget feature added significantly to complexity.
Length of Relationship	YELLOW	Technical immaturity necessitated a lengthy development program.
Time Sensitivity	YELLOW	Green after end of Cold War.
Operational Significance	YELLOW	Green after end of Cold War



CASE INDICATORS COMPARED

ATACMS

Ex Ante: 1 Red, 2 Yellow,
2 Green

In Progress

- Consistently on schedule, budget
- No major issues

JAVELIN

Ex Ante: 1 Red, 4 Yellow

In Progress

- Nunn-McCurdy breach
- Behind Schedule
- Governance issues: renegotiation (e.g., cost sharing), “rebaselined”



CASE RESULTS COMPARED

ATACMS

- On schedule (in time for Gulf War I)
- On budget
- Production options exercised w/savings
- Multiple block improvements followed
- Just ended last production run

JAVELIN

- Second critical component source needed to save program
- Significantly over Budget
- Significantly behind Schedule
- Still in production & use



VIII. Program Office Costs and TCE

- **Hypothesis: WBS may overlook important transaction cost variables resulting in low estimates**
 - Compare systems with significant transaction costs to programs with low transaction costs
- **How to measure transaction costs?**
 - Program Management Office (PMO) costs as proxy for transaction costs



Data for Major Acquisition Programs

- **Consolidated Acquisition Reporting System (CARS)**
 - Defense Acquisition University (DAU) Business Information Laboratory database
 - Includes information from Selected Acquisition Reports (SAR) and Defense Acquisition Executive Summaries (DAES)
- **Budget Item Justification sheets**
 - OSD budget



Problem with Existing Data

- SAR and DAES do not contain the level of detail necessary to identify PMO costs
- OSD budget is not consistent in reporting PMO costs across programs and years
- Information in CARS does not always track to OSD budget
 - SAR only includes the six largest active contracts



IX. CONCLUDING REMARKS

- INCLUDING TCE FACTORS ADDS EXPLANATORY POWER
- READILY AVAILABLE SOURCES OF DATA NOT WELL SUITED TO IDENTIFYING TCE FACTORS IN DOD ACQUISITION PROJECTS
- WHAT ELSE MIGHT BE DONE
 - DETAILED CASE STUDIES OF SELECTED PROGRAMS
 - LOOKING MORE DEEPLY INTO THE COST DATA (BEYOND STANDARD DATA BASES)



RECOMMENDATIONS FOR POLICY & PRACTICE (IN THE MEANTIME)

- **Reduce Complexity by Investing in a more complete contract and use of more mature technologies.**
- **Reduce Uncertainty through multi-year contracts (demand uncertainty); investing in more complete contracts (relationship uncertainty).**
- **Increase measurement and monitoring to reduce information asymmetries (and associated risks).**



RECOMMENDATIONS (Continued)

- **Provide credible deterrents to bad behavior: penalty clauses, warranties and bonding; multi-year contracts to gather information and reward good reputations.**
- **Mitigate effects of asset specificity: careful use of incentives, proper bundling of goods and services and GOCO assets.**
- **Increase contestability through government-controlled standby capacity, second sourcing, and preservation of real options (e.g., threat of competing suppliers), ...**

