

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

HOSTED BY

NAVAL CENTER FOR COST ANALYSIS
WASHINGTON, DC 20350-1100

PREPARED BY

MR. ROBERT E. LEE
CHAIRMAN, 26th ADODCAS

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT

TUESDAY, 9 SEPTEMBER 1992

1400 - 2100 REGISTRATION [MODULE 1 - SERVICE DESK]

1930 - 2100 ICE BREAKER - - Cash Bar [Red Commons - 2nd Floor]

WEDNESDAY, 9 SEPTEMBER 1992

0700 - 0800 REGISTRATION [MODULE 1 - SERVICE DESK]

0800 - 0805 PRESENTATION OF THE COLORS

0805 - 0815 ADMINISTRATION: Mr. Gary Aslin, Director of Xerox Center

0815 - 0900 GENERAL SESSION: Hon. Robert C. McCormack - Assistant Secretary of the Navy (Financial Management)

0915 - 1200 WORKSHOPS (Note: Army & Air Force also sponsoring 'ACES & ACE-IT' demo at this time, outside Theatre)

WORKSHOP SCHEDULE DAY 1 (page 1 of 2)

ACQUISITION STRATEGY [Room 3383]	ADP COST ESTIMATING [Room 4462]	AFFORDABILITY [Room 3370]	CONTRACTOR COST DATA ANALYSIS [Room 3376]	COST & OPERATIONAL EFFECT. ANALYSIS [Room 3462]	DEFENSE BUSINESS OPERATING FUND [Room 3465]
0915 - - - - -	Effort/Schedule Models for ADA Development, Wolfinger & Gallombaro	Affordability Analysis as a Management Tool by: C. Geisert & S. Dibley	Service Contract Cost Projection System by: K. Gallagher	- - - - -	Business Manager Concept by: L. Logan
1000 COFFEE	COFFEE	BREAK	COFFEE	COFFEE	COFFEE
1015 - - - - -	Automated Info System Cost Benefit Evaluation by: D. Skola	Surface Combatant Affordability Goals by: Glazman & Rocholl	Cost Performance Index Stability - Fact or Fiction by: K. Payne	- - - - -	Implementing DBOF: Military Airlift Command by: L. Schwartz
1100 - - - - -	Business Analysis for Mgmt Decision-Making by: J. Raner	Standardizing Nav Cost Benefit Anal - MANTECH by: W. Loell	Estimate at Completion Accuracy Measurement by: J. Kane	Aggregate Analysis by: M. Herry & W. Hogan	Revolving Fund Model by: R. Oeljen, S. Heggie
1115 - - - - -	Asset Revaluation/Incon for Cost Minimization by: W. Rogerson				
1200 - - - - -					

1200 - 1300 LUNCH - Xerox Cafeteria - Module 3 (Orange)

1300 - 1400 GENERAL SESSION: Ms. Eleanor Spector - Director of Defense Procurement, OUSD (A)

1415 - 1600 WORKSHOPS (Note: Army and Air Force also sponsoring 'ACES & ACE-IT' demo at this time, outside Theatre)

ACQUISITION STRATEGY [Room 3383]	ADP COST ESTIMATING [Room 4462]	AFFORDABILITY [Room 3370]	CONTRACTOR COST DATA ANALYSIS [Room 3471 (Theater)]	COST & OPERATIONAL EFFECT. ANALYSIS [Room 3462]
1415 Forecasting Defense Budgets in New World by: M. Jeffers	Army Automation Econ Analysis Model by: D. Hollis	Affordability Analyses for DAB Reviews by: M. Bolto	Analysis of Contractor Cost Performance Data	A Most Effective Way of Generating and Managing a COEA
1500 COFFEE	COFFEE	COFFEE		
1515 Presenting Cost Data in Source Selection by: Topp, Fredrick, Smith	- - - - -	LongRange Investment Planning Systems, OSD by: R. Kneese	(EXTENDED WORKSHOP)	(EXTENDED WORKSHOP)
1600 - - - - -			by: K. Curran & D. Traversa	by: B. Rudwick

1615 - 1700 SERVICE MEETINGS: Navy [Room 3460]; Army [Room 3471 (Theater)]; Air Force [Room 3462]

1730 - 1900 SOCIAL - - Cash Bar [Red Commons - 2nd Floor]

8/26/92

COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT

TUESDAY, 8 SEPTEMBER 1992

1400 - 2100 REGISTRATION (MODULE 1 - SERVICE DESK)

1930 - 2100 ICE BREAKER - Cash Bar [Red Commons - 2nd Floor]

WEDNESDAY, 9 SEPTEMBER 1992

0700 - 0800 REGISTRATION (MODULE 1 - SERVICE DESK)

0800 - 0805 PRESENTATION OF THE COLORS

0805 - 0815 ADMINISTRATION: Mr. Gary Aslin, Director of Xerox Center

0815 - 0900 GENERAL SESSION: Hon. Robert C. McCormack - Assistant Secretary of the Navy (Financial Management)

0915 - 1200 WORKSHOPS (Note: Army & Air Force also sponsoring "ACES & ACE-IT" demo at this time, outside Theatre)

WORKSHOP SCHEDULE DAY 1 (page 2 of 2)

O & S COST ESTIMATING I [Room 3257]	O & S COST ESTIMATING II [Room 3381]	PARAMETRIC COST ESTIMATING [Room 3466]	R & D COST ESTIMATING [Room 4466]	RISK ANALYSIS [Room 3464]	SOFTWARE COST ESTIMATING [Room 3460]
0915 OSD CAIG O&S Cost Estimating Guide by: J. Valatka	1000 Current Topics in Force Structure by: R. Suchan	1000 Diesel Engine Procurement Cost by: J. Chenwonik	1000 Tactical Missile Systems Development Costs by: O'Hara & Murphy & Simpson	1000 Intro. to Risk Analysis by: O'Hara & Murphy & Simpson	1000 Est Cost Develop Artificial Intel Systems w/o LOC by: Nemecek & Bernia
1000 BREAK	1000 COFFEE	1000 BREAK	1000 BREAK	1000 COFFEE	1000 BREAK
1015 O&S Cost Data Base Development by: Stukes & Martin	1100 Army's Glass IX Operation Consumption by: Campbell & Zavecz	1100 Prime Mission Equip Estimate Factor by: P. Johnson	1100 RDT&E Cost Est Using Price H Parametrics by: A. Milano	1100 Comprehensive Risk: MLSTAR Case Study by: D. Graham	1100 Cost Estimating in Rapid Prototyping by: M. Pridis
1115 Navy VAMOSC: Accomplish & Future Direction by: A. Doermann	1200 Service Contract Cost Engineering Study by: W. Doublerman	1200 Dev Cost Drivers: Case of Tracked Vehicles by: Boger & Malcolm	1200 Business Case Analysis for Mgmt Decision Making by: J. Raner	1200 Quantifying Expert Judgement by: R. Hazlett	1200 Data Collection and Analysis by: P. Wells

1200 - 1300 LUNCH - Xerox Cafeteria - Module 3 (Orange)

1300 - 1400 GENERAL SESSION: Ms. Eleanor Spector - Director of Defense Procurement, C JSD (A)

1415 - 1600 WORKSHOPS (Note: Army and Air Force also sponsoring "ACES & ACE-IT" demo at this time, outside Theatre)

O & S COST ESTIMATING I [Room 3257]	O & S COST ESTIMATING II [Room 3381]	PARAMETRIC COST ESTIMATING [Room 3466]	R & D COST ESTIMATING [Room 4466]	RISK ANALYSIS [Room 3464]	SOFTWARE COST ESTIMATING [Room 3460]
1415 Update of Navy's Engine O&S Cost Analysis by: D. Johnson	1500 - - - - -	1500 Nuclear Radiation Hardened Satellites by: Bul Kysar, Frazier	1500 T&E Cost Model for Nav Air - Launched Weapons by: D. Bell	1500 Source Selection Schedule Risk by: Frank & Poullot & Anderson	1500 Estimating Volume Independent of LOC by: Galorath & McRitchie
1500 BREAK	1500 COFFEE	1500 COFFEE	1500 COFFEE	1500 COFFEE	1500 BREAK
1515 Depot Maintenance Re-source Model by: O'Brien & Billman & Shine & Odean	1600 Replacing Structure in Eur w/ Reserve Rotations by: J. Cowardin	1600 CER's for U.S. Commercial Ships by: A. Hirschman	1600 RDT&E Resource Predictive Model by: P. Wakefield	1600 Error Propagation by: D. Topa	1600 Proposal for Establishing Model by: D. Beres

1615 - 1700 SERVICE MEETINGS: Navy [Room 3460]; Army [Room 3471 (Theatre)]; Air Force [Room 3462]

1730 - 1900 SOCIAL w/ Cash Bar [Red Commons - 2nd Floor]

8/31/92

COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT

THURSDAY 10 SEPTEMBER 1982

WORKSHOP SCHEDULE DAY 2 (page 1 of 2)

0700 -- 0800 REGISTRATION (MODULE 1 -- SERVICE DESK)

0800 -- 0900 GENERAL SESSION: Mr. Neil R. Ginnetti -- Acting Assistant of the Army (Financial Management)

0910 -- 1010, 1110 -- 1200 WORKSHOPS (Note: Army & Air Force sponsoring 'ACES & ACE - IT' demo also at this time, outside Theatre)

	ACQUISITION STRATEGY	AFFORDABILITY	CONTRACTOR COST DATA ANALYSIS	FINANCIAL ANALYSIS OF DEFENSE CONTRACTOR	INNOVATIVE APPROACHES	O & S COST ESTIMATING I	PARAMETRIC COST ESTIMATING
	[Room 3383]	[Room 3370]	[Room 3378]	[Room 4464]	[Room 4462]	[Room 3468]	[Room 3267]
0910	We Need to Change - Syst Acq Process	Effect of Service Life Extension on Foreign Mil Sales	Developing a Usable Workbreakdown (WBS) Structure	TQM: A Systematic Approach	Analytic Hierarchy Process to Produce ROM Estimate	Major Results O&S Est for MIG-29 Fighter AC	Learning Curve
1010	by: J. Pennett	by: R. DiCesare	by: N. Albert	by: J. Woody	by: P. Beck	by: J. Rieder	by: D. Topa
1010	COFFEE BREAK						
1020	GENERAL SESSION: Mr. Milton Margolis, Former Deputy Assistant Secretary of Defense (Resource Analysis), currently w/ LMI						
1110	-----	Beyond Cost Analysis	(CONTINUED WBS WORKSHOP)	-----	Engineering Costs Est (Javelin-based Model)	Economic Resource Impact Statement (ERIS)	Hidden Dimensions
1200		by: H. Frick	by: N. Albert		by: E. Lewis	by: C. Kennedy	by: T. Scarborough & D. Topa

1200 -- 1245 LUNCH -- Xerox Cafeteria -- Module 3 (Orange)

1245 -- 1330 GENERAL SESSION: Hon. Michael B. Donley -- Assistant Secretary of the Air Force (Financial Management & Comptroller)

1345 -- 1630 WORKSHOPS (Note: Army & Air Force sponsoring 'ACES & ACE - IT' demo also at this time, outside Theatre)

	ACQUISITION STRATEGY	AFFORDABILITY	CONTRACTOR COST DATA ANALYSIS	COST & OPERATIONAL EFFECT ANALYSIS	FINANCIAL ANALYSIS OF DEFENSE CONTRACTOR	INNOVATIVE APPROACHES	O & S COST ESTIMATING I
	[Room 3383]	[Room 3370]	[Room 3378]	[Room 3462]	[Room 4464]	[Room 4462]	[Room 3468]
1345	Source Selection - Improvements	Long term Force Planning - Constraints & Structure Dev	Army CEAC Acquisition Cost Info Architecture	Cost Benefit Analysis In Collaborating Eq. Prog	Projecting Overhead Rates w/ Changing Capitalization	Indicators of Learning Curve Accuracy: Reliability	Commonality Armored Systems Vehicle Mods
1430	by: D. Kirlin	by: Glazman & Rochell	by: R. Blahop	by: A. Radcliffe	by: J. Keller & H. Degel	by: O.D. Moses	by: Grove & Woppert
1430	COFFEE	BREAK	COFFEE	BREAK	BREAK	COFFEE	COFFEE
1445	Cost Evaluation Committee (CEC)	Army Horseblanket Review Process	Strat and Test Missile and Sensor Database	COEA Use In LX Analysis	Army Contractors: Financially Sound or ... Troubled?	Traditional Methods w/ Non-traditional Program	Systematic Approach to Better Long Range Est
1530	by: A. Henkel	by: M. Kroh	by: S. Messarvy	by: D. Adams	by: Weinhold & Lincoln	by: R. Hunt	by: Cukr, Meyer & Sauer
1545	Multi-yr Contracting In Shipbuilding	-----	-----	AH-64 Helo ATE Cost/ Benefit Analysis	Financial Analysis of Defense Contractors	Cost Archiva & Retrieval System (COSTARS)	Macro vs. Micro - Economic Analysis
1630	by: Mowad & Colman			by: L. Weggoner	by: J. Tobias	by: M. Hunter	by: E. Sauer

1730 -- 1900 SOCIAL w/ Cash Bar at Holiday Inn -- Dulles

1900 -- 2000 BANQUET at Holiday Inn -- Dulles

2000 -- 2045 GUEST SPEAKER: Hon. Donald J. Atwood, Jr. -- Deputy Secretary of Defense

2045 -- 2130 AWARDS/CLOSING

COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT

THURSDAY, 10 SEPTEMBER 1992

0700 - 0800 REGISTRATION [MODULE 1 - SERVICE DESK]

0800 - 0900 GENERAL SESSION: Mr. Neil R. Ginnetti - Acting Assistant of the Army (Financial Management)

0910- 1010,1110-1200 WORKSHOPS (Note: Army & Air Force sponsoring "ACES & ACE-IT" demo also at this time, outside Theatre)

	R & D COST ESTIMATING	RISK ANALYSIS	SOFTWARE COST ESTIMATING	WORKSHOP
	[Room 4466]	[Room 3464]	[Room 3460]	[Room 3471]
0910	Missile RDT&E Estima-	Total Cost Risk	Monitoring Contract	
-	tion: Another Tool	Methodology	Performance SW Dev	Economic Trends
1010	by: J. Kozicki	by: D. Olsen	by: E. Acosta	by: R. Raynsford

1010 - 1020 COFFEE BREAK

1020 - 1100 GENERAL SESSION: Mr. Milton Margolis, Former Deputy Assistant Secretary of Defense (Resource Analysis), currently w/ LMI

1110	Op Missile Analysis and Display Systems	Risk Management Approach to Cost Est	Using SEER-SEM A Tutorial
1200	by: M. Gierin	by: B. Rudwick	by: D. Galorath

1200 - 1245 LUNCH - Xerox Cafeteria - Module 3 (Orange)

1245 - 1330 GENERAL SESSION: Hon. Michael B. Donley - Assistant Secretary of the Air Force (Financial Management & Comptroller)

1345 - 1630 WORKSHOPS (Note: Army & Air Force sponsoring "ACES & ACE-IT" demo also at this time, outside Theatre)

	PARAMETRIC COST ESTIMATING	RISK ANALYSIS	SOFTWARE COST ESTIMATING
	[Room 3257]	[Room 3464]	[Room 3460]
1345	Cost Performance	Schedule Risk Profiles	Comparison PRICE S
-	Choices - Tact Aircraft	Army Strategic Missiles	and CEI System - 4
1430	by: R. Franck	by: L. Fichter	by: S. Rowland
1430	BREAK	COFFEE	BREAK
1445	Radios	Joint Probability Model for	Cost Analysis Using
-	by: D. Topa &	Cost/Sched Uncertainty	Function Point Metrics
1530	E. Kirchner - Staeuble	by: P. Garvey & A. Taub	by: B. Edmiston
1545	Calibration of	Reducing Guesswork,	An Evaluation of Three
-	Heuristic Factors	Maintaining Traceability	Function Point Models
1630	by: F. Fong	by: P. Smith & S. Book	by: D. Ferens

1730 - 1900 SOCIAL w/ Cash Bar at Holiday Inn - Dulles

1900 - 2000 BANQUET at Holiday Inn - Dulles

2000 - 2045 GUEST SPEAKER: Hon. Donald J. Alwood, Jr. - Deputy Secretary of Defense

2045 - 2130 AWARDS/CLOSING

COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT

FRIDAY, 11 SEPTEMBER 1992

0700 - 0800 REGISTRATION (MODULE 1 - SERVICE DESK)

0800 - 0900 GENERAL SESSION: Dr. David L. McNicol - Deputy Assistant Secretary of Defense (Resource Analysis)

0915 - 1200 WORKSHOPS

(Note: The BEST PAPERS will also be presented again at this time, in the Theatre.)

DAY 3 (page 1 of 1)

	COST & OPERATIONAL EFFECT ANALYSIS	INNOVATIVE APPROACHES	O & S COST ESTIMATING I	O & S COST ESTIMATING II	PARAMETRIC COST ESTIMATING	RISK ANALYSIS	SOFTWARE COST ESTIMATING
0815	Non-Weapon Systems Effectiveness Analysis	Simulating Correlated Effects w/Bounded Domain	USAF Spora Parts Process	---	General Coefficient of Determination	PC Scans Synopsis (Schedule Networks)	SW Est Improvement Project (SWEPP)
1000	by: M. Lambert	by: Lurie & Goldberg	by: S. Andraz	---	by: P.H. Young	by: D. Mortison	by: J.B. Donald
1000	COFFEE	BREAK	BREAK	COFFEE	BREAK	COFFEE	COFFEE
1015	---	Hazardous Material Mgmt LCC Model	Depot Level Reparables: Cost Factor Development	Savings from Simulation?? A Plausible Quantification	---	Assessment of Risk Potential	Functional Sizing Meth for Missiles
1100	---	by: Long & King & Vasil	by: W. Jameson	by: E. Acosta	---	by: R. Trehan	by: R. Wilson
1115	Playback Analysis Used In Army COEAs	Space System Division Satellite Cost Factors	Def Mgmt Rev Decisions In Dev O&S Cost Factors	Cost Comparison: PCS Rotational Squadron	---	Monte Carlo Simulation of Project Schedule	---
1200	by: Johnson & Miller	by: O.Y. Choi	by: Campbell & Zavecz	by: J. Pugh	---	by: S. Book & P. Young	---

1200 - 1300 LUNCH - Xerox Cafeteria - Module 3 (Orange)

1300 - 1400 GENERAL SESSION: Dr. J.D. Morgan, Director Force & Infrastructure Cost Analysis Division, OASD(PA&E)

1400 - 1430 CONCLUDING REMARKS

Accession For	
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DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Avail and/or	
Special	
Dist	A-1

** HAVE A SAFE RETURN TRIP HOME **

26th ANNUAL DoD COST ANALYSIS SYMPOSIUM
9-11 SEPTEMBER 1992
XEROX TRAINING CENTER, LEESBURG, VA.

DTIC QUALITY ASSURED 3

8/31/92

REGISTRATION PROCEDURES

OFFICIAL REGISTRATION FOR DODCAS:

Must do steps in order!

STEP ONE. Register with Xerox registration desk. Payment must be by government check, government purchase order, personal check, or personal credit card.

STEP TWO. Go to the respective service table (Air Force, Army, Navy, or OSD/contractors) after you finish the Xerox registration. You must show your Xerox receipt to receive a DODCAS folder and badge. You must wear the badge in order to be admitted the DODCAS classrooms and to be served meals.

NOTE: All shared registration participants (primary and alternates) must check in with Xerox and their respective service table each morning they attend to pay or confirm payment to Xerox and receive their folders and badges. If you have alternates on your registration, please try to inform them of this requirement before they arrive at the Xerox Center.

RESERVATIONS OF AIRPORT TRANSPORTATION ON FRIDAY, 11 SEPTEMBER:

Transportation is available from Xerox to Dulles airport and National airport at 1400 on Friday, 11 September 1992. You must sign-up for the transportation at the Xerox registration desk by 1700 on Wednesday, 9 September 1992. The cost of the transportation to either airport is \$7 per person.

BANQUET TICKETS AND TRANSPORTATION:

Banquet tickets are still available. If you haven't registered for the banquet and would like to attend, tickets are being sold starting at 0800 on Wednesday, 9 September, in Room 3350. There is a limited amount available so it will be first come, first serve.

Transportation is available between Xerox and the banquet location. Shuttles to the banquet are available outside the entrance to the Xerox registration desk at 1700, 1715, 1730, and 1745. You must sign up in advance for the shuttle. Sign-up will be at the Navy service desk until 0900 on Wednesday; after 0900 Wednesday, sign-up will be in room 3350.

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

BANQUET

HOLIDAY INN - DULLES

1730-1900	Cocktail Hour with hors d'oeuvre (Cash Bar)
1845-1900	Move to Dinner
1900-1910	Welcome {Recognition of Head Table, VIPs and Foreign Visitors}
1910-2000	Dinner (Menu on back)
2000-2045	Guest Speaker Honorable Donald J. Atwood, Jr., Deputy Secretary of Defense
2045-2115	Recognition of DODCAS Chairman and Awards
2115-2130	Closing, Night Cap available in Scroopies

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

BANQUET

MENU

Garden Salad

Combination Entree:

Roast Prime Rib of Beef, Au Jus

and

Grilled Pacific Swordfish with Herbed Butter

Duchess Potatoes

Broiled Tomato with Parmesan and Basil

Warm Rolls and Butter

Coffee, Tea and Decaf

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

DIRECTIONS TO THE HOLIDAY INN WASHINGTON-DULLES

- From Leesburg:** Go EAST on ROUTE 7 until you reach ROUTE 28 (approximately 7 miles). At the traffic light at Route 28, TURN RIGHT (South). Go through 2 traffic lights. Take your first LEFT. If you get to the light at Route 606, you missed us!
- From Sterling:** Go to Sterling Blvd and take a LEFT (South) at the traffic light at Route 28. Then your first LEFT. We are at the corner of Route 28 and Holiday Drive. OR take a LEFT onto Shaw Road from Sterling Blvd, and a RIGHT onto Holiday Drive. The Holiday Inn will be on your LEFT at Route 28.
- From Herndon:** Take Route 606 (West) to Route 28. Turn RIGHT onto Route 28 (North), and the first right onto Holiday Drive and the Holiday Inn - Dulles. You will probably notice the Shell gas station.
- From I-66:** Go North on Route 28, crossing Route 50 and Dulles Access Road. From the Dulles Access Road, go approximately 1.3 miles through the light at Route 606. Then your first RIGHT (onto Holiday Drive). You might notice the Shell gas station and the Hampton Inn sign.
- From Dulles Access Road:** Exit the Access Road at Exit 1. Turn RIGHT (North) onto Route 28 (Sully Road). Go about 1.3 Miles. The Holiday Inn will be on your RIGHT approximately 350 yards north of the traffic light at Route 606. If you go as far as Sterling Blvd., you've gone too far. (You might notice the Shell gas station when you turn to the Holiday Inn.
- From Wash., D.C.:** Take either I-495 or I-66 and get off at the Dulles Access Road. Go through the toll booths (50¢) and continue until you reach Exit 1 (35¢). Turn RIGHT onto Route 28 (North). This is also Sully Road. Go approximately 1.3 miles. The Holiday Inn Dulles will be on your RIGHT after the traffic light at Route 606.
- From Tyson's Corner:** Go North on Route 7 to the Dulles Access Road (WEST). Go to Exit 1 (35¢) and turn RIGHT (North) onto Route 28 (Sully Road). Go approximately 1.3 miles through the light at Route 606 and take your NEXT RIGHT (about 350 yards from Route 606). We will be on your RIGHT - if you get to Sterling Blvd, you've gone too far.

TABLE OF CONTENTS

- HOST
- GENERAL SESSION SPEAKERS AND HONORED GUEST
- EXECUTIVE COMMITTEE
- WORKSHOPS
 - ACQUISITION STRATEGY
 - ADP COST ESTIMATING
 - AFFORDABILITY
 - CONTRACTOR COST DATA ANALYSIS
 - COST & OPERATIONAL EFFECTIVENESS ANALYSIS
 - DEFENSE BUSINESS OPERATING FUND (DBOF) ISSUES
 - OPERATIONS & SUPPORT COST ESTIMATING
 - PARAMETRIC & COST ESTIMATING RELATIONSHIPS
 - R&D COST ESTIMATING
 - RISK ANALYSIS
 - SOFTWARE COST ESTIMATING
 - FINANCIAL ANALYSIS OF DEFENSE CONTRACTORS
 - INNOVATIVE APPROACHES TO COST ESTIMATING
 - SPECIAL INTEREST SESSIONS

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

HOSTED BY

**NAVAL CENTER FOR COST ANALYSIS
WASHINGTON, DC 20350-1100**

**DIRECTOR
CAPTAIN RICHARD L. COLEMAN, USN**

**TECHNICAL DIRECTOR
MR. JAMES H. HERD**

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

**CAPTAIN RICHARD LEWIS COLEMAN, USN
DIRECTOR, NAVAL CENTER FOR COST ANALYSIS**

Captain Richard L. Coleman was born in November 1946 in Pittsburgh, California. The son of COL and Mrs Irving M. Coleman, CAPT Coleman lived throughout the United States and the Far East before graduating from Punahou School in Honolulu, Hawaii in 1964. He was commissioned upon graduation from the United States Naval Academy in 1968, where he received a B.S. in Naval Engineering with a minor in Operations Analysis.

During his career in the Navy, Captain Coleman has served as CIC Officer on board USS O'HARE (DD 889), CIC/AAW/EW Officer on the staff of Commander, Cruiser Destroyer Flotilla TWO, Operations Officer on board USS AYLWIN (FF 1081), Enlisted Systems Project Officer for Decision Support Systems, OPNAV (OP-16), Operations Officer on board USS CALIFORNIA (CGN 36), Executive Officer on board USS WORDEN (CG 18), Section Head and Command, Control and Communications Analyst at the Office of Program Appraisal, OPNAV (OP-81), Commanding Officer of USS DEWEY (DDG 45), and Head, Surface-to-Air Missile Section at Commander, Operational Test and Evaluation Force. He is currently assigned as Director, Naval Center for Cost Analysis.

He received a Master of Science Degree in Operations Research from the Naval Postgraduate School in Monterey, California in September 1974. Graduating first in his class with a 4.0 Grade Point Average, Captain Coleman was the recipient of the Chief of Naval Operations Award for Excellence in Operations Research.

His awards include the Meritorious Service Medal with two Gold Stars, and the Navy Commendation Medal with one Gold Star.

Captain Coleman married the former Mary Ruth Sanders of Newport News, Virginia in 1968. They have two sons, John, a graduate student at Clemson University, and David, a sophomore at James Madison University.

**JAMES H. HERD
TECHNICAL DIRECTOR
NAVAL CENTER FOR COST ANALYSIS**

SCEA/ICA:

- National
 - Director (PROTEM), SCEA (1990-91)
 - Member (1982-present)
- Washington, DC Chapter
 - President 1988-90
 - Vice President 1986-88
 - Membership Chairperson 1984-86
 - Newsletter Editor 1984-86

o Previous Position:

- Navy Department, Navy Sea Systems Command
Deputy Director, Cost Analysis Division
Chief, Underwater Systems Br., Cost Analysis Division
- Navy Department, NCA
Chief, Ship Systems Branch
- Navy Department, Naval Material Command
Head, Ship Systems Branch, Cost Analysis Division
- DAI, Ex. VP and Mgr., Cost Analysis Division
- RMG., Inc., VP and Mgr., Engineering and Operations
Research Division
- Naval Ordnance Laboratory, Senior Engineer, Surface
Weapons Department

o Experience:

- Performing Engineering and parametric cost analysis/estimating since mid-1960's
- Experienced in costing electronics, ships, aircraft, missile, torpedo, ADP hardware and software, and health care systems and subsystems.
- Ten years in weapon/electronics systems RDT&E

o Education:

BS Mechanical Engineering
Graduate study, Mechanical Engineering

6. Awards and Other Recognition

- Certified Cost Analyst, Soc. Cost Est & Anal (SCEA)
- President, Washington Chapter, SCEA (Elected)
- Director, SCEA National Board (Elected)
- Member, Committee (Appointed) to develop university level curriculum in Cost Analysis

7. 05/17/91 COEA ACTION OFFICER WORKSHOP
06/30/90 INSTITUTE OF COST ANALYSIS SEMINAR
05/06/90 CLASSIFICATION FOR SUPV & MANAGERS
09/27/89 SES WORKSHOP
06/30/89 INSTITUTE OF COST ANALYSIS SEMINAR
05/22/88 INTRODUCTION TO SES SERVICE
ANNUAL EEO TRAINING (E.G. SEXUAL HARASSMENT, DRUG FREE
WORKPLACE, ETC.)
1983 - PRESENT PROFESSIONAL ORGANIZATION: OFFICER/MEMBER,
SOCIETY OF COST ESTIMATING AND ANALYSIS
(SCEA)
1990 TQM WORKSHOP

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

GENERAL SESSION SPEAKERS

AND

HONORED GUESTS

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

ROBERT C. MCCORMACK
ASSISTANT SECRETARY OF THE NAVY
(FINANCIAL MANAGEMENT)

Robert C. McCormack was sworn-in on January 12, 1990, as the Assistant Secretary of the Navy (Financial Management) and Comptroller of the Navy. He is responsible for developing and maintaining policies, standards and procedures for obtaining resources and operating financial systems throughout the Department to include budgeting, accounting, disbursing, financing and statistical reporting.

Prior to his present position, Mr. McCormack was designated by the Secretary of Defense as the Acting Principal Deputy to the Under Secretary of Defense (Acquisition). In the position, he was the primary advisor to the Under Secretary (Acquisition), who is responsible for all matters relating to the acquisition system; research and development; production; logistics; command, control, communications, and intelligence activities related to acquisition; military construction; environmental matters; and procurement.

Mr. McCormack was the first Deputy Under Secretary of Defense for Industrial and International Programs. This organization, established October 1, 1988, merged the offices of Industrial Resources and International Programs and Technology under one Deputy Under Secretary within the Office of the Under Secretary of Defense for Acquisition. For his efforts in centralizing management of defense industrial base issues and U.S. efforts in international armaments cooperation, Mr. McCormack was awarded the Defense Distinguished Public Service Medal.

Mr. McCormack was the Deputy Assistant Secretary of Defense (Production Support) from July 1987 through September 1988. He was responsible for OSD policy development in the areas of industrial preparedness and mobilization, productivity, quality, standardization and data management. Specific programs under the purview of his responsibilities included: Industrial Preparedness Planning, Priorities and Allocations, National Stockpile and critical Materials, Defense Production Act, Manufacturing Technology, Industrial Modernization and Incentives, Value Engineering, Acquisition Streamlining, Standardization, Acquisition Data Management and Quality.

From 1981 to 1987, Mr. McCormack was with the investment banking firm, Morgan Stanley & Co. Incorporated, as the Managing Director in Corporate Finance, focusing on industrial and technology companies. Responsibilities included developing financing plans and advising on mergers and acquisitions for U.S. and international companies. Financing activities involved U.S. and Eurodollar markets, as well as client activities in major foreign

currency markets. Acquisition activities included work with Japanese clients and U.S. subsidiaries of foreign companies. A significant part of his responsibilities involved close coordination with Morgan Stanley's London and Tokyo offices.

Prior to the move to Morgan Stanley, Mr. McCormack was the Senior Vice President and Manager of Dillan, Read & Co.'s Chicago Office (1977-1981). He was responsible for the firm's corporate finance business in the Midwest. During the period 1968-1977, Mr. McCormack held positions in the New York office in corporate finance. Activities included both domestic and international financing and cross-border mergers and acquisitions. He also had extensive experience working on public finance projects such as the Washington Metropolitan Transit Authority.

From 1962 to 1966, Mr. McCormack was on active duty as a Lieutenant in the United States Navy.

Mr. McCormack has also served as a former Director of Illinois Tool Works, Inc. and as a Trustee of the Illinois Institute of Technology. He earned a M.B.A. from the University of Chicago Graduate School of Business in 1968 and received a B.A. in Economics from the University of North Carolina in 1962.

Mr. McCormack was born in New York on November 7, 1939. He and his wife, Mary, have three sons, Robert, Walter and Scott.

ELEANOR R. SPECTOR

DIRECTOR OF DEFENSE PROCUREMENT

Mrs. Eleanor R. Spector assumed her position as Director of Defense Procurement in February 1991. Prior to this appointment, she served as Deputy Assistant Secretary of Defense for Procurement.

She graduated from Barnard College in 1964 and has done graduate work at George Washington University and Nazareth College.

Mrs. Spector joined the Department of the Navy as a management intern. She came to the Office of the Secretary of Defense after 13 years at the Naval Air Systems Command (NAVAIR), where she was involved in all phases of airframe and missile contracting--as a Contract Specialist, Procurement Contracting Officer (PCO), and as Director of the Cost Analysis Division.

Mrs. Spector was PCO of the LAMPS MK III helicopter system program during the issuance and pricing of initial production contracts with four prime contractors. On leaving her post as Cost Analysis Division Director, Mrs. Spector received the Navy's highest civilian service award for being the principal architect in consolidating NAVAIR cost estimating functions and for improving the quality of cost estimates.

In her present position, Mrs. Spector is responsible for all matters related to procurement policy in the Defense Department. This includes supervision of the Defense Acquisition Regulations Council, contract pricing and financing, contract administration, regulatory reform, and international contracting. Mrs. Spector is also the advisor on procurement to the Defense Acquisition Board.

She was awarded the Navy Superior Civilian Medal in 1982, the Navy Distinguished Civilian Service Medal in 1985, the Department of Defense for Public Administration 1987 Mid-Career Award, a Presidential Rank Award (Meritorious Executive) in 1989, a Presidential Rank Award (Distinguished Executive) in 1990; and named a National Contract Management Association Fellow in 1990.

Mrs. Spector was born in New York City. She and her husband have a daughter and son.

NEIL R. GINETTI
ACTING ASSISTANT SECRETARY OF THE ARMY
(FINANCIAL MANAGEMENT)

Duties Statement

Serves as Acting Assistant Secretary of the Army for Financial Management (ASA(FM)) and is responsible for oversight of Army-wide financial management functions and duties as delegated by the Secretary of the Army. These responsibilities encompass oversight of the Army Planning, Programming, Budget and Execution System, preparation of the Army budget request and execution of the Congressionally enacted Army budget; supervision of the U.S. Army Finance and Accounting and the U.S. Army Cost and Economic Analysis Centers; directing the Army's review and oversight functions; providing independent resource analysis of trends and overall department program performance; the application of effective business management practices throughout the Army; and overseeing integration of all Army information systems that contain financial information.

Qualification Summary

Birth Date	February 19, 1936, - Yonkers, New York
a. Education	
1975-1976	Industrial College of the Armed Forces
1966-1967	MBA - Syracuse University
1953-1957	BS - Connecticut State College
b. Experience	
Jul 92 - Present	Acting Assistant Secretary of the Army (FM)
Oct 90 - Jun 92	Principal Deputy Assistant Secretary of the Army (FM)
Mar 90 - Oct 90	Acting Principal Deputy Assistant Secretary of the Army (FM)
Oct 89 - Mar 90	Acting Assistant Secretary of the Army (FM)
Mar 89 - Oct 89	Acting Principal Deputy Assistant Secretary of the Army (Financial Management)
1987 - Mar 89	Director for Independent Resource Analysis, OASA(FM)
1983 - 1986	Deputy for PPBE, OASA(FM)
1980 - 1983	Asst Dep for Resource Analysis, OASA(FM)
1976 - 1980	Comptroller/Deputy Comptroller, Communications-Electronics Materiel Readiness Command
1971 - 1976	Dep Chief, Cost Analysis Division, USAMC
1970 - 1971	Branch Chief, Cost Analysis Division, Munitions Command
1967 - 1970	Program Analyst, Comptroller, HQ, DARCOM
1957 - 1963	Educator, Okinawa and Newington, Conn.

- c. **Professional Societies**
American Society of Military Comptrollers
Senior Executive Association
Association of Government Accountants
Army Finance Association
- d. **Personal**
Wife Susan Meyer Ginnetti
Children Pamela, Paul, Jill, Neil
Hobbies Model railroading, photography, hi-fi/stereo

MILTON A. MARGOLIS

Experience

1989 to present	Research Scientist, Logistics Mangement Institute
1988 - 1989	Research Analyst, RAND Corporation
1979 - 1988	Deputy Assistant Secretary of Defense (Resource Analysis), OASD(PA&E)
1969 - 1979	Director, Cost Analysis, OASD(PA&E)
1967 - 1969	Manager, Resource Analysis Division Resource Management Corporation
1952 - 1967	Head, Advanced Systems Group, Cost Analysis Department, RAND Corporation
1950 - 1952	Systems Engineer, Willow Run Research Center, University of Michigan
1948 - 1950	Teaching Fellow and Research Assistant, The Johns Hopkins University

Publications

"Sources, Availability and Costs of Propellants," M.A. Margolis and S.H. Dole, chapter in The Chemistry of Propellants, edited by S.S. Penner and J. Ducarme, Pergamon Press, London, 1960.

"Economic Aspects of Developing and Orbiting a Space Station," Aero Space Engineering, May 1960.

"Economic Consideration of Space Flight Ground-Support Requirements," M.A. Margolis and F.S. Pardee, presented at the Aviation Conference of the American Society of Mechanical Engineers, Los Angeles, California, March 9-12, 1959.

"Use of Cost-Estimating Relationships in the Airframe Industry," presented at the Thirteenth National Meeting of the Operations Research Society of America, Durham, North Carolina, October 18, 1966.

"The Space Program," M.A. Margolis and S.M. Barro, chapter in Program Budgeting - Program Analysis and the Federal Budget, edited by David Novick, Harvard University Press, Cambridge, Massachusetts, 1965, and circulated by the G.P.O. in abridged form.

"Cost Factors and Ground Facilities," M.A. Margolis, S.M. Barro and L.B. Early, chapter in Concepts and Procedures of Cost Analysis, edited by J.P. Large, RAND Corporation Memorandum RM-3589PR, June 1963.

"Sensitivity Examination of Alternative Manned Space Plans," M.A. Margolis, et alia, RAND Corporation Memorandum RM-5088 NASA, August 1966.

"The CAIG: In Pursuit of Improved Cost Estimates," M.A. Margolis, Defense Management Journal, January 1975.

"Improving Cost Estimating in the Department of Defense," M.A. Margolis, Concepts: The Journal of Defense Systems Acquisition Management, Spring 1981.

Awards

Meritorious and Distinguished Civilian Service Medals

Presidential Rank Award - Distinguished Executive in the SES 1980

MR. MICHAEL B. DONLEY
ASSTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT & COMPTROLLER)

Mr. Michael B. Donley serves as the Air Force's chief financial officer responsible for providing the financial services necessary for the effective and efficient use and management of Air Force resources.

Mr. Donley was born October 4, 1952, at Hamilton Air Force, California. He earned a Bachelor of Arts degree in 1977 and a master's degree in International Relations in 1978 from the University of Southern California. He completed the program for Senior Executives in National Security at Harvard University in 1987.

He served in the U.S. Army from September 1972 to September 1975, and was assigned to the XVIIIth Airborne Corps and the 5th Special Forces Group. He is a graduate of the U.S. Army's intelligence and parachute schools, and the Defense Language Institute.

In 1978, Mr. Donley was selected to be the first editor of the National Security Record, a monthly publication of the Heritage Foundation.

Before joining the Senate Armed Services Committee, he served as legislative assistant to Sen. Roger Jepsen, for whom he staffed the major Senate debates of 1979-80, including increases in defense spending, selective service registration, and the SALT-II agreements.

From January 1981 to June 1984, Mr. Donley was a professional staff member of the Senate Committee of Armed Services under chairman Sen. John Tower. His oversight responsibilities included overall defense budget analysis, readiness issues, procurement of munitions, the operations and maintenance budget, and other matters related to the preparedness subcommittee.

From June 1984 to December 1987, Mr. Donley was Director of Defense Programs at the National Security Council (NSC). He was the primary staff officer for review of the defense budget and served as NSC observer to the Defense Resources Board. His responsibilities included issues related to general defense policy and management, the Joint Chiefs of Staff and the unified and specified commands. He was an NSC staff liaison to the president's Blue Ribbon Commission on Defense Management, and led interagency review and coordination of presidential directives concerning defense reorganization and national security strategy.

In January 1988, Mr. Donley was appointed deputy executive secretary of the National Security Council and senior director of the White House situation support staff. He was responsible for providing information support to the assistant to the president for national security affairs and the NSC staff, and for coordinating interagency procedures for crisis management. In addition, he supervised the White House situation room, NSC computer systems and emergency planning. He assumed his present position in November 1989.

Mr. Donley is married to the former Gail Ellestad of Palos Verdes, California. They have three daughters: Katie, Cameron and Jacquie.

DONALD J. ATWOOD
DEPUTY SECRETARY OF DEFENSE

Donald J. Atwood was nominated by President Bush to be Deputy Secretary of Defense on January 29, 1989, was confirmed on April 19, 1989, and took the oath of office on April 24, 1989.

Before his nomination to be Deputy Secretary of Defense, Mr. Atwood was Vice Chairman of the Board of General Motors and President, Delco Electronics Corporation and GM Hughes Electronics.

Mr. Atwood was born May 25, 1924, in Haverhill, Massachusetts. He attended the Massachusetts Institute of Technology and was awarded Bachelor's and Master's degrees in Electrical Engineering. While at MIT, he was associated with the research work which pioneered the development of inertial guidance systems. In May 1988, Mr. Atwood received an Honorary Doctor of Engineering Degree from Rose-Hulman Institute of Technology. He served in the U.S. Army from 1943 to 1946.

Mr. Atwood joined General Motors in 1959 as an associate director of the Research and Development Laboratory of the AC Spark Plug Division. In 1961, he became director of the facility. In 1962 he was named Director of Engineering of the AC Spark Plug Division in Milwaukee, Wisconsin. In 1970, when the Detroit Diesel Engine and Allison Divisions were consolidated into the Detroit Diesel Allison Division, Mr. Atwood was named manager of the Indianapolis Operations.

In 1974 he became the first General Manager of GM's new transportation Systems Division, and later that year was named General Manager of the Delco Electronics division. In 1978 Mr. Atwood was named Vice President and General Manager of Detroit Diesel Allison Division. Three years later he was named Vice President and group Executive in Charge of the Electrical Components Group, and in November 1981, he was given responsibility for the worldwide Truck and Bus Group. In 1984 he was named Executive Vice President of the Corporation, and was elevated to the position of Vice Chairman of the Board in 1987.

Mr. Atwood has been active in many civic and industry related organizations. These include: Corporation of the Massachusetts Institute of Technology; the Board of Directors of the Charles Stark Draper Laboratory, Inc.; the National Academy of Engineering; the American Institute of Aeronautics and Astronautics; the Board of Directors of the Michigan Opera Theatre; and the National Executive Board of the Boy Scouts of America.

Mr. Atwood is married to the former Sue Harian, and has two children: Susan Atwood Lavole and Donald J. Atwood III.

DAVID L. McNICOL

Position Deputy Assistant Secretary of Defense For Resource Analysis, Office of the Assistant Secretary of Defense (Program Analysis and Evaluation)

Education B.A., Magna Cum Laude, Harvard University, 1966
M.S., Management, MIT, 1968
Ph.D., Economics/Finance, MIT, 1973

Experience

1982 - 1988 Director, Economic Analysis and Resource Planning Division, OASD(PA&E)

1980 - 1982 Deputy Assistant Administrator, Office of Applied Analysis; Director, Office of Economic Analysis, Energy Information Administration, Department of Energy

1977 - 1979 Senior Economist, Office of the Secretary, Department of the Treasury

1976 Senior Staff Economist, Council of Economic Advisors

1971 - 1975 Assistant Professor of Economics, University of Pennsylvania

Honors, Awards and Special Achievements

DOE Special Service Award, 1982
Presidential Rank Award (Meritorious Executive), 1988
DoD Civilian Distinguished Service Medal, 1989
DoD Civilian Meritorious Service Medal, 1990

Publications

Author of over twenty publications on commodity markets, regulatory economics, energy issues, and economic aspects of the defense program.

DR. JOHN D. MORGAN

Dr. John D. Morgan is Director, Force and Infrastructure Cost Analysis, in the Office of the Secretary of Defense, having joined the OSD staff in December 1979. In this position, he directs studies to estimate defense resource changes associated with force and infrastructure initiatives sponsored by the Assistant Secretary of Defense (Program Analysis & Evaluation). He also directs cost analyses for major weapon systems programs that will be reviewed by the Defense Acquisition Board, leading to approval action by the Secretary of Defense. Dr. Morgan develops and provides guidance to the military services on performance of the operating and support and support acquisition cost analysis functions within DoD.

Dr. Morgan's division is also the staff focal point for Defense Planning and Resources Board, chaired by the Deputy Secretary of Defense. During these reviews decisions are made on the military departments' six-year programs leading to the preparation and submission of their budgets to be included in the President's Annual Budget for the Executive Department.

Prior to joining OSD, Dr. Morgan was a member of the professional staff at the Institute for Defense Analyses. In almost ten years at IDA, Dr. Morgan was project leader on twelve major studies relating to weapon systems acquisition, logistic support, and planning, programming and budgeting systems. Earlier, he served in several positions in the Air Force including Chief, Weapons Systems Program Division, Headquarters Air Force Research and Development Command; chief, Cost Analysis, Headquarters USAF; Special Assistant to the Chief of Staff, SHAPE; and, Deputy Comptroller, Air Force Logistics Command.

Dr. Morgan is a graduate of the University of Kansas, the Columbia University Graduate School of Business, the Harvard Advanced Management Program and the Industrial College of the Armed Forces. He received his PhD in Economics from Georgetown University.

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

EXECUTIVE COMMITTEE

"COST ANALYSIS IN AN UNCEPAIN DEFENSE ENVIRONMENT"

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

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Office of the Assistant Secretary of the Navy (Financial
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Naval Center for Cost Analysis

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U.S. Army Cost & Economic Analysis Center

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Office of the Assistant Secretary of the Air Force
(Cost & Economics)

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

WORKSHOP ABSTRACTS

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

ACQUISITION STRATEGY

WORKSHOP CHAIRPERSON

MAJOR ROBERT T. WEST

Major Robert T. West is Chief, Boosters, Missiles and Munitions Program Division, Air Force Cost Analysis Agency, Crystal City, VA. Major West has spent over 11 years at various levels within the Air Force Acquisition Community. He has a MBA in Finance from Wilkes College and a BS in Biology from King's College, both in Wilkes-Barre, PA. He is married to the former Maureen Gregg. They live in Bowie, MD.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

ASSET REVALUATION POLICIES AND INCENTIVES FOR COST-MINIMIZING BEHAVIOR IN DEFENSE PROCUREMENT

Recent cutbacks in defense spending have caused a wave of asset sales, financial restructuring, and mergers in the defense industry. When analogous events occur among purely commercial firms, adherence to generally accepted accounting principles (GAAP) often results in significant asset write-ups. There is currently an extremely large controversy over what accounting treatment is appropriate for defense firms to follow in similar circumstances when they calculate costs for purposes of pricing government contracts. Defense firms have strongly argued that GAAP ought to be followed; the DoD has argued equally strongly that such a procedure would be unfair, and that a fair policy would either prohibit asset write-ups or require some compensating payment to the DoD. The current version of the regulations was issued in July 1990 and is relatively consistent with the DoD position. The previous version of the regulations was much closer to the industry position. In response to the ensuing outcry over this change, the regulatory authority responsible for issuing regulations in the area, the Cost Accounting Standards Board (CASB), has indicated that it will reconsider the entire issue of asset revaluations in the near future.

This paper applies economic analysis to this policy issue by determining the incentives for cost-minimizing behavior that various alternative rules create. Two cases are considered. For the ongoing firms case, an asset sale can potentially occur between two ongoing firms. For the business combination case, one firm can potentially take over another firm, including all of its assets. In both cases, it is shown that there exists unique asset revaluation rules which induces firms to behave efficiently. Furthermore, a different rule is optimal for each case. These results provide clear policy guidance in an area which is important and in which policy is currently evolving rapidly.

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**FORECASTING DEFENSE BUDGETS IN A NEW WORLD ORDER:
AN ECONOMIC PERSPECTIVE**

During the past two to three years, we have witnessed a sea change in the geo-political balance in the world. The collapse of the Soviet Union and its "empire" into a number of distinct and independent nations, some of which are, as yet, unformed, has dramatically changed the apparent threats to the national security of the US and its allies in both magnitude and kind. The full implications of these still ongoing changes cannot be fully foreseen. For the US Defense Department, the bottom line seems clear enough; very substantial cuts in defense budgets loom on the horizon. But how substantial? And, what factors will influence "the bottom" for declining budgets. This paper approaches these questions, in a quantitative way, from an economic point of view.

In the "New World Order," economic competitiveness will take on increased emphasis. The idea of "national security" is likely to broaden to encompass economic growth and productivity in addition to military strength. The demise of the Soviet Union has left the United States as the only full fledged military and economic superpower. However, both Japan and the emerging "superstate" of the European Community are attaining comparable superpower status economically. Other nations - the Asian "mini-dragons" for example - are also rapidly advancing in economic competitiveness. These developments have potentially profound implications for US Defense Budgets.

This paper presents an analysis of international economic aggregates in order to illustrate differences in (normalized) military expenditures across nations. It will be shown that US military expenditures - absolutely, as a fraction of GNP, and per capita- are substantially greater than in economically comparable nations. The author's thesis is that, for predominately economic reasons, this state of affairs cannot continue. Interpretation of these factors provides a basis for forecasting possible future US defense budgets, under assumptions about the geo-political trends in the New World Order

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**PRESENTING COST DATA IN SOURCE SELECTION PROPOSALS:
WHAT DOES THE GOVERNMENT WANT?**

Government cost analysts write a large number of Additional Information Requests (AIRs) while evaluating source selection cost proposals. The Additional Information Requests often ask for data that was originally requested in Section L: Instructions to Offerors in the Request For Proposals (RFP). It is apparent that Section L: Instructions to Offerors is not fully understood by offerors. This paper offers advice from Naval Air Systems Command (NAVAIR) and Naval Air Warfare Center-Aircraft Division (NAWC-AD) cost analysts to proposal authors. It lists the major reasons AIRs are written. It discusses what cost data NAVAIR and NAWC-AD needs to have and what the cost analysts do with the cost proposals from the day they are received through contract award. NAVAIR is currently working at revising Section L: Instructions to Offerors and this paper will address those changes. A better understanding of the cost evaluation may help offerors write the best possible proposal.

Carol Topp, Carol Friederick and Kimberly Smith
Naval Air Warfare Center-Aircraft Division, Indianapolis
Systems Cost Analysis Division D/270
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Indianapolis, IN 46219-2189

**WE NEED TO CHANGE: RECOMMENDED CHANGES TO THE MAJOR WEAPONS
SYSTEM ACQUISITION PROCESS**

The major weapon system acquisition processes forged during the Cold War may not be practical in today's climate of reduced major power threats and declining defense budgets. The paper presents a historical perspective of the current acquisition procedures. Examples of previously fielded weapon systems are used to illustrate some of the potential problems that can be encountered in a rush to production. The current methods of selection major weapons systems using the Defense Acquisition Board (DAB) process is summarized for those unfamiliar with the current system and to highlight past trends favoring consolidation of early DAB milestones. The role of Cost and Operational Effectiveness Analysis (COEA) at DAB milestone reviews is described in detail with the aim of recommending changes in the treatment of the COEA. Formal introduction of the COEA options prior to the first milestone is recommended. The benefits of building a prototype early in the development phase is examined as a risk reduction step during demonstration validation. The paper shows how incorporating the results of prototype testing performance in future COEA option comparisons limits optimistic performance prediction and possible bias toward a preferred weapon system solution. The resultant recommendation is for a longer RDT&E period within the current DAB milestone structure (about 3500 words, 4 figures)

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SOURCE SELECTION COST EVALUATION PROCESS IMPROVEMENTS

This paper discusses in detail the many changes implemented by the Aeronautical Systems Center (ASC) to make significant improvements to the cost evaluation process in source selections. The improvements were directed at three groups of customers: the source selection authority and the source selection advisory council, the source selection evaluation team, and the offerors. The objectives of these changes are to ensure the government's most probable life cycle cost (MPLCC) estimate reflects the integrated assessment of the entire source selection evaluation team (SSET), to illuminate the MPLCC process to everyone involved, and to help offerors understand the requirements of the cost proposal and give them honest feedback on their proposal efforts.

The improvements range from pre-evaluation activities like tutorials for bidders to show them how to fill out the various cost forms and for SSET members to explain the MPLCC process to post award activities like open and honest debriefings for losing offerors. However, most of these changes have been made to the source selection cost evaluation process itself and include the incorporation and quantification of the most probable schedule risk assessment and of the other panels' evaluations as well as a cost briefing to Area Chiefs after the evaluations have been completed. An explanation of when these changes apply is also given.

In addition, the standard cost briefing charts have been revised not only to more clearly follow the thread of the integrated assessment but also to help illuminate the MPLCC process to the source selection authority and the source selection advisory council. A copy of the revised charts appears in the appendix. Finally, the results of earlier initiatives to improve the process are also discussed. These include cost data collection at level three of the work breakdown structure and the restrictions on requesting certified cost and pricing data.

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THE COST EVALUATION COMMITTEE (CEC)

1. One of the most important results of a good cost analysis is a successful contract award at a reasonable percentage plus or minus the estimated dollars. The final step in this process is the Source Selection Evaluation Board (SSEB) which reviews the proposals from the contractors and recommends a winner to the Source Selection Advisory Council and the Contracting Officer.
2. The SSEB is made up of a technical evaluation group, a Performance Risk Assessment Group (PRAG), and the Cost Evaluation Committee (CEC). The technical evaluation is the most heavily weighted part of the SSEB with the PRAG and the CEC being of less weight. The DOD does not have to choose the low bidder but must choose the best value to the government. This is where the PRAG and the CEC compliment the technical evaluation. Between the technical evaluation, risk assessment, and cost a decision is made.
3. The chairman of the CEC has a difficult task and this paper is about the conduct of a CEC and all that is required to have a successful final report. Many cost analysts get called to participate in CEC and are not familiar with the process. Some cost analysts prepare independent government cost estimates (IGCE) or other cost estimates that support the SSEB process. These cost estimates are almost useless to the CEC if they are not in the proper format and detail. Hours, materials and rates need to be estimated in the CLIN/SUBCLIN format to be of help to the CEC.
4. This paper will outline the CEC report format covering all pertinent topics and the spreadsheet used to help evaluate the costs. Preparation prior to the start of the CEC and procedures for the conduct of the CEC will be addressed. Things to do and not to do will be identified and techniques for evaluation of labor hours, materials, subcontractors, rates and other direct costs will be addressed.
5. You have to award the contract to the best offeror before you can start monitoring his costs and schedule. A successful SSEB and CEC is essential. CEC are an important part of the material acquisition process and the link between estimated dollars and real contract dollars. Knowing how to participate or run a successful CEC is an important part of every cost analysts education and experience.

Albert M. Henkell
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MULTI-YEAR CONTRACTING IN SHIPBUILDING - SAVINGS VS. RISKS

The purpose of this paper is to examine multi-year contracting in a low production/high dollar market such as shipbuilding. The first part of the paper will examine the types of savings that could be achieved with multi-year procurements. The second part of the paper will provide a method for determining termination liability, the cost for which the government is responsible if a multi-year contract is canceled before all the ships are authorized. This cost includes the shipbuilder commitments on terminated hulls and the impact on hulls that are not terminated. In conclusion the savings and risks of multi-year contracting will be compared to annual procurements and annual procurements with options.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

ADP COST ESTIMATING

WORKSHOP CHAIRPERSON

MR. FRED L. ABRAHAM

Mr. Fred L. Abraham is a Supervisory Operations Research Analyst and Chief, Major Systems Cost Branch, Deputy Chief of Staff for Resource Management, HQ United States Army Information Systems Command, Fort Huachuca, Arizona. His office provides MACOM cost validation reviews on Army Information Systems prior to DA/OSD MAISRC; and also serves as the cost and economic analysis matrix support group for The Defense Finance and Accounting Service - Indianapolis Center on Financial Information Systems. Mr. Abraham has been a Department of Army Civilian for twenty-six years with previous assignments in AMC and TRADOC. He has a Bachelor's degree (Statistics) from the University of Mississippi and an M.B.A. (Quantitative Methods) from Loyola University of Chicago. He is a graduate of the Army War College.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

EFFORT AND SCHEDULE ESTIMATING MODELS FOR ADA DEVELOPMENTS

Twenty-one Ada projects were analyzed during a research span of commercial and military applications. They fall into two groups: early, first-time, smaller developments and larger, real time embedded developments. The early Ada projects are mainly smaller avionics, telecommunications, simulation, and information management systems while the larger, embedded projects include command and control, communications, message processing, simulation and training systems. All of the embedded projects are Department of Defense (DoD) developments, with six of the projects being acquired under the auspices of the Electronic Systems Division (ESD) of the U.S. Air Force.

Linear and nonlinear regression techniques were employed to fit the data to basic effort-estimating models. An intermediate effort model that takes into account development environment and personnel factors was analyzed to determine if modeling errors could be reduced. Several statistical measures of goodness of fit were analyzed to evaluate the various model forms that were developed. We also calibrated schedule-estimating models to the project data for predicting the duration of Ada software developments. Analysis of the schedule data supported the traditional theory that project duration is a nonlinear function of the software development effort.

An additional finding was that the prediction errors resulting from the calibrated effort and schedule equations were highly correlated. An investigation of a schedule-estimating model incorporating software size as the independent variable resulted in a calibrated schedule equation with only a slight increase in model error over the traditional schedule equation.

This paper compares the effort and schedule equations calibrated for the early Ada developments with those for the larger, embedded developments. Comparisons of the models for Ada developments are made to models that have been developed for non-Ada developments. The paper proposes a methodology for bounding the prediction errors and recommends an approach for developing an estimate range for development effort and schedule.

Barbara E. Wolfinger
Robert J. Giallombardo
The MITRE Corporation
Bedford, Massachusetts 01730
617-271-7319

BUSINESS CASE ANALYSIS FOR MANAGEMENT DECISION-MAKING

This paper discusses the use of Business Case Analysis (BCA) for improving performance and reducing costs of the functions, information systems, and organizations of the Department of Defense (DoD). It introduces a BCA conceptual framework, defines three BCA subtypes--Functional Economic Analysis (FEA), Systems Economic Analysis (SEA), and Organizational Economic Analysis (OEA)--plus four compound subtypes, and discusses their applicability. It cites an FEA reference methodology developed in a prototype FEA project for a DoD contract payment function, and indicates a need for developing SEA and OEA reference methodologies. It suggests a need for integrating the reference methodologies into a unified BCA approach, and indicates a need to develop "diagnostic" techniques for tailoring the BCA approach. Finally, it summarizes the major conclusions and recommendations. Other chapters in this book contain detailed summaries of the FEA reference methodology and the prototype FEA for contract payment, respectively.

James L. Raney, Ph.D.
Center for Information Management
Defense Information Systems Agency
(703) 285-5377

AUTOMATED INFORMATION SYSTEM COST BENEFIT EVALUATION

This paper presents a method for calculating the benefit to cost and benefit to investment economic indicators for automated information systems (AISs). These indicators are developed from an analysis of the estimated life cycle costs and benefits of a notional AIS and the status quo baseline. The life cycle cost estimates of the AIS and status quo are delineated by cost element in constant and present value dollars. The costs in present value dollars of the AIS are subtracted from the status quo in order to generate cost reductions (benefits) and cost increases.

Equations for calculating the benefit to cost and benefit to investment for the notional AIS are developed. The impact of functional benefits which are external to the AIS life cycle cost is considered. The sensitivity of the economic indicators to variation in AIS cost parameters is presented.

This methodology is currently in use at the Program Executive Office for Standard Army Information Systems (PEO STAMIS). The application of this methodology to the calculation of the economic indicators for the Corps/Theater ADP Service Center II (CTASC-II) economic analysis is included in this paper.

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ARMY AUTOMATION ECONOMIC ANALYSIS MODELING

This abstract is being submitted for consideration for presentation of an automation economic analysis model and accompanying paper to the 26th Annual DoD Cost and Economic Analysis Symposium. Both authors are currently working on automation Economic Analyses (EA) from the ISSC location at Building 1465, Fort Belvoir, VA 22060 (phone (703) 806-3265). They both have extensive experience in operations research, cost and simulation modeling, systems analysis and software engineering.

This model is intended to support Army hardware and software development and fielding Project Managers (PM). It specifically targets those PMs with the requirement to present formal economic analysis to the Army's Major Automated Information System Review Council (MAISRC). This is an improved version of the ISSC model that has been used successfully in the past for major automation projects. The improvements are quite extensive and merit a fresh review. This latest version provides rapid development and printing of the traditionally cumbersome EAs. It allows sensitivity analysis, affordability studies and excursionary analysis that were previously too time consuming for typical analysis.

The model provides output in accordance with the applicable Army Regulations and Letters of Instruction concerning EAs. It utilizes approximately 50 LOTUS 1-2-3 Version 3.1 spreadsheets electronically linked to provide a hierarchical analysis, calculation, compilation and output of data. The model automatically calculates Inflation Factor, Discount Factors, Present Value and Net Present Value. The projected data is input in constant dollars as set by the model operator. Sunk cost is input as current dollars. Alternatives are compared against a baseline status quo cost estimate.

This briefing will acquaint the DoD cost analysis community with a powerful and proven tool for Army MAISRC format economic analysis development and presentation.

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GROWTH OF A COST REDUCTION PROGRAM

Project costs often grow between the initial cost estimates and the actual project implementation. In like manner, studies also have a tendency to grow. In this paper, we will provide those reasons why one such study grew in order to properly answer those questions which originally prompted the study.

Currently the Army uses paper microfiche, and magnetic media for certain types of data storage and retrieval. As these systems are not state-of-the-art, they are inadequate and expensive to operate. The Army has some experience in the use of Compact Disk Read Only Memory (CD-ROM) which indicates that CD-ROM is superior to the current system. What is unclear is if the investment costs can be recouped from actual monetary savings realized by using CD-ROM.

A preliminary evaluation indicated that it would be viable to replace microfiche with CD-ROM in order to provide catalog data. Based on this evaluation, a proposal to change to CD-ROM was provided to the Operating and Support Cost Reduction (OSCR) General Officer Steering Committee (GOSC). The GOSC directed us to conduct an analysis of replacing microfiche at the Unit Level Logistics System (ULLS) with CD-ROM.

As the analysis evolved, it became apparent that the original scope was too narrow and that significant cost savings could be realized by expanding the scope to cover all systems using catalog data. This meant analyzing the replacement of magnetic tapes as well as microfiche, and estimating the costs, savings, and benefits resulting from the extensive reprogramming of all affected systems.

During the conduct of the study, it became apparent that the CD-ROM readers would also be available for making software changes. This change was incorporated into the study and generated an additional \$11 million in savings.

The full program requires 25,000 CD-ROM readers at a cost of \$11 million. The total savings realized is approximately \$81 million.

Expansion of the limited scope of the original study has resulted in a significant increase in total savings.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

AFFORDABILITY

WORKSHOP CHAIRPERSON

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Mr. Corey is an Operations Research Analyst, Cost Estimating & Analysis Division, Naval Sea Systems Command, Washington, D. C. Mr. Corey graduated from Loyola College, Baltimore, with a BS in Economics in 1970. He has held a variety of financial positions in the Army and Navy, including being a budget officer in Army hospitals, and a cost analyst for the A-76 Commercial Activities Programs, an economist with the Naval Education and Training Command, and a cost estimator with both the Naval Air Systems and Sea Systems Commands.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

AFFORDABILITY ANALYSIS AS A MANAGEMENT TOOL

The trend in EMD contracts has shifted over recent years from firm fixed price to cost plus. To help insure that a program remains affordable into production, an annual affordability analysis can be developed with the contractor. This process begins with the first submittal included as part of the source selection cost proposal with annual updates thereafter. The focus of the Affordability Analysis is on both EMD and Production as well as O&S goals. The decisions and trade-offs made during EMD are linked, analyzed and evaluated for the full impact on production. It is a living document, submitted to the government annually, and provides a vehicle for not only tracking changes to the program but more importantly the steps that will be taken to achieve an affordable weapons system.

This paper will focus on how the Affordability Analysis process is implemented, examine how it can be used as a management tool to help control cost, and discuss how the contractor is measured against his proposal prediction. Affordability Analysis is presented as a vehicle that will identify high leverage cost reduction areas, document cost reduction initiatives, and track programmatic changes impacting cost.

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**SURFACE COMBATANT AFFORDABILITY GOALS:
FROM FORCE LEVELS TO ENGINEERING**

Affordability has been defined in many ways and at vastly different system levels. For long term planning for the Aegis program, a set of affordability goals has been defined for surface combatants. These goal sets were constructed at the Navy budgeting levels, the force structure level, the battle group level, the individual ship level and the engineering level and they are all interconnected. The purpose of having the different levels is that each has its utility. Ship programs are obviously constrained by budgets; affordability is most applicable at the force structure level; battle groups and ships are the level at which effectiveness studies are conducted; ships are the programmatic level; and the engineering level is where concept and design trade-off are done. This paper presents a methodology and quantitative affordability goals for surface combatants. We believe this can be expanded and utilized for many other systems as well.

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**STANDARDIZING COST BENEFITS ANALYSIS FOR THE
MANTECH PROGRAM - THE NAVY'S APPROACH**

Cost benefits determination has been part of the Navy's Manufacturing Program since its inception as part of the requirement for determining the priority of projects worth funding as well as the cost savings resulting from the technologies' applications.

The determination of cost savings/benefits following the actual production implementation of the technology for DOD and USN weapons systems and ship construction became a standardized process by mid-year in 1984. Since that time the process (cost savings verification analysis) has been refined and improved upon to reflect lessons learned. Cost savings verification has become routine and provides a benchmark for potential users to avoid the pitfalls of accepting "soft" data as supporting back-up. The Navy's approach has passed rigorous GAO and comptroller scrutiny at a time when questions of "costs" and "return on investments" (ROI) have become standard vocabulary. This paper will provide examples of the process and illustrate the importance of providing a paper trail.

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AFFORDABILITY ANALYSES FOR DAB REVIEWS

In February 1991, DoD leadership signed DODD 5000.1 and DODI 5000.2 which require affordability assessments for programs undergoing DAB reviews. The requirement for affordability assessments is a new requirement in the acquisition process, and the concept is subjective enough that there is some debate regarding what is required and what kinds of questions should be asked and answered. This paper will discuss the need for affordability assessments, what kinds of questions should be asked and answered, and kinds of assessments the Office of the Secretary of Defense has done to date.

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LONG-RANGE INVESTMENT PLANNING SYSTEMS IN THE OFFICE OF THE SECRETARY OF DEFENSE

Several recent developments have led to a need for a more systematic approach to long-range investment planning in the Office of the Secretary of Defense. The 1989 Defense Management Report (DMR) to the President called for the formulation of a 20-year "investment roadmap" to guide the investment planning process and support Defense Acquisition Board (DAB) reviews. Subsequently, the primary documents that govern the acquisition process, DODD 5000.1 and DODI 5000.2, expanded on this concept with more specific direction as to what long-range investment planning should entail. Responding to these and other imperatives the Office of the Secretary of Defense (Acquisition and Program Analysis & Evaluation) and the Joint Staff joined forces beginning in 1991 to develop a long-range projection for the Department to support investment planning as well as other areas of long-term concern. The Office of the Under Secretary for Acquisition has continued to develop computer-assisted techniques for maintaining long-range investment plans. These plans must be formulated in sufficient detail to support affordability analyses of individual major acquisition programs and assessments of specific investment areas, but they also must be complete fiscal and programmatic projections so that the investment plan can be related to the entire defense program. This paper will discuss the context for long-range investment planning in the DoD and outline specific approaches and techniques that have been successfully applied to achieving effective long-range investment planning in the Office of the Secretary of Defense.

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**THE EFFECT OF SERVICE LIFE EXTENSION PROGRAMS
ON FOREIGN MILITARY SALES**

A recurring question in fleet management is when to extend the service lives of aging trucks. This paper will specifically examine the cost repercussions of Service Life Extension programs as applied to trucks intended for Foreign Military Sale.

Since the value of a vehicle on the foreign market is an indicator of its potential value to the Army, this paper can also be thought of as a study of the balance Service Life Extension expenses and the increased readiness of the truck fleet.

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BEYOND COST ANALYSIS

In the evaluation of proposals for weapons systems, physical facilities, computer systems and software, manufacturing equipment, and every other sort of asset, a basic concern is the quantity of resources required to provide that asset. Of even greater importance, however, is what that asset will provide; that is, the benefits of acquisition.

A depot automated storage and retrieval system (ASRS) is of no value in itself. The value lies in what the ASRS does for the depot. How many items of what sizes will it store? How quickly will a particular spare part be retrieved? What will be the accuracy of the inventory records?

Historically, economic analyses have included extensive, sophisticated cost analysis -- but have drastically short-changed the decision maker with respect to providing quantitative information as to what he/she will get for the resource expenditure.

The paper will use the complete economic analysis process to demonstrate why the analyst must provide identification and quantification of program/project benefits in addition to total resource requirements -- and how these benefits are of utmost importance to the decision maker. Establishment of value for specific levels of individual benefits will be demonstrated through the use of worth functions. Relative ranking, adjective rating, and weighted point rating will be used for benefit aggregation and corresponding relationship with cost.

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**A LONG TERM FORCE PLANNING PROCESS-
RESOURCE CONSTRAINTS AND FORCE
STRUCTURES DEVELOPMENT**

Two years ago the Naval Surface Warfare Center/Dahlgren Division initiated a process to define requirements for promising technologies and combat system concepts for surface ships. The requirements generation led to a process identifying new ship concepts and looking out 40 years, the time frame of full utilization of potential technologies. In order to evaluate the ship concepts, a top down methodology has been created. This paper describes the resource constraints and force level derivation part of that process.

The methodology is predicated on the notion that one can identify time-phased alternative futures and can evaluate concepts based on their flexibility and value across the alternative conditions. To this end, a set of geopolitical futures has been developed along with time-phased and consistent geo-economic futures for the U.S. These futures define the resource streams available to the U.S., the Department of Defense, the Navy, and Surface Warfare, which in turn constrained the procurement of forces. This methodology and example data are described herein.

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ARMY HORSEBLANKET REVIEW PROCESS

Over many years, the horseblanket (HB) review process has proven to be an effective mangement tool to surface and resolve programmatic issues in the Army's major weapon and automated information systems. The detailed comparison of selected Life Cycle Cost Requirements (in the Army Cost Position) to funds programmed and budgeted has surfaced many inconsistencies which could have caused significant resource shortfalls and operational problems for Army field commanders.

The actual implementation of the HB and its documentation; however, has shown some systemic problems which need correction to attain full benefit from the time and effort involved.

This paper will describe the HB process from an "in-the-trenches" viewpoint, highlight the use of effective and current data bases for presentation, and show an example of the final product. Problems encountered and transfer of Army knowledge to may be applicable to other DoD agencies.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

CONTRACTOR COST DATA ANALYSIS

WORKSHOP CHAIRPERSON

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Mr. Cardarelli is currently assigned as a section supervisor in NAVAIR's Cost Analysis Division (AIR-524) with responsibility for Avionics. His educational background is a BA and MBA from the State University of New York at Buffalo with fifteen (15) years experience in DOD cost analysis. Mr. Cardarelli's task assignments and analysis support during that time period have covered a range of activities from weapons system platforms (SH-60B and F, and SH-2F) to a myriad of sub-system programs (eg., radios, radars, sonobuoy receivers, etc.).

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

SERVICE CONTRACT COST PROJECTION SYSTEM (SCCPS)

White Sands Missile Range (WSMR) uses several cost-plus service contracts to support its testing mission. The largest of these contracts totals approximately \$90 million. A portion of these contracts are funded by range customers while the remainder is paid from WSMR's annual budget. In order to manage costs to budget and to maintain reasonable test costs, there is a need to closely manage these contracts' costs.

Contract managers receive a tabular Contractor's Cost Performance Report which provides data, but does not visually display information consisting of trends; past, present, or projected. SCCPS was derived from a program for production contracts called CAPPs, Contract Appraisal System, to serve as an information tool tailored for service contracts.

SCCPS provides the following services and information to users:

1. An overview of the contract's to date and projected cost status.
2. Graphical comparison of actual and projected costs to a user provided plan.
3. Contract projections based on cumulative, last three, and last one month's costs.
4. Management at various levels of the contract. For example, total contract cost or at a more detailed level such as vehicle insurance or materials.
5. Forewarns the WSMR COR to determine whether customers or WSMR would be funding contract cost growths. If customers aren't and WSMR does not have additional funding, the COR can initiate action to slow projected spending.
6. A tool for insight on contract costs rather than just "checking the bottom line."

SCCPS is a valuable tool used to manage WSMR's service contract costs and can also be used throughout DoD to improve service contract cost management.

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COST PERFORMANCE INDEX STABILITY -- FACT OR FICTION

This study examines the stability of the Cost Performance Index (CPI). The CPI is an indicator of the cost performance efficiency achieved on a contract and is used to analyze cost performance on defense contracts. It has long been asserted that the index does not change by more than 10 percent after a contract is 50 percent complete, but an exhaustive literature search did not locate any empirical work that supports this assertion. Knowing that the CPI is stable is important because it indicates that a contractor has a healthy management system, it increases the reliability we place in the contractor's planning process, it gives us confidence in our Estimate at Completion computations, and if a contractor is overrunning his budget, it gives us confidence when we declare the contractor in trouble.

After defining CPI stability two methods to test for stability were developed. The two methods chosen were: first, to measure the range of the CPIs that occurred at greater than 50 percent complete and second, to calculate a percentage interval and verify that the CPI falls within the bounds of this interval. The results of both methods show that the CPI is stable after a contract is 50 percent complete.

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ESTIMATE AT COMPLETION (EAC) ACCURACY MEASUREMENT

Recent experience with the US Navy's A-12 program underscores the importance of developing highly accurate estimates of the final cost of a contract. Also, the shrinking defense budget coupled with the down-sizing of the Army will require development of more accurate estimates of the costs of completing ongoing contracts.

This study examines in detail the nine different methods that are currently used by USAMICOM to estimate final contract cost (EAC). All methods are based on a two dimensional linear cost model. Monthly cost performance reports (CPRs) provide data for the model primarily in the form of actual cost of work performed (ACWP) and budgeted cost of work performed (BCWP). There is no empirical evidence to suggest that any one method is more accurate than the others.

In this research effort several contracts that were either complete or nearing completion were randomly selected. Data from the sample contracts were then used to derive EACs associated with each of the nine methods. These EACs were computed at various months throughout each contract's life cycle. The EACs were then compared against actual final contract costs to determine which methods were more accurate.

The accuracy comparisons have been entered into a database which contains not only these results, but also other pertinent contract parameters such as type (i.e. production or research) and at what stage (i.e. early, mid, or late) of the contract lifecycle each of the EACs were generated.

Analysis of the database provides the basis for ranking the methods in order of accuracy. Also, the analysis determines which methods are best for either production or research contracts. Finally, the analysis determines which methods provide the best accuracy at various times in the contract lifecycle.

The study concludes with an exploration of possible new methods of deriving the EAC. New methods discussed include development of a three dimensional model and increased use of the schedule performance index (SPI) factor.

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PERFORMANCE ANALYZER WORKSHOP

Performance Analyzer (PA) is an OSD approved software package used to analyze contractor performance data. PA accepts data from contract Cost Performance Reports (CPRs) and Cost/Schedule Status Reports (C/SSRs) are required on high dollar value on high risk contracts as defined in the newly revised acquisition regulations, DoD 5000.1, 5000.2 and 5000.2M. These regulations firmly require the use of Earned Value (EV) principles and practices for compiling and reporting contractor performance status and trends as well as estimated contract cost at completion. When properly applied EV can reliably tell where a problem is, how much it is costing in time and dollars, and how much a contract is predicted to cost at completion.

PA is a tool that analysts and managers can use to automate the monthly assessment of performance status and trends. PA produces a variety of graphs and reports which display current contract status, cost and schedule trends and forecasts of contract cost at completion.

This workshop will describe the type of data available from CPRs and C/SSRs, discuss the forecasting techniques utilized by PA and present an overview of PA capabilities. Most importantly the workshop will highlight the role of the analyst and the PM in evaluating and interpreting this critical data.

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DEVELOPING A USABLE WORK BREAKDOWN STRUCTURE

The work breakdown structure (WBS) is the framework used within the U.S. Department of Defense to manage the acquisition and collection of costs for major weapon systems. MILITARY STANDARD 881A (MIL-STD-881A), April 1975, currently defines the WBS elements to be used for all major weapon systems acquisitions. Since the time of the 1975 revision of the MIL-STD-881, many changes have taken place in the technologies and process used in military weapon system design and production. In 1985 Air Force Systems command (AFSC), as the Executive Agent for the MIL-STD-881A, and the Office of the Secretary of Defense (OSD/PA&E), initiated a complete revision of the document to ensure the WBS is in step with these changes. The results of these revisions is MIL-STD-881B to be issued during the summer 1992.

Included in the revision of the MIL-STD, for the first time, is a User's Guide. This guide provides a detailed set of instructions on how to develop a work breakdown structure and when to use it. With the MIL-STD revision many companies of DoD components are recognizing the need for and critical nature of a good work breakdown structure. Cost visibility and program planning cannot be properly addressed if these structures are inappropriately developed. Without a good work breakdown structure, major acquisitions could be delayed until the structure is accurately defined. The presentation will focus on how a work breakdown structure should be developed using MIL-STD-881B as a guide; the approaches to be taken when using multiple structures; the prime/subcontract relationship; the application of software work breakdown structure elements; and the use of the WBS for cost reporting and evaluation.

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**U.S. ARMY COST AND ECONOMIC ANALYSIS CENTER
ACQUISITION COST INFORMATION ARCHITECTURE**

The U.S. Army Cost and Economic Analysis Center (USACEAC) in cooperation with its' cost research contractors has developed a common data base architecture for collecting, storing, accessing and displaying Cost Data for major acquisition programs. This data base currently includes common structures for Aircraft (rotary wing), Missiles, Wheel and Tracked Combat Vehicles (WTCV), Communication and Electronic systems with future plans for including Information Management Systems and Force Cost information. The cost data may be derived from either Contract Cost Data Reports (CCDRs), Contract Performance Reports (CPRs), Contracts, or other sources of financial records.

There are several advantages of a common structure. One advantage is this structure allows the results of hours of data collection and analysis (mapping and normalization) to be saved and shared with other users. The data analysis, mapping and normalization are performed in a standard manner and can be reviewed for accuracy and improved over time. Another advantage is that a cost analyst working in one area such as Missiles can move to a job in Communications & Electronics and not have to learn a new data base program. Analyst can have ready access to the data in another functional area.

One guiding principle of the data base development was that any cost can be tracked back to the original hard copy or Microfiche document within 24 hours, this includes the inflation normalization.

The architecture and the specific data bases have been demonstrated and tested at the major Army sub-commands. Many enhancements have been made as a result of these field beta tests.

The Aircraft, Missile, and WTCV data bases are populated and operational. The Communications and Electronics data base has been demonstrated with a small subset of old data. The C-E data base is expected to be ready for beta testing at CECOM in early summer and is expected to be operational by June 1992.

The presentation will contain a PC based demonstration of the reports and features of the Information Architecture. The data base contains proprietary information which is releasable to government organizations with the proper certifications.

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STRATEGIC AND TACTICAL MISSILE AND SENSOR DATABASE

This paper will discuss and update to our existing strategic and tactical missile database currently being implemented at the command. It is a very efficient database which uses Librarian software for query and management. It has also been translated into Foxpro database software.

It uses a multi-media software and hardware base. Text, videos, documents, and abstracts are stored on 12" laser disc and read directly by the software for access, viewing, printing, etc. A camera system is also part of the database, which allows the office to put whatever documents they want into the database through a simple camera shot onto the laser disc.

Both hardware, software, and an integrated example will be explained in the paper and subsequent presentation.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

COST & OPERATIONAL EFFECTIVENESS ANALYSIS

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"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

AGGREGATE ANALYSIS

A recent Army study showed that almost \$800,000 in personnel costs could be saved by eliminating an on-going program. The truth of the matter is that the time that accumulated to \$800,000 was expended in five and ten minute increments by hundreds of people at scores of installations. Not one single person spent enough time on the program to be eliminated. Consequently, elimination of the program would not save a single penny in personnel costs. This same study showed that a large savings would be realized in equipment costs if the program was eliminated. All of the equipment was on hand, had been procured for other purposes, and would continue to be used at practically the same rate even if the program was canceled. Again, no savings. In another study, the use of simulators was expected to reduce operating hours on the major end item, in this case a helicopter. In actual practice, commanders put experienced pilots in the simulators and let their less experienced pilots fly the helicopter the additional time provided by the other pilots. The net result was no savings in OPTEMPO, no break-even point for the simulators, but better trained pilots which further study might have shown provided long term savings in reduced peacetime attrition of the helicopters. The term, aggregate analysis, applies to doing this type of research; that is, examining the aggregated numbers to see their real composition, application, or roll-up, rather than determining a savings which won't happen in reality. This paper will describe the aggregate analysis process in detail, using other study examples.

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**A MOST EFFECTIVE WAY OF GENERATING AND MANAGING A
COST AND OPERATIONAL EFFECTIVENESS ANALYSIS**

With the advent of DODD 5000.2 and the downsizing of the DoD acquisition budget, the requirement for generating a credible Cost and Operational Effectiveness Analysis (COEA) at Milestones I, II and III is much more important than it was in former years. In addition, OSD is emphasizing that the COEA should be the systematic basis for evaluating an alternative rather than merely justifying an alternative that has already been selected.

This paper will describe a systems approach to the process of evaluating proposed alternatives and will illustrate this evaluation process with an appropriate defense example. It will emphasize the various generic models which should be used in generating a COEA, and how a COEA differs when proceeding from Milestone I to II to III.

Finally, it will describe how to properly manage both the COEA and the Concept Exploration work process; who are the players contributing to both efforts; what experience and data each player contributes; and why the management of both efforts should be coordinated for best effectiveness of results and efficiency of resources.

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COEA USE IN LX ANALYSIS

This presentation outlines the methodology used to develop cost inputs to the Cost and Operational Effectiveness Analysis (COEA) required for the LX Program's Milestone I decision. The LX is the next generation of amphibious assault ship. The presentation begins with a brief description of COEAs and their controlling DOD instructions. Following that, the LX program background is briefly outlined; with emphasis on troop and equipment lift requirements, current amphibious ships assets, program status, and a summary of the competing alternatives. The costing methodology is discussed in depth, covering developments, formatting, and utilization of the costs. Special emphasis is placed on the working relationship between the Naval Sea Systems Command (NAVSEA), and the Center for Naval Analyses (CNA). NAVSEA was responsible for the bulk of the cost estimates; with CNA responsible for integrating all the cost inputs into the study's optimization analyses. Lessons learned are also discussed.

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**COST/BENEFIT ANALYSIS OF THE AH-64 (APACHE) HELICOPTER
AUTOMATED TEST EQUIPMENT (ATE)**

A cost/benefit analysis was conducted to evaluate the Automated Test Equipment (ATE) requirements to provide fault detection capability for electronic components for the support of the AH-64 Apache helicopter. The Apache currently uses a dedicated Electronic Equipment Test Facility (EETF) to provide this capability. It is Army policy, however, that the Integrated Family of Test Equipment (IFTE) be the standard ATE for providing this capability.

A life cycle cost analysis was conducted in which alternatives were compared over a 20-year time frame. The analysis compares the costs, benefits and feasibility of continuing to use EETF versus various options for transitioning to IFTE in support of Apache. In summary, the life cycle costs for EETF are significantly less than IFTE. While the sustainment costs for IFTE are less than EETF, they do not offset the higher IFTE acquisition costs. Moreover, based on sensitivity analyses, the ranking of alternatives is unaffected by assumptions concerning the fielding schedule, life cycle period, peacetime quantity requirements, dedicated vs. shared ATE support, replacement of non-tactical EETF's, retention of Apache peculiar equipment and inflation and discounting. In every case, retaining the EETF and continuing with the current computer upgrade being implemented is the least costly alternative. Sensitivity analyses comparing the costs of buying ATE in sufficient quantities to meet wartime requirements, however, show IFTE being competitive or even less costly than EETF.

Transitioning to IFTE is feasible and there are benefits and advantages to doing so. IFTE with the S-280 shelter provides multi-system support; better transportability; nuclear, biological and chemical protection; technological advancements and enhanced user friendliness. However, there is limited space in the S-280 shelter for the electro-optics bench, Apache peculiar equipment and the test program sets and interconnecting devices needed for Apache. Disruption of the current maintenance support structure caused by pulling EETFs out of the field in order to install the IFTE base shop test station into the vans would be a major disadvantage.

In conclusion, the EETF with the computer upgrade is the least cost approach for the peacetime support of Apache. However, if Army policy were ever changed to buy ATE to wartime requirements, then IFTE would be the preferred alternative.

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**COST AND EFFECTIVENESS IN NON-WEAPON SYSTEMS:
AN EFFECTIVENESS ANALYSIS METHODOLOGY**

Increased emphasis on Cost and Operational Effectiveness Analysis (COEA) within DoD has stirred efforts to improve evaluation techniques in both area. While many of these efforts have been pursued independently, at some point in time, the two components must come together for a COEA to be successful. Analysts working on the effectiveness side have been able to get relatively clear picture of what the cost analysis will address, based on long-standing, pre-established standards within the cost community. On the other hand, the cost analyst has not had a similar opportunity to gain insight into the effectiveness analysis. Without this understanding, there is significant risk that important cost driving elements may be overlooked or misunderstood, and incorrect overall assessments may be made.

The problem of understanding effectiveness is particularly acute for non-weapon systems, such C³ systems. For these systems, the wartime impact is particularly obscure, and as a result, traditional campaign model-based effectiveness analyses are unlikely to be available.

This paper presents a methodology for conducting the effectiveness analysis for non-weapon systems, along with a view of how cost and effectiveness analyses can interact. The methodology explicitly defines the links between measures of performance and the program mission needs, functional objectives and, ultimately, measures of effectiveness. Since cost can also be linked to performance, this methodology allows a direct mapping to both cost and effectiveness through this performance expectations. The methods presented here draw on the available base of informal knowledge and experience of experts and synthesize an unbiased assessment to allow for rank ordering of the alternatives in the absence of validated higher level models.

The COEA developed for the DoD National Airspace System is used to highlight aspects of methodology and the cost interactions.

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AN EXAMINATION OF CASH FLOW DISCOUNTING IN GOVERNMENT PRESENT VALUE ANALYSES

Due to the continued growth of the federal deficit, increased pressure has been placed on the U.S. economy. Such pressure has contributed to slow economic growth, a poor balance of trade, and fewer jobs. As a result of this immense burden, currently in excess of one trillion dollars, spending by federal agencies is being heavily scrutinized. In particular, Department of Defense (DoD) budgets are being examined closely by Congress especially as the military threat to the U.S. declines.

Given the increased importance of prudent fiscal management, it is imperative that the processes involved in analyzing federal programs requiring funding are sound. For this reason, this paper examines the procedures inherent in present value analysis, an increasingly common tool used to evaluate programs / projects competing for scarce budget dollars. In DoD, present value analysis is an integral part of Cost and Operational Effectiveness Analyses (COEAs) required by DoD as part of the program milestone decision making process.

The emphasis of this analysis is on assessing the reasonableness of the discount factor currently mandated by the Office of Management and Budget (OMB) for use in all present value analyses including those performed in COEAs. After examining the theoretical underpinnings of the current rate, this paper formulates an alternative rate which better represents the opportunity cost of government funds. Finally, the paper evaluates the effects of the proposed rate vice the current rate on resource allocation decisions.

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**DECISION COSTS FOR COEAs:
PAYBACK ANALYSIS USED IN ARMY COEAs**

This study presents the concept of using payback analysis in decision costing. It discusses payback analysis related to projected resource trade-offs and presents an analytical tool based on a PC spreadsheet methodology which is useful in structuring payback analyses in a variety of study applications. Examples of the use of the methodology in current army studies are presented for consideration.

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**COST BENEFIT ANALYSIS IN A COLLABORATIVE EQUIPMENT PROGRAM:
A UK PERSPECTIVE**

Affordability is the watchword. Today's budgetary pressures on defense programs have led to increased emphasis on value for money in the determination of acquisition strategies and collaborative programs have come to the forefront of procurement policy.

Cost benefit analysis, in a variety of forms, has always been an important feature in determining the most efficient and effective strategies but in today's environment it has a much higher priority in the decision making process. Collaboration on equipment procurement is only a means to an end and the analysis still needs to be performed.

The issues of costs versus benefits are rarely straightforward. With collaborative projects the complexity increases as many additional and some quite unique features need to be addressed. Within the US/UK Surface Ship Torpedo Defense Joint Project the aim is to make the maximum possible use of each others efforts; to agree on a common costing baseline; ensure fiscal reality in the budget cycles; and ease the path through the approval processes.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

DEFENSE BUSINESS OPERATING FUND (DBOF) ISSUES

WORKSHOP CHAIRPERSON

MAJOR PAUL G. HOUGH

Maj Paul G. Hough has been deeply involved with Air Force implementation of Unit Cost Resourcing and the Defense Business Operations Fund for the past two years. Although he began working this program while assigned to the Air Force Cost Analysis Agency, he was recently transferred to the Assistant Secretary of the Air Force for Financial Management, Director of Budget Programs. Maj Hough's responsibilities as a headquarter's budget analyst include teaching the concepts and practices of unit cost resourcing to financial and functional managers throughout the Air Force.

Prior assignments in cost analysis include Research Fellow at the RAND Corporation (Santa Monica, CA); Chief of Command Support and Economic Analysis at HQ Tactical Air Command (Langley AFB, VA); Chief of Cost and Management Analysis at the 56th TTW (MacDill AFB, FL); and Weapon Systems Cost Analyst at ASD/YYPa (Wright-Patterson AFB, OH).

Maj Hough is a graduate of the USAF Academy, and has a M.S. from the University of Wisconsin and a M.P.A. from Golden Gate University. He is a Certified Cost Estimator/Analyst, and is currently working on his Ph.D. in Public Policy at George Mason University.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

BUSINESS MANAGER CONCEPT

- I. CONCEPT**
 - * Business managers assigned to each unit cost output
 - * Implemented in March 1992
- II. ASSIGNMENTS**
 - * One manager for each of our eight cost outputs
 - * One manager for general and administrative costs
- III. RESPONSIBILITIES**
 - * Set goals within assigned output - submit to director for approval
 - * Develop plan to accomplish goal
 - * Review efficiency of current processes
 - * Recommend and implement changes to lower unit cost
- IV. DUTIES**
 - * Study ways to reduce unit costs through process improvements
 - * Be involved in planning for travel, training and procurement
 - * Ensure labor is efficiently utilized
 - * Review and help solve policy problems
 - * Utilize total quality management concept
 - * Regularly review costs assigned to the output
- V. IMPLEMENTATION**
 - * Business charters and certificates have been distributed
 - * Performance standards have been added to the business manager's critical elements
 - * Specific tasks were assigned to business managers
- VI. BENEFITS**
 - * Planning and oversight within each output
 - * Major cost savings improvements
 - * Most efficient use of resources
 - * Automation or improvement of processes
- VII. STATUS OF EFFORT**
 - * Current climate
 - * Lessons learned

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**IMPLEMENTING THE DEFENSE BUSINESS OPERATIONS FUND:
THE CASE OF THE MILITARY AIRLIFT COMMAND**

The DoD Comptroller is replacing the Military Departments' industrial and stock funds with a single Defense Business Operations Fund (DBOF). DBOF is designed to raise cost-consciousness by developing operating budgets for defined business areas, by including more costs in customer prices, and by monitoring efficiency and spending much more closely. However, some organizations have had problems in defining unrelated business areas, in developing workload measures that are indicative of the business areas' outputs, and in translating unit costs into prices, budgets, and efficiency. We believe that organizations that have highly interrelated operating areas and overlapping workloads experience difficulty in implementing DBOF. Using the Military Airlift Command as a case study, we develop an improved methodology for overcoming these difficulties.

- o *Composite Business Area:* Employ correlation analysis of workloads to cluster highly related operating areas into a business area.
- o *Comprehensive Workload Measurement:* Apply principal component analysis to develop a composite workload index for the composite business area.
- o *Budgets and Efficiency:* Use regression analysis to derive operating budgets and demonstrate unit-cost efficiency for each composite business area.
- o *Pricing:* Apply cost-allocating methods to price individual services in the multi-service business area.

Specific approaches are developed for each of these areas to facilitate DBOF implementation.

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REVOLVING FUND MODEL (REVOLVER)

A reduction in the defense budget has begun to impact heavily on force levels and mix as well as mission requirements. In an atmosphere of diminishing budget dollars and a radically redefined force structure, it is imperative that resource managers have the appropriate analytical tools at their disposal to perform quick and accurate "what-if" analysis of the resource implications of alternatives.

The Program Management Systems Development Agency (PMSDA), a Staff Support Agency under the Program Analysis and Evaluation Directorate (PAED) in the Office of the Chief of Staff, Army (OCSA) is developing and refining a Family of Resource Predictive Models to estimate the resource requirements to accomplish the missions of the varied and diverse functional areas of the Army. The overall intent and objective of these models is to support the Planning, Programming, Budgeting and Execution System (PPBES).

The Army Industrial Fund and the Army Stock Fund have been transferred to the Defense Business Operation Fund (DBOF). Customers pair only for consumable Class IX (about \$1 billion a year). Effective 01 April 1992, customers will pay for Depot Level Reparables (DLR) Class IX which were previously funded by Procurement Appropriations and free issued to customers (about \$4.5 billion a year). Some systems already exist to predict Class IX demands (i.e., CCSS), but no single, central tool is available to integrate demand forecasts from all customers (sales) with maintenance, supply and transportation costs (expenses).

The Army needs the ability to balance Revolving Fund sales and expenses to insure that planned readiness is achievable within available resources for program and budget years. REVOLVER is being developed by Calibre Systems, Inc., and a team of other contractors to allow the Army to forecast demands, appropriated funds and revolving fund sales based on force structure, equipment density and OPTEMPO. It will allow the Army to compute the surcharge needed to balance sales and expenses. REVOLVER will also allow the user to do "what if" analysis by changing training, logistics and policy variables to determine the affect on demands and O&M costs. This paper will address the development process and capabilities of REVOLVER.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

OPERATIONS & SUPPORT COST ESTIMATING

WORKSHOP CHAIRPERSON I

ANITA JANINE CUKR

Major Cukr has served for thirteen years in the Air Force Comptroller career field in varied assignments. She is currently assigned to the Air Force Cost Analysis Agency, Operating & Support Division. Her work includes providing cost estimating expertise to the Power Projection Team in support of the resource allocation process. She is also the action officer for the Systematic Approach to Better Long Range Estimating Model (SABLE), which is the subject of her presentation at the Cost Symposium.

Major Cukr holds a Bachelor's degree in Business Management from the Air Force University in Paris, France and a Master of Science in System Management (Cost Analysis) from the Air Force Institute of Technology. She earned her commission through Officer Training School in November 1989. She has worked as a budget officer at Headquarters, Air Force Logistics Command; a Cost/Schedule Control Systems Criteria Analyst at the Air Force Plant Representative Office at the Boeing Company in Seattle, Washington; and instructor at the Air Force Institute of Technology; and the executive officer for the Air Force Cost Analysis Agency Commander.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

OPERATIONS & SUPPORT COST ESTIMATING

WORKSHOP CHAIRPERSON II

AMANDA J.A. CARDIEL

Present Position and Duties:

- Cost Analyst for the Surface Warfare Analysis Office (D25) at the Naval Surface Warfare Center in Dahlgren, Virginia.
- Current duties are Cost Group Leader for the Advance Minor Caliber Gun System (AMCGS)/Stabilized Weapon Platform System (SWPS) COEA.
- Coordinated and directed Louisville, Crane, G11, SEA-017 and Technomics on the costing portion of the COEA on a daily basis.
- Analyzed the costing portions of the various groups to ensure the cost data was realistic and consistent across alternatives.
- Ensured products were on time and on schedule.
- Interfaced and briefed the status and results to NCA, ASN, OP-351, OP-354, SEA-062Y and SOCOM.
- Currently in the process of trying to build D25's capabilities through collection of various cost analysis tools, CERS, models, etc. and building a listing for easy access and location.
- Manage and direct our support contractor, Technomics of various tasks (COEA and SCEAM).

Degrees:

- MBA - Florida Institute of Technology, 1989
- BS - Virginia Tech, 1981
 - Major: Statistics
 - Minor: Math

Other Activities:

- SCEA member (joined 7/92)

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

OSD CAIG OPERATING & SUPPORT COST-ESTIMATING GUIDE

Significant changes have taken place this past year which affect how we address acquisition and support of weapons systems. Increased emphasis on O&S costs by Congress, the General Accounting Office, and DoD officials has been further amplified by real decreases in the defense budget. Major revisions in FY 1991 and FY 1992 of key DoD directives concerning defense acquisition management policies have resulted in the need to more clearly specify the methodology for developing O&S cost estimates. The charter of the Office of the Secretary of Defense, Cost Analysis Improvement Group (CAIG) and the reporting of operating and support costs of major weapons systems are also under revision. In addition, the proposed implementation of the Defense Business Operations Fund (DBOF) will impact how funds are budgeted and expended through reimbursement by the resource consumers.

These changes, combined with the requirement to provide a standardized methodology to prepare, present and document O&S estimates that are submitted to the CAIG created the need for a new Operating and Support Cost Estimating Guide. Under the direction of OSD(PA&E), Management Consulting and Research, Inc. conducted a study of the O&S estimating requirements and processes. Each Service was actively involved from the initial review of Service O&S guidance, many differences in approach, methodology, and consistency were identified. Throughout the review process, the CAIG identified typical shortcomings in the preparation and documentation of major system O&S cost estimates. The primary objective of this guide is to provide the user a tool to achieve consistent and clearly documented O&S estimates which are sufficient to permit reconstruction by an independent party.

The approach presented in the new 1 May 1992 Operating and Support Cost-Estimating Guide discusses the O&S estimating process and an approach to documentation and presentation of the final results. Standardized presentation formats are discussed and various Cost Element Structures and element definitions for a generic system and five major system commodities are provided.

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CURRENT TOPICS IN FORCE STRUCTURE COSTING

Force Costing has been gaining attention for the past several years. This paper reviews the fundamentals of force structure costing, where the automated process is today and briefly describes it's issue in two studies for which USACEAC provided the costing support.

In this era of declining resources, managers at all levels are investigating ways to get more productivity from the workforce. Force costing can provide a valuable tool to assist the decision maker by providing reliable costs for various force structure options.

The Army Force Structure Costing System (TAFCS) provides quick turn-around cost estimates of various force structures. These estimates can support decisions on activation/inactivation or active/reserve.

The Army War College requested our assistance in providing them with acquisition and operations costs of a corps slice and a ranger regiment. We had already provided them with costs for various divisions. They used these costs in their instruction of a macro approach to force development and costing.

TAFCS was also used in determining the additional cost to operate in Germany or Korea as compared with CONUS. These costs provided the basis for several discussions within the Army and between the Army and the Congress.

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OPERATING AND SUPPORT COST DATA BASE DEVELOPMENT

There is growing emphasis within DoD to improve the quality and credibility of estimates for operating and support (O&S) costs in life-cycle cost (LCC) estimates. The cost analyst has been hampered by the limited amount of validated and relevant O&S historical cost data.

This paper describes two on-going cost research projects funded and managed by the Air Force Space Systems Division (Directorate of Cost Analysis) and implemented by Management Consulting & Research, Inc.:

- o Software Development Data Base, now being augmented with software maintenance cost data, and
- o Space Hardware Operating and Support Cost Data Base.

The Software Maintenance Data Base has evolved over several years (and had been described in DODCAS presentations during each of those years) with an emphasis on sizing parameters and development costs. Now, software maintenance data is being added to the data base which will support the use of commercial software life-cycle parametric estimating models. The paper describes the data fields and cost drivers which are common to those models and which have been added to the data base. A summary and example of the historical data which has been collected for those fields is also included.

The Space Hardware O&S Data Base is a new start this year with emphasis on historical data for both scheduled and unscheduled maintenance of flight hardware and ground support hardware. The paper describes basic hardware O&S parametric estimating procedures and discusses the major space O&S cost drivers. Special emphasis has been made to define O&S data consistent with commercial hardware life-cycle parametric estimating models. O&S peculiar to space programs will be discussed.

The paper will conclude with a general overview of the process of some pertinent lessons learned from earlier data base development projects.

Attendees to the presentation will be invited to participate in the collection and the sharing of historical O&S data.

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**ESTIMATING THE ARMY'S CLASS IX CONSUMPTION DURING
OPERATION DESERT STORM**

Class IX obligations increased dramatically from FY90 to FY91. This increase was a direct result of Operation Desert Storm. The U.S. Army Cost and Economic Analysis Center (USACEAC) was given the mission of estimating the dollar value of Class IX material actually consumed to assure the Army leadership that the DoA demonstrated good stewardship of financial and material resources. USACEAC, using the Operating and Support Management Information System (OSMIS), compared OPTEMPO factors prior to and during Operations Desert Storm to develop a wartime multiplier to estimate the cost of wartime Class IX consumption.

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NAVY VAMOSC: ACCOMPLISHMENTS AND FUTURE DIRECTIONS

This paper will delineate the improvements accomplished since the merger of VAMOSC-SHIPS and VAMOSC-AIR under the authority of Naval Center for Cost Analysis. Improvements in the processing, reporting, and accuracy of Navy and Marine Corps aircraft data will be identified. Tasks completed, to include O&S costs for Navy missiles and torpedoes, will be addressed. Planned enhancements to improve customer support and include additional data in the Navy VAMOSC integrated data base will be discussed.

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SERVICE CONTRACT COST ENGINEERING (SCCE) STUDY

White Sands Missile Range (WSMR) is the largest overland National Test Range within DoD. WSMR tests Air Defense and Land Combat individual components and weapons systems for all service branches, NASA, NATO and even the civilian community. Extraordinary capabilities include operating nuclear and high energy laser systems test facilities. Due to the cutbacks in civil service employees, Service Contracting has become an integral component in the daily operating of WSMR. Contracts valued in the tens of millions are common. WSMR has 11 cost plus service contracts which total \$350,000,000 in value. Controlling costs on cost plus service contracts is what Service Contract Cost Engineering (SCCE...pronounced "Ski") is all about.

The uniformed services habitually conduct "Should Cost" studies of hard goods production contracts. The point is to develop realistic negotiation objectives. Assuming efficiencies, economies and reasonable management practices, the Should Cost study will determine what the contract should cost. They give the government a basis for which negotiations may be conducted. Monetary size of such contracts warrant the cost for the study. Sufficient benefit from the study assures that its expense is justified. And so goes the Service Contract Cost Engineering (SCCE) study for service contracts.

The SCCE Study is a methodology derived from the classic "Should Cost" study. Instead of being performed on hard goods contracts it is performed on service contracts. Four SCCE studies have been performed today at WSMR. Cost avoidances of between 10 and 30 percent have been realized since inception of the SCCE study.

An Independent Government Cost Estimate (IGCE) must be performed for service contracts because the procurement office needs a basis for negotiation. The person responsible for the IGCE is not usually well informed about how they are derived. We begin to question its validity. The SCCE study is comprised of several fully competent persons who can apply objectivity and rationality to all aspects of the study. Consequently its validity leaves little room for questioning.

Because of the track record of the SCCE study, White Sands Missile Range has institutionalized its methodology. The SCCE study is saving money at White Sands Missile Range.

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**THE UPDATE OF THE NAVY'S ENGINE
OPERATION AND SUPPORT COST ANALYSIS MODEL**

The Naval Air Systems Command requires a fast and efficient means of analyzing the cost effectiveness of alternative hardware logistics support. As an aid to predicting the life cycle cost (LCC) of its aircraft engines, and as an effective way of analyzing its maintenance policies, the Navy Engine Maintenance Model (NAVEMM) was developed. NAVEMM is a Monte Carlo simulation model which allows simultaneous tracking of up to eight different engine components. Planned or projected aircraft operations as well as design changes can be evaluated to optimize operations and support cost of the weapon system. The NAVEMM program has undergone an update to allow it to be used with a spreadsheet-based, menu-driven system. This has significantly reduced the time required to conduct engine cost analysis.

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SAVINGS FROM CONSOLIDATION OF NAVAL AVIATION DEPOTS

This paper examines the scale economies associated with the Naval Aviation Depots (NADEPs). Scale economies depict how costs relate to output. To the extent that costs do not increase proportionately with the output of a facility, there is a gain from having a few large facilities as opposed to many small facilities. The scale economies estimated for the NADEPs can be used to compute the savings from closing some and redistributing the workload to others. The paper also provides rough estimate of the capacity of the remaining NADEPs to perform the redistributed workload within the current facilities.

The approach to estimating scale economies and the data used is briefly described. A cost function for a multiproduct activity is estimated. Previous research has shown that the returns to scale inherent to the production function can be estimated from the cost function. Statistically, the data is a combination of six NADEPs over a 13 year period. This is generally known as panel data. Fixed-effects and random-effects models are estimated. This is followed by a series of statistical estimates showing cost-to-workload relationships, the economies of scale, and the savings from closing a NADEP. The relationships differ by the inclusion of additional factors, such as workload variance, economies of scope, and a partial adjustment process.

The capacity of NADEPs is computed. The capacity estimates suggest the ability of NADEPs to expand and take on the workload of other NADEPs that are closed. The ability to expand workload is calculated based on the historical workloads. The assumptions underlying the capacity estimates are:

- direct labor hours (DLH) are a good proxy for output,
- the period 1978 to 1990 is sufficiently similar to today that peak output during that period can be thought of as potential output today, and
- NADEPs can at least return to the historically high DLH, if they can attract and train the additional labor.

The paper advances previous work in this area in its use of both cross-sectional and time-series data, its recognition that facilities are multi-output activities, and its examination of more than base operating support costs.

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DEPOT MAINTENANCE RESOURCE PREDICTIVE MODEL (DMRPM)

A reduction in the defense budget has begun to impact heavily on force levels and mix as well as mission requirements. In an atmosphere of diminishing budget dollars and a radically redefined force structure, it is imperative that resource managers have the appropriate analytical tools at their disposal to perform quick and accurate "what-if" analysis.

The Program Management Systems Development Agency (PMSDA), a Staff Support Agency under the Program Analysis and Evaluation Directorate (PAED) in the Office of the Chief of Staff, Army is developing and refining a Family of Resource Predictive Models to estimate the resource requirements to accomplish the missions of the varied and diverse functional areas of the Army. The overall intent and objective of these models is support the Planning, Programming, Budgeting and Execution System (PPBES).

Due to the significant financial resources dedicated to depot maintenance (\$1.2B FY92) and a DoD recommendation to improve determination of depot maintenance requirements contained in a 1988 report to the Deputy Secretary of Defense entitled "Enhancing the Credibility of the Depot Maintenance Requirements Process," PMSDA contracted with Automated Research Systems, LTD in September 1988 to build the DMRPM. Version one of the DMRPM was delivered in December 1989. It was limited to data manipulation and reports generation. Version two is a modification and improvement over version one and uses C++ (object oriented) programming in a Windows environment. DMRPM is an automated tool that allows users to analyze the impact of changes in the depot maintenance program quickly that result from changes to Army funding availability. It was designed to support budget formulation and execution as well as POM development. DMRPM includes the capability to predict depot maintenance requirements by end and secondary items for ground combat systems subject to force structure or OPTEMPO changes. This paper will discuss the development process and capabilities of the DMRPM.

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**COSTS OF REPLACING STRUCTURE IN EUROPE WITH
RESERVE COMPONENT ROTATIONS**

Proposals have been made to replace forward deployed force structure of local national personnel with rotating Reserve Components personnel. It is viewed as a win-win action since the Army saves money and the Reserves practice deployments. Operating and maintenance cost estimates were developed for a variety of proposals. All estimates proved counter intuitive and cost rather than saved money. Paper provides details of methodology and results.

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**MAJOR RESULTS OF AN OPERATION & SUPPORT COST ESTIMATE
FOR THE MIG-29 FIGHTER AIRCRAFT**

With the unification of Germany almost two years ago the German Air Force (GAF) inherited among other weapon systems 24 Soviet built MIG-29 fighter aircraft from the Nationale Volksarmee (National People's Army).

Tactical, operational, logistics and cost aspects were evaluated during a decision making process. If and how the aircraft could be utilized in a GAF environment was entered in the overall analysis. This is the first time a western country gained such deep insight into a former enemy weapon system.

Following a short description of the aircraft and its significant deviations from western built aircraft, the operation of the aircraft within the former East German Air Force is characterized. Special emphasis is put on maintenance and overhaul aspects. After describing the parameters which determine the weapons system and its planned operation, in major results, both surprising and not, will be discussed.

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ECONOMIC RESOURCE IMPACT STATEMENT (ERIS)

In 1983, the first Economic Resource Impact Statement (ERIS) was completed to provide a means of measuring direct base impact and Total Economic Impact (TEI) of Air Force base expenditures and Secondary Jobs Created (SJC) supported by those Air Force base expenditures. Since that time, the ERIS has become a refined data base of the most current information on personnel, facilities, and mission activities. The ERIS has provided the Air Force planners, community leaders, legislators, and installation visitors a source of information on the socio-economic characteristics unique to each base. An increase in local income and jobs is the result of the flow of these federal funds from outside the local community; direct or indirect as it ripples through the local economy. For example, the community adjacent to an Air Force base benefits from the payroll spent by military and civilian employees, and profits by serving many procurement needs for the base. For if a person is paid one dollar and spends sixty cents in the local economy, that sixty cents will be respent several times until by the ninth round of spending, only one cent will be available for respending. When calculating the TEI of that dollar all spending rounds are included. So, that initial payroll dollar has actually generated an average of \$2.50 worth of local economic activity (each base has its own TEI factor to determine total impact of each dollar). Information such as this can assist in evaluating the impact of many programs; base closure, realignments, joint use, etc.

This paper covers the data provided within the ERIS, formulas, and examples where this information can be used to make the best planning decisions both within the Air Force and the outlying communities.

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**ANALYSIS OF THE IMPACTS OF COMMONALITY IN THE
ARMORED SYSTEMS MODERNIZATION (ASM)
FUTURE ARMORED RESUPPLY VEHICLE (FARV) PROGRAM**

The U.S. Army Material Systems Analysis Activity (AMSAS) conducted an analysis to determine the logistics impacts of commonality on the operation and support of the Future Armored Resupply Vehicle (FARV). The FARV mission modules can be placed on a variety of vehicle chassis. The chassis choice will dictate how well the FARV can meet its Required Operational Capability (ROC) and what level of commonality the Army is willing to accept/develop. The purpose of this analysis was to determine the logistics costs and benefits associated with the FARV on the medium (Bradley) chassis and also the ASM objective heavy chassis. The analysis addressed the effect/impact of vehicle chassis commonality on maintenance manhours, Military Occupational Specialist (MOS) training, initial provisioning parts stockage, fuel consumption, transportability, survivability, and cost. The study focused only on the package 1 systems which include the tank, infantry fighting vehicle, howitzer, rearm/resupply vehicle, anti-tank vehicle, and the engineer vehicle.

The results of the analysis showed that the FARV on the medium (Bradley) chassis will reduce logistical requirements when compared to the heavy chassis variant. Requirements for maintenance manhours/manyears, fuel consumption, initial parts stockage and transportability are reduced when the FARV is placed on the Bradley chassis. Although the FARV on the Bradley chassis appears to be best from a cost benefits perspective, many of the requirements described in the ROC (e.g. survivability, payload) will not be met with the lighter FARV. The FARV placed on the ASM objective heavy chassis has the weight capacity to carry a larger payload and the weight of additional armor protection. However, this alternative will place greater cost and logistics demands on the Army.

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**THE SYSTEMATIC APPROACH TO
BETTER LONG-RANGE ESTIMATING (SABLE) MODEL**

The SABLE model is a Lotus 1-2-3 based tool to estimate the variable operating & support costs of Air Force aircraft squadrons over the years of the Future Year Defense Program (FYDP). The model has a built in database of "typical" aircraft squadron or wing data. The model is user friendly and gives quick answers to questions that many organizations are asking in the Air Force today: what does a squadron of F15Es cost compared to a squadron of F16Cs? How does a squadron of F-16s at a USAFE location compare in operating cost to a squadron of CONUS based F16s? How do Air National Guard and Air Force Reserve squadrons compare to active duty squadrons? And, in the current drawdown environment, the logical follow-on to these questions is: how much can we save by cutting out a squadron or wing or aircraft?

The advantage that SABLE brings to the table is its ease of use and its availability. It provides quick answers to the sort of questions decision makers have, and since most organizations have Lotus 1-2-3, the model can be widely used. It is no surprise, that the user must exercise care to apply the model correctly. It also behooves the user to gain a thorough understanding of the data that goes into the model.

This paper takes the reader through a specific estimating example. The use of the underlying cost factors is explored. The author will also demonstrate the use of the model, assisted by the alternate SABLE model project officer.

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MACRO VS MICRO- ECONOMIC ANALYSIS

This paper examines the potential impact on the Army from inferring macro level savings based on a micro level analysis.

Operating and Support (O&S) cost today consumes approximately 60 percent of the Army budget. With the increased emphasis on budget reductions we can not afford to advertise savings if the analysis is not reasonably accurate. The potential impact of inaccurate analysis could lead to devastating budget cuts on the field.

This paper examines a potential budget reduction based on the shifting of depot maintenance tasks to the field soldiers.

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THE USAF SPARE PARTS PROCESS

This paper examines the USAF spare parts process as a holistic system. Because numerous organizations are involved with this process, definitions and policies tend to become obscure as each organization defines the overall process in the light of their contribution. Organizations tend to be unable to see how their contribution affects the entire system. This paper attempts to tie together the various facets of spare parts planning in a single document.

The paper begins with a presentation of spare parts planning as a function of logistics engineering. Concepts of reliability and maintainability are explained with their effect upon supply support. This is followed by an examination of how "pipelines" are established to support spare part needs. Since the term "pipeline" is not specifically defined in USAF regulations, the author attempts to define this critical term so that it can be consistently applied in any situation.

The paper then explains how fluctuation in supply needs is accomplished through safety stock planning. A full explanation is given for how and when safety stock is planned. Also presented are the safety stock substitutes used in the USAF supply system. The paper points out several specific contradictions between policy and actual practice in assessing safety level needs.

Finally, how spare part needs are financed is explained. This section shows how the spare part system's processes become blurred as the logistic and the budget functions attempt to manage the same process.

In short, this paper acts as a initial primer to understanding the USAF spare parts systems. This system is explained from the mind-set of the provisioning, requirements, supply and budget functions. It has already gained some use as reading material by new O&S cost analysts with two SPOs.

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DEPOT LEVEL REPARABLES: COST FACTOR DEVELOPMENT

This paper discusses the current DLR cost factor development cycle (FY94 BES), plus the two previous DLR cost factor development cycles (FY93 ABES and FY92 POM). The discussion covers major changes in the DLR cost factor development methodology from one factor development cycle to the next, along with the dollar value impacts in the Air Force's budget. Also covered, is the DLR cost factor definition, cost elements and current factor development methodology, along with the AF CAIG review process. An actual DLR cost factor build for a specific MDS is highlighted as well. The paper concludes with a look at the world of logistic cost factors before and after DMRD 904, and brings to light the "tween", conveying to very cost/logistics analyst the "difference", .i.e. between the new and old way depot maintenance and DLR cost factors are built.

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**SAVINGS FROM SIMULATORS ? ?
A PLAUSIBLE QUANTIFICATION**

Assertion: Astute increases in the use of simulators as sustainment training devices will generate sizable savings.

Support for the Assertion: This paper first identifies several areas in which increased usage of simulators may result in cost avoidance:

Operating Tempo
Ammo for Live Fire
Safety
Collective and Larger Scale Exercises
Command & Control and Staff Exercises
Transportability

Then, for each of the areas, a plausible quantification of the costs avoided is developed. (Assumptions are explicitly presented.) Also, for each area, a plausible quantification of additional costs is presented. The calculated net savings are gathered, to provide an indication of the magnitude of the potential savings. Impacts on appropriations (RDT&E, Procurement, Operating & Maintenance) are hypothesized.

Finally, the paper calls on the training community to conduct experiments to measure any difference in performance between personnel who trained mainly on actual platforms and personnel who trained mainly in simulators.

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**IMPLEMENTATION OF DEFENSE MANAGEMENT REVIEW DECISIONS (DMRDs)
IN DEVELOPING OPERATING AND SUPPORT COST FACTORS**

The U.S. Army Cost and Economic Analysis Center (USACEAC) has the mission to develop, on a recurring basis, Operating and Support Cost Factors which include consumable, reparable and Petroleum, Oil and Lubricant (POL) Cost Factors. USACEAC, using the Operating and Support Management Information System (OSMIS), develops these factors to reflect current logistics and financial policy. These factors are used by the Army Flying Hour Program and for the Training Resource Model (TRM). DMRD 901, Reducing Supply System Cost, affected the methodology used to calculate the consumable portion of the Operating and Support Cost Factor. DMRD 904c, Stock Funding of Depot Level Reparables (DLR), affected the methodology used to calculate the reparable portion of the Operating and Support Cost Factor. The Methodology used in FY 92 and FY 93 will be compared and contrasted.

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COST COMPARISON: PCS VS. ROTATIONAL SQUADRON

With the collapse of the Warsaw Pact and the perception of decreased threat in Europe, some lawmakers have called for additional cuts to the US military presence Europe. During testimony to Congress, senior US military leaders in Europe were questioned on the cost of European-based units. Many questions concerned the cost of European-based forces, versus CONUS-based forces performing the same mission.

HQ USAFE/FM prepared an analysis comparing the quantifiable costs associated with a notional one-squadron base in Europe with personnel in PCS status, versus rotational aircraft with personnel from the CONUS providing a year-round mission ready force. Three deployment cases are examined: (1) deployments to an existing main operating base (MOB) with other missions and in-place infrastructure, (2) deployments to a base with no other missions and a core of PCS personnel in remote status, and (3) deployments to a base with no other missions and all personnel TDY.

The results of this analysis show that in all cases, it is less expensive to base forces in Europe, than continuously rotate aircraft and personnel from home stations in the CONUS to perform the same mission. The analysis was briefed by CINCUSAFE to other senior leaders in HQ US European Command (USEUCOM) and provided to Air Staff for release to Congress.

The paper describes the approach, assumptions, and methodology used in preparing the analysis. In addition, a sensitivity analysis on each key variable is examined. The model developed for this analysis provides an accurate, easy-to-use tool for analyzing the costs associated with overseas force structure comparisons.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

PARAMETRIC & COST ESTIMATING RELATIONSHIPS

WORKSHOP CHAIRPERSON

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Mr. Morteza Anvari is the Production Branch Chief of the Aircraft and Missiles Division at the US Army Cost and Economic Analysis Center (CEAC). Mr. Anvari's professional experience with the Army also include the Acting Director of Financial Analysis with the Office of Assistant Secretary of Army (Financial Management) at the Pentagon, and Industrial Engineer with the US Army Tank Automotive Command. Prior to joining the government, Mr. Anvari has worked as a project engineer at the General Motors Corporation and a Lecturer at the University of Michigan. His two masters degrees are in Mechanical Engineering and Industrial & System Engineering. Mr. Anvari is a graduate of the Army Management Staff College and a Certified Cost Analyst. He is the author of numerous publications in the area of Cost modeling and Expert System applications. Mr. Anvari has two children and resides in McLean Virginia.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

A PARAMETRIC APPROACH TO ESTIMATING DIESEL ENGINE PROCUREMENT COST

In the early stages of a weapon system program, when only gross parameters are identified, it is difficult to derive an estimate of system cost. The parametric approach to cost estimation is one method by which those parameters are statistically related to cost. In this paper, a database of historical diesel engine cost and engine characteristics was constructed. Regression analysis was used to derive a model which estimates cost as a function of engine horsepower. Based on application of linear and nonlinear regression techniques, the power (multiplicative) model provided the best fit of the data collected. Specifically, for the Advanced Amphibious Assault Vehicle (AAAV) Independent Cost Estimate (ICE), where only the horsepower requirement was specified for the diesel engine component, engine cost was estimated using the parametric model derived in this paper.

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PRIME MISSION EQUIPMENT ESTIMATING FACTOR

Factors were developed to calculate electronic system Prime Mission Equipment (PME) costs from system-level costs for both Research and Development (R&D) and Production phases.

The R&D and Production data sets each have 18 electronic systems which include nine radars, two radios, two digital message devices, two laser range finder/designators, a crypto, a computer, and a sonar system. The data are comprised of R&D average total costs and Production T1s at both the PME and System level, government in-house engineering costs, fleet support costs, and engineering development model (EDM) quantities.

R&D and Production ratios are calculated for the data set. R&D ratios are derived by dividing average-system-level cost into average-PME-level cost, and Production ratios are derived by dividing T1 at the System-level cost into T1 at the PME-level cost. Regression analyses show that R&D ratios are independent of the number of EDMs, but a power regression analysis shows that Production ratios are dependent on the number of EDMs. The R&D PME factor is calculated by computing the mean of the ratios for 11 systems. The production PME factor is calculated by utilizing a power function equation given the EDM quantities. The regression analysis that generates the power function equation uses six systems. Both data sets have good supporting descriptive statistics.

The results from the study give a 35 percent R&D PME factor. A power function regression equation calculates the Production PME factor. A Production PME factor of 52 percent can be used if the number of EDMs is not available, but the supporting descriptive statistics indicate that this factor is not as good a predictor as the power function equation. The R&D PME factor is used in the Tomahawk Block III Independent Cost Estimate (ICE) to calculate the Development PME costs of two electronic systems in the Tomahawk missile, the Global Positioning Section (GPS) and Digital Scene Matching Area Correlator (DSMAC). The production PME factor (power function equation) is not used in this study, but can be useful in future cost estimating studies.

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**DEVELOPMENT PHASE COST DRIVERS FOR PRODUCTION COSTS:
THE CASE OF TRACKED VEHICLES**

There are two different approaches, the disjoint and sequential models, which attempt to account for differences between development unit cost and production unit cost. The disjoint model uses production cost improvement curve that is physically separate from the development cost improvement curve. Hence, any cost improvement which occurs during the fabrication of development units is not transferable to production units and so does not affect their cost. In the case of the sequential model, however, the first unit cost of production units directly follows the last development unit due to a carryover of the cost improvement process. The sequential model allows discontinuities, such as a decrease in unit cost, in the cost improvement curve between the last development unit and the first production unit.

This paper, using a sample of seven armored tactical tracked vehicles, first obtains the theoretical first unit production costs for the vehicles under both sequential and disjoint models. Then, using various measures of activities in the development phase, CERs are obtained for both models which relate activities in the development phase to theoretical first unit production cost. The results indicate that, for the disjoint model, first unit production costs depend on both development first unit costs and the time span between end of development and beginning of production. For the sequential model, first unit production costs depend on the average development cost as well as the time span between end of development and beginning of production.

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**THE PRICE OF PERFORMANCE:
ANALYSIS OF NAVAL SHIP AND SUBMARINE COST DRIVERS**

Traditional ship and submarine cost studies have typically used cost estimating relationships based predominantly on weights of major ship subsystems or components. The weight-based approach is sound from an engineering point of view, and will probably remain the method of choice for estimates made in the budgeting and acquisition processes. However, weight based cost estimating has serious limitations in the earliest stages of requirements definition and concept exploration. Analyses performed in these very early phases usually precede and often support the development of a Cost and Operational Effectiveness Analysis (COEA). System definitions in the pre-COEA period are from an engineering point of view, very soft at best. Thus, the credibility of any weight estimates on which weight based cost estimates must depend is open to serious question.

At the pre-COEA stage, the tradeoffs under consideration are usually among fairly high level performance factors. How fast should this cruiser go? How many missiles should it carry? What kind of sensors should be installed? How deep should our submarine be able to dive? What noise characteristics should it have? How many torpedoes should it carry? From the cost analysis point of view, these kinds of questions require cost estimating relationships based, not on weight, but on significant performance measure like speed, weapons carrying capacity, sensor performance, range, etc. These underlying performance factors are the fundamental "cost drivers" whose influence should be considered in the pre-COEA phase.

This paper develops approaches to identifying and ranking performance oriented cost drivers, demonstrates a regression analysis approach to quantifying the influence of principal performance factors, and illustrates a number of techniques for displaying the multi-dimensional results of these analyses.

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**COST ESTIMATING RELATIONSHIPS (CERs) FOR
U.S. BUILT COMMERCIAL SHIPS**

Lessons from "Desert Storm" highlighted a current and future shortage of sealift capability of military supplies. This identified shortage served as the basis for the Navy to define requirements for large commercial containerships and develop cost estimates for procurement of these ships. However, the Navy's primary estimating experience has been in military spec ships. Therefore, new cost estimating methods had to be developed to estimate commercial spec ships.

Literature on this subject usually focuses on CERs which relate ship prices to some measure of carrying capacity, i.e. gross registered tonnage (GRT). Analysis of containership data indicated that the correlation between GRT and ship price, and GRT and various ship design parameters is not a tight fit. The CERs which use GRT as a variable usually result in an estimate with a high coefficient of variation (CV). Therefore, this study focused on CERs which relate ship price as a function of ship design characteristic(s). The study resulted in a statistically significant CER (high R^2 , high T values for independent variables, high F ratio, and CV of +/- 13.5%) which estimates commercial containership price as a function of the ship's steel weight, outfitting weight, and machinery weight.

This paper details the data collection effort and resulting database, the data normalization process, the statistical analysis which led to the "best" cost estimating relationship for commercial containerships, and the application of the CER to the estimating problem. The data collected included information on other types of commercial ships which allowed the development of CERs for tankers and breakbulk ships which this paper additionally provides.

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LEARNING CURVE

Forcing the non-linear learning curve model through a linear regression degrades the accuracy and greatly complicates the solution. We show here that a direct least squares fit to the bivariate learning curve model can be reduced to a trivial one-dimensional maximization problem, which is simpler and more accurate than a linear regression.

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HIDDEN DIMENSIONS

Many cost estimating relationships are a function of one to a few variables and the data can look more like a scatter diagram than a curve. This is often because we are either looking at the wrong variables or ignoring critical variables. We explore the types of trouble this creates and discuss methods to detect hidden dimensions.

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**COST PERFORMANCE CHOICES
IN MAJOR WEAPON SYSTEMS:
The Case of U.S. Tactical Aircraft**

This presentation is an exploration of actual cost-performance choices made in the design of major weapon systems. It summarizes the conventional view of cost-performance choices; i.e., the process excludes intelligent tradeoffs between cost and performance specifications. It then constructs two predictive models of costs and performance over time. The "baroque arsenal" hypothesis predicts increasing marginal costs of performance over time, which a "rational choice" model predicts consistent choices based on the perceived importance of performance relative to quantity in combat. The hypotheses are then assessed using the case of U.S. tactical aircraft -- using TASCFORM measures of performance and actual budget data for cost. It turns out that the data provides some support for the rational choice hypothesis, and none for the "baroque arsenal" hypothesis.

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RATIOS

You don't add fractions by summing the numerators and denominators, yet this is precisely what happens when projections of performance are made. Using the estimate at completion as an example, this paper explores the distortions caused by this pathological arithmetic. We show this can induce errors arbitrarily high or low. In practice, errors of several percent are found. We also show the circumstances where this method is a reasonable approximation.

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CALIBRATION OF HEURISTIC FACTORS TO CERS POTENTIAL ISSUES AND INTERPRETATIONS

There is often a need for the working estimator to extend the applicability of a Cost Estimating Relationship (CER) beyond the scope of just the raw historical data on which a parametric relationship is based. Sometimes this is done on an ad hoc basis; sometimes a more systematic approach is built into the estimating methodology.

In the past one method involved "normalizing" the raw data behind the CER to some baseline (for example for technical complexity), analyzing the baseline data to develop CERS, and applying normalization factors to the "normalized" CERS to estimate new systems. However, as parametric analysis gets more sophisticated, deeper, and goes to a lower level (read becomes more cumbersome and more labor intensive) and as "knowledge" of developments in high technology areas becomes more volatile, it becomes more desirable to separate the normalization process from the raw data. Since conceptually, a CER in some sense represents the "average" of the data behind it, in theory, a normalization factor could be calibrated to the CER rather than directly to the data behind it.

If a rational conceptual framework for this process can be devised there may be multiple benefits. These include avoiding the need to track multiple CERS and databases for various normalization schemes and making updates easier as new knowledge becomes available. Issues include independence of factors, factor hierarchy, calibration criteria and their interpretation.

This paper discusses a possible methodology flow for a heuristic factor, possible heuristic factors, a possible calibration method, possible calibration criteria, and possible comparative measures of results with examples from spacecraft experience.

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GENERALIZED COEFFICIENT OF DETERMINATION

In the theory of cost-estimating-relationship (CER) development using the method of ordinary least-squares (OLS) linear regression, where the dependent variable is y (e.g., cost) and the independent variable is x (e.g., weight, power, thrust, etc.), the square of the correlation coefficient is called the "coefficient of (linear) determination". Usually denoted by the symbol R^2 , the coefficient represents the proportion of variation in y that can be explained by passing variations in x up through the linear relationship. As such, it is often interpreted as providing a measure of the quality of the CER as a predictor of cost. The present report offers a generalized definition of the coefficient of determination that is valid for comparing the quality of non-linear versus linear CERs and has none of the well know drawbacks (e.g., those related to the logarithmic transformation) of other proposed definitions.

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COST OF NUCLEAR RADIATION HARDENED SATELLITES

The cost to harden satellites against nuclear radiation effects is an important topic due to the proliferation of hardened military satellites in the past decade. Contemporary systems like MILSTAR was said to have a major portion of its cost attributed to hardening. The Institute for Defense Analyses (IDA) was tasked by the Defense Information Systems Agency (DISA) to investigate the cost drivers for hardened communications satellites and to quantify the added cost of hardening. IDA used a parametric approach to develop satellite subsystem cost estimating relationships which included hardening parameters to quantify hardening cost. The results showed hardening cost to be higher than the five percent to 10 percent of satellite cost from prior studies.

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R&D COST ESTIMATING

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Mr. Hoy has been the principle or lead analyst for many cost related studies concerning advanced materials and manufacturing techniques associated with DoD missiles, aircraft, ships, space, and electronics systems. His current focus is on advanced Navy systems. He has experience in developing a wide variety of data bases and cost estimating tools as well as construction cost estimates for one or more phases of a systems life cycle. As a member of the DC Chapter of the Society for Cost Estimating and Analysis (SCEA), Mr. Hoy actively supports the development of cost analysis and estimating techniques that are appropriate for the ever-changing advanced technology base and systems acquisition process. He has been a Chairperson or presented papers at a number of past professional cost analysis/estimating functions, including SCEA and the annual Department of Defense Cost Analysis Symposium (ADODCAS). Mr. Hoy was a Certified Cost Analyst (CCA) under the Institute for Cost Analysis (ICA) and has been re-certified by SCEA.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

TACTICAL MISSILE SYSTEMS DEVELOPMENT COSTS

This paper examines the funding characteristics of tactical missile Research, Development, Test and Evaluation (RDT&E). The intent of this study was to provide a means of estimating tactical missile development costs. The initial approach of our study was a broad investigation of RDT&E expenditures. This investigation focused on two major RDT&E components, Demonstration and Validation (D&V) phase and Engineering & Manufacturing Development (EMD) phase.

The results of our analysis were based on historical data compiled for ten tactical missile systems. Our study identified statistical relationships between development units produced, development time, and development costs for D&V and EMD phases.

In addition, we looked at the time-phased cost expenditures for the missile systems in our data base during each phase of development.

The second phase of our study involved a more detailed examination of the RDT&E cost estimating relationships (CERs) for each Work Breakdown Structure (WBS) element. Using the Naval Weapons Center, China Lake RDT&E Cost Model as a guide, we developed CERs for both D&V and EMD phases of development.

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**A METHOD OF RDT&E COST ESTIMATING USING THE
PRICE H PARAMETRIC COST MODEL**

The project assessed the potential of a commercially available parametric cost model to estimate the development cost of research, development, test and evaluation (RDT&E) programs. The GE PRICE H parametric cost model was chosen because of its capability of estimating development costs for a wide variety of electronic and mechanical systems. In addition PRICE H responds to a large number of input parameters, which can be tailored to particular production and development environments and processes.

We used military aircraft development data to assess the PRICE H model. We calibrated model input parameters as functions of high level system performance parameters, technical characteristics, and programmatic. Based on the calibration process, we developed procedures to determine cost model input parameter values for use in the estimation of development costs of other Naval systems.

We demonstrated the procedures by estimating the development engineering cost for an unmanned autonomous air vehicle which is an Advanced Technology Demonstration (ATD) project, and a 6.2 composite mast exploratory development project.

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**TEST AND EVALUATION (T&E) COST MODEL
FOR
NAVY AIR-LAUNCHED WEAPONS**

Research, Development, Test and Evaluation (RDT&E) are costly and time-consuming tasks for the U.S. Navy and the Department of Defense in general. The unavailability of historical test cost data has contributed to poor fiscal planning of many Navy R&D programs. No systemized effort has yet been described to develop T&E costs early in the program development phase in the Life Cycle. The Test and Evaluation Cost Model was developed from detailed test data sources for missiles and ordnance at NAWC (then NWC), China Lake, CA. Since tests performed at NAWC comprise most of the tests for air-launched missiles and ordnance, the data serves as a comprehensive basis for program test planning. A computer model was developed from this data, in spreadsheet form, by Tecolote Research, Inc. under contract to NAWC. It is menu-driven, user-friendly and written in LOTUS for use on IBM-compatible personal computers.

T&E data were gathered directly from China Lake T&E sources covering all aspects of missile testing and qualification: environmental, aerodynamics, guidance, control, lethality, survivability, propulsion, ordnance and all-up-round (AUR). The data came from test engineers, not from program budget centers. This model provides detailed subsystem T&E cost estimation and "quick look" R&D test cost estimating capability to be used early in program development. Component test cost data have been gathered, but are not included in the model at this time.

The model is useful in several respects. First, it helps program managers plan dynamic test cost scenarios. Second, it acquaints the user with the diversity of missile testing and helps with schedule planning. Perhaps the model's biggest benefit is an identification of potential cost overrun situations through an understatement of required test resources.

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RDT&E RESOURCE PREDICTIVE MODEL

ABSTRACT: A reduction in the defense budget has begun to impact heavily the Science and Technology Base and its ability to deliver technology capable of future weapon system needs. In an environment of scarce resources coupled with radical policy changes it is imperative that resource managers have analytical resource tools for analyzing programs, budgets and projects quickly, and consistent with national defense initiatives.

The Program Management Systems Development Agency (PMSDA), a Staff Support Agency under the Program Analysis and Evaluation Directorate (PAED) in the Army Chief of Staff's Office is developing a resource predictive model to evaluate the resource requirements for the technology base.

Beyond the current downsizing of the services, the capability to deliver capable weapon systems rests primarily on the technology base. The National Security Strategy, August 1991 stated "This difficult task will require us to invest in hedging options.... It will require careful attention to vital elements of our military potential: the Industrial Base; Science and Technology; Manpower."

The Program Management Systems Development Agency contracted with American Power Jet Company in September 1990 to establish a mathematical model for predicting the technology base program requirements with full attention to acquisition and logistical support interfaces. The methodological process utilized is:

- a. Regression Analysis -- S&T vs Procurement
- b. Historical Analysis -- Assignment of S&T by Battlefield Functional Mission Areas (BFMA).
- c. Allocation Percentages -- Distribution of future S&T 6.X dollars within BFMA's and Acquisition Budget Categories.

RDT&E categories predictive model is designed to support the Program Objective Memorandum and Budget formulation.

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MISSILE RDT&E ESTIMATION: ANOTHER TOOL

A feasibility study was conducted to ascertain the reasonableness of a CER to estimate missile RDT&E costs prior to Milestone 0 and/or 1. The relationship: cost as a function of a number of development articles produced; schedule length; and, cumulative average cost of the 1000th unit (CAC1000) was hypothesized. Study premises were that development article quantities captured material and test costs; schedule length captured the engineering effort to develop the missile; and, CAC1000 captured cost of the technology of the missile under development. The annual President's Budget Submission to Congress was used as the data source. Missile types in the study data base included air to air, surface to air, and cruise. RDT&E was considered to end at the start of production. Additional RDT&E costs after production were not considered. Results confirmed that a strong relationship existed between unit cost as a function of development article quantities and CAC1000. Some improvement in the relationship could be gained by including schedule, but a weak relationship existed between schedule length and development quantities. These relationships were shown to exist across missile types and technologies. The study premises were validated and another tool for cost analysis is available.

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OPERATIONAL MISSILE ANALYSIS AND DISPLAY SYSTEMS (OMADS)

The Missile Analysis and Display System (MADS) is a data base of cost and technical characteristics for 19 missile systems from the three Services. It provides a basis for making cost estimates which cover the entire full-scale development (FSD) phase of a missile system. MADS provides several estimating methods (cost estimating relationship, cost factor, estimate by analogy). It provides one or more method for all work breakdown structure elements for both Development Engineering and Prototype Manufacturing. It provides one or more estimating method for all other FSD cost elements at the total system level. MADS (1991, Engineering and Economics Research, Inc.) is an update of the MAD model (1981, System Planning Corporation).

Operational Missile Analysis and Display System (OMADS) is an effort to completely automate MADS. It is an entirely in-house Government effort. OMADS uses off-the-shelf software. The software used is the Data Desk exploratory data analysis program. Data Desk contains statistical, graphical, and data base features organized to facilitate examination and analysis of data. Use of Data Desk provides tremendous economies in development time and hence cost to the Government when compared to use of a more generic tool (such as a programming language, or a relational data base management program).

Cost and non-cost data have been input to OMADS. Cost factors, summary statistics, tables, cost estimating relationships, scatterplots, 3 dimensional rotating plots, and other derived analyses reside in OMADS. All of this derived information updates automatically in response to a revision of any data, or to the addition of a new weapon system. New variables can be added easily. The relevance of new variables can be examined quickly and easily both graphically and statistically. OMADS includes descriptions of all variables used. OMADS contains verbal descriptions of the different estimating methods provided.

OMADS will enable the continuous revision of MADS through the revision and addition of data. It will facilitate extension of MADS through use of additional explanatory variables and further analysis of existing variables. Revisions to OMADS can be distributed electronically. With OMADS Government employees will be able to update and distribute hard copy versions of MADS on a yearly (as opposed to the current decennial) schedule.

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RISK ANALYSIS

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Mr. Trainor is the Chief, Cost Risk Analysis, US Army Cost and Economic Analysis Center, Washington D.C. He plans, conducts and/or directs the Department of Army risk research, studies/projects. Assesses the impact of technical and schedule risk uncertainty during all phases of a system's life cycle. Provides risk guidance to the DA staff, and the Army cost estimating community. Advises the Director on matters concerning risk in the realism of major weapons/material/information systems' cost estimates.

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"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

AN INTRODUCTION TO COST RISK ANALYSIS

An important part of an Independent Cost Estimate is the characterization of the cost risk associated with the estimate. This paper has several objectives. First, we formally define and classify the problem of cost risk analysis. Basic concepts and definitions are reviewed to introduce the topic and help the unacquainted reader understand the problems and complexities involved in cost risk analysis. The second objective is to review methodologies proposed to date and classify them in terms of the assumptions made and techniques employed in addressing cost risk. The final objective is to more completely discuss the problem of estimating cost risk under the assumption of WBS element dependencies. We propose a simple but general methodology for evaluating cost risk models developed for this form of the problem

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COMPREHENSIVE RISK ANALYSIS - WHAT IT TAKES: A CASE STUDY

A concerted effort was made to totally integrate the results of a technical assessment team's results with the cost analysis team's results in estimating the total cost risk for the Space Segment of the Milstar program in support of a June 1992 Interim Program DAB Review. We employed the services of one journeyman-level econometrician full-time and one senior operations research analyst half-time in the assessment of cost risk that involved data gathering (interviews of technical experts, attending system requirements reviews, studying requirements documents, etc.) and synthesis of that information with the aid of commercially available PC-based risk computational software. We developed cost risk distributions for all WBS element with medium or high technical risk, summed them analytically, and accounted for WBS interaction effects with dependency correlation matrices embedded in the calculations.

Results indicated that the devotion of full time resources to the cost-risk task produced a solid analysis that provided a comprehensive measure of the dollar impacts due to risk. These results were beneficial to the ICE team and decision makers at this stage of the program as a "snapshot in time" of the dollar value of the risk impacts and also as a foundation for the System Program Office to build a continuing assessment of the risk impacts in the future as a focus for concentrating risk management efforts. Presentation of the process, calculations, results, conclusions, recommendations, and lessons learned will constitute the content of the paper and workshop.

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QUANTIFYING EXPERT JUDGEMENT

Cost Analysts and Schedule Analysts as a group are more sensitive than most to the quantitative and probabilistic aspects of risk analysis. Although cost and schedule estimates implicitly contain risk themselves, the fact remains that time and money are the currency used by management to buy their way out of risk that originates elsewhere. Thus analysts must begin to think of the "cost of risk" as opposed to "cost risk." Available analytical tools produce quantitative results from quantitative inputs. Obtaining the quantitative inputs is typically the most difficult part of the analysis because the understanding and explanation of risk lies in the mind of the engineer and program manager. Going from vague thoughts to well articulated narrative statements to numerical inputs for risk models is the major effort in a good risk analysis. This paper treats several techniques used in recent risk analyses to bridge the gap from the mind of the technical specialist to inputs suitable for use in currently available risk models.

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**SOURCE SELECTION SCHEDULE RISK ANALYSIS
THE AIR FORCE TRAINING SPO PERSPECTIVE**

The emphasis at Aeronautical Systems Division (ASD) is to award contracts that will be executed within budget and on time. Past source selections, though intense and completed in good faith, have not been fully integrated, particularly between the cost and schedule functions. This lack of integration between all functionals in the source selection process, and the resultant negative impact to cost and schedule, mandate the use of schedule risk analysis in most, if not all, future source selections. Source selection schedule risk analysis (SRA) is a process which quantifies risk associated with offerors' proposed schedules and develops realistic expected program schedules.

Although SRA is subjective, it enhances the selection process in various ways. Over time, as offerors come to fully understand the SRA process, they will find it necessary to plan their schedule proposals in greater depth. Additionally, it will enable ASD to provide customers, the using commands, with a more realistic schedule for each offerer in terms of probability. Finally, SRA will focus managements' attention on the high risk areas by identifying the major schedule drivers.

This paper will describe the purpose of SRA, how SRA is implemented, possible implications for cost evaluations (Firm Fixed Price and Cost Plus), and benefits of the process. Lessons learned and personal experiences from source selections using SRA will be incorporated into the paper to provide analytical insight. The thrust of our effort is to communicate a process we feel will help ASD and other acquisition agencies fully realize their goals.

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ERROR PROPAGATION

Cost analysis is based upon series of analytic calculations. Yet seldom do these calculations explicitly evaluate the uncertainty introduced by the calculation, and we have wrongly ignored the explicit calculation of how data error percolates through an analysis. Adding a subjective risk factor is a poor substitute. This paper explicitly shows how to calculate the propagation of errors.

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THE TOTAL COST RISK METHODOLOGY

The paper and presentation will describe the Total Cost Risk Assessment Methodology developed by The Analytic Sciences Corporation. The methodology provides a rationale and framework for quantifying the uncertainty surrounding the development of new technology projects. It explicitly considers many types of uncertainty which may impact the final costs of the proposed system. It also facilitates the development of a systematic risk assessment process, ensures the development of a clear audit trail and provides a first step towards the development of a risk management plan.

The TASC methodology is a departure from other cost risk assessments methods. Typically, cost risk assessments do not segregate uncertainty impacts into those that are caused by cost estimating error, and those driven by schedule or technical considerations. By dividing cost risk into these subcategories, TASC is able to not only estimate the total risk dollars associated with a project, but to gain insight into the risk cost drivers within that project.

The structured nature of the TASC methodology uses parametric modeling techniques, the Delphi method for assessing technological risk, and the independent judgement of the cost analyst. Derived risk distributions are mated to their WBS items and point estimates. The cost risk distribution is derived through a Monte Carlo simulation, using a commercial simulation software package.

The TAC methodology is currently in use for all SDIO cost estimates. It is applicable to most cost risk estimating problems, as it offers the user the ability to apply both strict mathematical modeling techniques and human judgement to assess the impact of uncertainty on the project.

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**A RISK MANAGEMENT APPROACH TO COST ESTIMATING
OR
HOW TO INCREASE THE ACCURACY OF A COST ESTIMATE**

For a number of years I have consulted and conducted research in the Risk Management area as it applies to the system acquisition process. This included the functions of planning, including evaluation of system alternatives, in particular cost and operational effectiveness analysis; cost estimating; and the management control process.

The research has consisted of an analysis of the work process involved in these functions as it is now performed in the field, the pitfalls and shortcomings of each work process, (Risk Assessment and Analysis) and ways of overcoming these shortcomings (Risk Handling).

This paper focuses on the process of cost estimating, analyzing the steps, and the data required for generating a credible cost estimate. Various pitfalls which introduce inaccuracies in the cost estimating process are discussed and methods for reducing such inaccuracies are presented.

The approach described can be used to accomplish the following objectives:

1. Enable a cost analyst to improve the accuracy of his/her cost estimates.
2. Enable a cost analyst to select the most appropriate cost estimating model when alternatives are available.
3. Enable a government agency to motivate a contractor to improve their cost estimating process.
4. Enable a government agency to more readily validate a contractor's cost estimate.

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**SCHEDULE RISK PROFILES
FOR
U.S. ARMY STRATEGIC MISSILE PROGRAMS**

System Program scheduled, particularly the estimated length of specific Program Phases, are coming under increasing scrutiny by Army and DoD Staff Offices, who frequently use "nominal" program schedules as a sanity check for the reasonableness of a proposed schedule. This process is necessary to also insure that other program variables that are schedule related, such as cost, are consistent.

This paper describes the results of research specifically focused on defining realistic and defensible program schedule and milestone profiles. Using readily available historical data (e.g. the Selected Acquisition Report), programmatic variables and technical complexity characteristics which can drive program schedules are identified and categorized according to their overall impact on Program Schedule.

Using the variables identified, a family of curves (Time Estimating Relationships) were developed that can be used to predict expected schedule performance for a range of hardware components and technologies specific to the U.S. Army Strategic Defense Command.

Data from selected programs were analyzed using Tecolote's Schedule, Cost, and Network System (SCANS) model for the purpose of comparing actual program schedule data with data derived from a simulated program network.

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A JOINT PROBABILITY MODEL FOR COST AND SCHEDULE UNCERTAINTIES

Systems being acquired by the Department of Defense face numerous technical and program related uncertainties that can significantly impact their cost and schedule. Although it has long been recognized that cost and schedule are correlated, little has been published in the cost field on the use of bivariate probability distributions to analytically describe their joint behavior.

This paper discusses a probability model from which the joint distribution of cost and schedule can be described, analyzed, and presented to decision-makers. Specifically, the bivariate lognormal model is discussed. Evidence from independently conducted Monte Carlo simulations suggest that this model can approximate the joint behavior between cost and schedule probability distributions.

Use of distributions such as the bivariate lognormal enables decision-makers to study and conduct tradeoffs on joint probabilities of the form

$$P(\text{Cost} \leq a \text{ and Schedule} \leq b)$$

at the program level. Probability statements of the type shown above have not been a common product of cost uncertainty analyses. It is especially important that these types of insights be provided to decision-makers, particularly in a environment of shrinking funds and challenging schedules. The model presented permits the examination of the sensitivity of joint probabilities to the cost and schedule driving issues unique to a program.

The conditional distributions and moments of the bivariate lognormal model are also presented. This supports examining an issue such as the probability that the cost of a program will not be exceeded for a given schedule.

Examples are provided that illustrate the theory. A specific case is presented that demonstrates how the bivariate lognormal model was applied to an actual system cost estimate. In addition, historical data on program costs and schedules have been analyzed and their empirical correlations are presented.

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**REDUCING SUBJECTIVE GUESSWORK
AND MAINTAINING TRACEABILITY WHEN ESTIMATING
THE "RISK" ASSOCIATED WITH A COST ESTIMATE**

Specifying the "risk" that the eventual cost of a system will exceed the current cost estimate involves a lot of subjective guesswork. Commercial risk-analysis software products such as PLAN and @RISK do not reduce the amount of this guesswork. In fact, these programs require estimators specifying dozens, sometimes even hundreds, of uncertain input values, such as statistical characteristics of WBS-element costs and correlations among them. The approach proposed in the report recognizes the inherent uncertainties in providing these inputs and addresses the need for a simple, traceable, standardized procedure for computing them from cost-estimating error bands and technical descriptions of the system being evaluated. An analyst can use the procedure described here to obtain a "quickie" estimate of the cost-risk or to derive inputs for more detailed studies using commercial software products.

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PC SCANS SYNOPSIS

SCANS is a new PC based Schedule Cost and Network System model designed to analyze complex schedule networks. SCANS allows the analyst to assess activity precedence (network logic), activity start/finish dates, activity slack, and network critical paths. Unlike CPM (Critical Path Method) and PERT (Program Review and Technique) based models, SCANS generates unbiased schedule estimates using Monte Carlo simulation in a simulated network methodology.

CPM and PERT based schedule analyses have well known shortcomings. CPM tends to underestimate whenever the duration estimates of the activities represent a most likely value or mode of a distribution skewed to the high side. The CPM method simply sums most likely (modes in the case of skewed distributions) duration estimates. The sum of modes does not sum to an expected value or the mode of the sum. Traditional scheduling methodologies have relied upon PERT to solve the skewness problems (i.e. modal bias) of the CPM estimate. The PERT methodology, which uses risk distributions (low, mode, high duration inputs) to convert most likely durations (modes) to expected values. Then expected values can be added throughout the network to obtain an unbiased schedule estimate. The PERT methodology, while solving the limitations of the CPM methodology, still suffers from the inherent bias caused by parallel path through the network. If a schedule has many parallel (concurrent) paths then PERT will tend to underestimate schedule length because PERT does not account for critical path switching (i.e. nodal bias).

The SCANS model was developed to eliminate the pitfalls of CPM and PERT. SCANS avoids the biased estimates inherent in the CPM and PERT methodologies by using a simulated network methodology. Monte Carlo simulation (100 passes through the network using the risk distributions defined for each activity) allows the analyst to assess critical path switching and how that impacts schedule completion.

SCANS includes other network specifications such as activity concurrency and lagging, finish-start and finish-finish predecessor relationships, and time/cost and time/time correlations. The model output includes various summary and detailed reports, graphic network layouts, Gantt chart, S-curve plots and graphics. Interfaces with other software packages are also available.

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ASSESSMENT OF RISK POTENTIAL

There are many interrelated factors that determine whether a weapon system will or will not, in its acquisition phase, incur significant cost growth in comparison to early estimates. No one can estimate the extent of cost growth with a high degree of accuracy. However, review of 30-40 years of cold war history does allow the development of a check list of indicators of cost growth. This paper describes these indicators and their assembly into an overall Assessment of Risk Potential (ARP).

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**MONTE-CARLO SIMULATION
OF PROJECT SCHEDULE DURATION
WHEN ACTIVITY TIMES ARE CORRELATED**

Quantifying uncertainty in schedule duration is, from the schedule estimator's point of view, the primary objective of schedule-risk analysis. Schedule-risk analysis comprises a series of engineering assessments and mathematical techniques whose joint goal is to measure the degree of confidence in which the schedule estimate (usually the duration of the critical path) is held. A three-step procedure built upon the results of a technical-risk study typically forms the schedule-risk analysis. First, an engineering assessment of the various technologies and procedures called for in the activity structure, vis-a-vis contractor experience and current state of the art, leads to probability distributions, such as beta, triangular, or normal, of the individual activity times. Second, these distributions are combined in a way that reflects the underlying parallel and serial relationships among the various activities that comprise the schedule. Once the total schedule-duration distribution has been established, the 50th, 70th, 90th and other duration percentiles can be read off the graph. For example, if the probability (taking all risks into account) that the true schedule duration is within a particular time period is 0.70, then that time period is referred to as the "70th percentile duration".

The duration-estimation process often assigns low, best, and high cost estimates to the several activities, and then estimates of the mean, variance, and percentiles of each activity time can be determined. Difficulties arise when it comes time to estimate the mean, variance and percentiles of the total schedule duration. It is not possible to find a general formula that expresses, for example, the 90th percentile, median, or most likely (mode) schedule duration in terms of parameters of the several activity time distributions and the relationships among them. Indeed, for all practical purposes, this latter statement holds true even if the activities are all parallel and independent. The present report describes a method of using Monte-Carlo simulation to generate the schedule distribution, based on time distributions of the activities and correlations among them. Percentiles and most likely duration can then be estimated from the distribution. No restrictions are imposed regarding allowable forms of activity time distributions and the extent of serial, parallel, or other effects on inter-activity-time correlation.

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

SOFTWARE COST ESTIMATING

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Mr. Stephen Gross presently serves as Head, Automated Information Systems (AIS) Division, Naval Center for Cost Analysis (NCA) with the responsibility for the performance of independent cost benefit analyses on all major Navy AIS programs. Additionally, he serves as the NCA technical leader in the area of software cost modeling and estimation. Previously he was the Head, Aircraft and Missile Branch of the Cost Analysis Division, Naval Material Command, and prior to the time he has held positions with the Air Force Data Services Center, OASD(PA&E), the Army Material Command and the IBM Corporation. He served as a commissioned officer in the USAF for four years and has a BA and MS in Applied Mathematics and an ABD in IEOR.

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

**ESTIMATING THE COST OF DEVELOPING ARTIFICIAL INTELLIGENCE SYSTEMS:
WHAT TO DO IF THERE ARE NO LINES OF CODE?**

Traditional software costing estimation models depend, directly or indirectly, on lines of code (LOC). The basic approach of LOC models is to translate LOC to effort (in units of work per time period) after which effort is translated to dollars (in units of \$/work per time period).

LOC models have a number of problems:

Definition of what constitutes a LOC: Count comments? Count command languages? How to count reused code?

The relation of LOC count to effort. Do five sub-projects of 5,000 LOC require the same effort as one project of 25,000 LOC?

Does the effort to develop 1K LOC in language X in an environment of a decade ago equal the effort to develop 1K LOC in language Y today's environment?

How does one determine LOC (a product of the programming phase) at the beginning of a project (when we estimate its cost)?

However, it is in the costing of the development of artificial intelligence (AI) systems where a most perplexing limitation in the use of LOC models arises: what to do when there are no LOC? Where are the LOC in developing an expert system with an existing shell? Where are the LOC in training a neural net?

But most LOC models have a feature which seem generally applicable to software development, they are nonlinear. We are developing a nonlinear model for cost estimation of such AI systems which are developed using existing AI tools. Initial steps address expert systems development using commercially available shells.

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SOFTWARE COST ESTIMATING IN A RAPID PROTOTYPING ENVIRONMENT

Because the majority of cost estimating tools available today have been calibrated using data from projects developed using traditional software development methodologies, estimates computed using these tools do not necessarily provide accurate cost projections for applications developed in a rapid prototyping/rapid development environment.

This paper presents a discussion of the efforts of this office on dealing with this scenario: the strengths and weaknesses of traditional cost estimating tools, new tools that are available for use, and recommendations on how to calibrate the models to provide more accurate predictions (e.g., how to incorporate actual data from applications developed in the rapid prototyping environment and how to adjust constants and coefficients to provide more accurate reflections of the development environment).

The information presented in this paper is based on actual estimates prepared by this office for numerous Army applications/programs, and on the comparisons with actual expenditures for the projects.

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SOFTWARE DATA COLLECTION AND ANALYSIS

In the past computer hardware development has been a challenge to the cost estimating world. However, with hardware technology forcefully advancing Non-Developmental Items (NDI) have become the primary acquisition solution throughout DoD. Software development has become the technical challenge of today - consequently the need for accurate and more efficient software cost estimating methodologies (tools) has emerged.

This paper analyzes and stratifies the data in the Electronics Systems Division (ESD) software cost data base and defines several cost estimating relationships (CERs) which were developed from this data. These CERs use few variables in order to create an accurate and a quick way of estimating ESD developmental software. In addition, due to the nature of how the CERs were designed as new data is collected and analyzed, updated CERs can easily be derived.

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ESTIMATING SOFTWARE VOLUME INDEPENDENT OF LINES OF CODE

The search for the "perfect" software measure of volume has been on-going for over twenty years. Lines of code has provided good results in most cases, but it is difficult for many persons to comprehend and apply. Adding to the problem is the current plausibility of code generators, reusable software repositories, and integration of off-the-shelf packages, making lines of code, in some cases meaningless.

Standard function points approach the problem by identifying functionality, but yield less than adequate results for aerospace and defense software. Additionally, large discrepancies in function point counts are an ongoing problem, especially in data base oriented and graphics oriented systems. There are even issues as to which part of function points describe volume versus which describe effort. People have often combined the two sides inadvertently.

The issues of software reuse cause yet another problem when dealing with software repositories, and non-line of code measures.

This paper discusses non-line of code methods that provide adequate volume definitions for both off-the-shelf software and new systems while keeping the benefits of standard lines of code measures.

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**PROPOSAL FOR ESTABLISHING A SOFTWARE
COST ESTIMATING MODEL**

This paper is an analysis of various software cost estimating models (e.g., COCOMO, SLIM, SEER, and Price-S) performed for the Naval Air Warfare Center-Weapons Division, China Lake. Research showed that the United States Navy, Air Force and Army cost estimating centers in Washington, D.C. all use several models, selecting the best model for the task at hand or using one model to check another. This analysis shows that the commercial models being considered possess many common features.

Leasing expensive component models does not guarantee success, since approximately 14 percent of the models leased are used successfully. To obtain a cost effective software cost estimating model, management must be as committed to keeping software metrics as it is to using a software cost estimation model. The paper contains concrete recommendations for implementation in any organization.

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**MONITORING CONTRACTOR PERFORMANCE
OF
SOFTWARE DEVELOPMENT EFFORTS:
Difficulties & Approaches**

Unfortunately, within DoD is it still typical (almost universal) that software-intensive acquisition projects encounter substantial difficulties ... because of inadequate customer scrutiny of contractors' development efforts. In contrast to the software-specific monitoring tools which have recently emerged (e.g., 2167A, the SEI Maturity Model, numerous Metrics), the Cost/Schedule Control System provides a familiar framework which customers may modify and use to extract performance information from reluctant contractors.

This paper first addresses specific difficulties that arise from modifying and applying Contractor Performance Reports (CPRs) to monitor software development efforts. The first major difficulty is for both customers and prime contractors to explicitly acknowledge that software deserves relentless visibility and "stringent" management attention. Subsequent to successfully negotiating "Special Interest" Software CPRs, technically adept customer and supplier analysts must assure that the Contract WBS actually does segregate (i.e., makes visible!) software effort from more aggregated hardware WBS elements ... and that distinctions between hardware and software effort are clearly reflected in the WBS dictionary. Then, Work Packages must be appropriately defined (IAW 2167A), and budgeted for via "disciplined" estimating techniques. After deliveries of Special Interest CPRs begin, Variance Reports and updates of Estimates at Completion receive special attention. And all of the above difficulties must also be addressed for subcontractor effort!

This paper then presents unique techniques that customer analysts may use to overcome difficulties involved in establishing and evaluating "software-specific" CPRs.

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USING SEER-SEM; A TUTORIAL

by

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No abstract was received for this paper

**A COMPARATIVE ANALYSIS OF THE GE PRICE S
AND THE CEI SYSTEM-4 SOFTWARE COST ESTIMATING MODELS**

The GE PRICE S (Programmed Review of Information for Costing and Evaluation-Software) model is commonly used at Aeronautical Systems Division (ASD) to estimate software development costs. During recent source selections, it has been standard practice to cross-check the software cost estimate using another method/model. The purpose of having a cross-check is not to simply obtain an identical estimate but to ensure that a similar estimate will be produced while the integrity of the effort being estimated is maintained. The Computer Economics Incorporated (CEI) System-4 model can be used as a cross-check to the PRICE S model if the correlation between the inputs of the two models is understood and the estimator realizes the basic differences in the estimating assumptions between the models.

This paper describes the evolution of cost estimating weapon system software and traditional problems that are incurred. Parametric models and their use are discussed. Overviews of The GE PRICE S model and The CEI System-4 model are provided as well as a guide on how the inputs between the models correlate. A software development project is defined and the corresponding estimates from the two models are evaluated to support the hypothesis that similar estimates are created. Differences between the two models which may skew the estimate, are identified. Finally, the current AF Form 2499a is evaluated based on the inputs of both models. Modifications are suggested so that the data provided on the form accommodates the input parameters of either model.

The goal of this paper is threefold:

- 1) to prove that similar estimates are created when System-4 and PRICE S models are applied correctly,
- 2) propose modifications to the AF Form 2499 so that it is adaptable to either model,
- 3) provide estimators guidance for using System-4 as a cross-check to PRICE S.

Thus the overall objective is to make System-4 easier to use as a cross-check for PRICE S and expand the software estimating tools available to estimators.

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SOFTWARE COST ANALYSIS USING FUNCTION POINT METRICS

Software Development and Operation and Support requirements could produce by 2025 the world's largest occupation. The importance of continuing to improve software in military weapon systems was demonstrated in Desert Storm. The current economic situation dictates that accurate cost analysis be performed early in the development phase. With every military program competing for steadily declining resources, upgrading to State of the Art modern languages and equipment is becoming a manager's economic Waterloo.

Traditional Lines of Code (LOC) measurement methodologies have delivered greatly fluctuating program projections against completed program results. With the A-10, congress has demonstrated to analysts, the necessity of staying within their estimate and budget.

Function Point Software Metrics was developed by IBM and is currently used by 600+ software production/operational support organizations internationally to provide the "Logic behind the Measurement" analysis.

Measurement using Function Points effectively controls the development process; enables the productivity, cost and quality improvement cycle; more accurately estimates the development effort; and insures customer satisfaction with the finished product.

Function Points overcomes the objections against LOC's as a metric because LOC's are dependent upon technology, controlled by the individuals being measured, and not understandable by most customers.

This paper will review the International Function Point Counting Practices, 3.2 manual. It will discuss how the U.S. Air Force Standard Systems Center baseline 42 Computer Software Configuration Items for their initial Function Point survey and lessons learned. It will include the findings of a MIT survey that covers consistency between various Function Point counting personnel.

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**AN EVALUATION OF THREE FUNCTION POINT MODELS
FOR ESTIMATION OF SOFTWARE EFFORT**

Function point analysis has become well-established as a method for estimating software size and, sometimes, software effort. However, the accuracy of estimation models using function points to estimate size or effort has not been ascertained significantly. This paper summarizes a study performed at the Air Force Institute of Technology (AFIT) in 1991 to assess the expected accuracy of three function point-based models: the Tecelote Software Program Acquisition Network Simulation (SPANS) model, the Checkpoint model, and the Costar model.

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A FUNCTIONAL SIZING METHODOLOGY FOR ESTIMATING MISSILE SOFTWARE COSTS

The increase in missile guidance system sophistication have resulted in corresponding increases in requirements for complex software system development for both launch and guidance systems. Based on the operational characteristics of missile guidance systems we have developed a functional work breakdown structure (WBS) and collected a database (in source lines of code) (SLOC) on four missile systems. These are the Standard Missile II, (BLK IV, ER); the Phoenix (AIM-54C); Advanced Air-to-Air Missile (AAAM); and the Sidewinder (AIM-9R) software guidance systems. Each guidance function has been identified and a statistical summarization of the data have been completed. A descriptive characterization of each WBS element have been accomplished that allows an analyst to compare a proposed software effort with similar efforts in the database in order to accomplish both a sizing and a resource estimate. Both the WBS and database was implemented in the SASSET model. An illustrative example is given estimating sizing and software conversion costs using the Common ADA Missile Parts (CAMP) component library framework.

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**AIR FORCE COST ANALYSIS AGENCY SOFTWARE ESTIMATING INITIATIVES
SOFTWARE ESTIMATING IMPROVEMENT PROJECT (SWEIP)**

The Air Force Cost analysis Agency (AFCAA) is developing a plan to improve Air Force capability to estimate the effort and schedule of software development and support. Several efforts have already been initiated while others are continuing to be developed. This presentation will be a review of the Overall plan including both the on-going and planned efforts. Attendee participation with constructive comments and suggestions will be solicited.

The following is an outline of the topics to be discussed.

- I. AIR FORCE SOFTWARE ESTIMATING NEEDS/REQUIREMENTS - Review of the stimuli, processes and information used to identify Air Force software estimating requirements and needs.
- II. MODEL SELECTION - Identification of the software estimating tools selected and known "gaps" in the existing suite of tools.
- III. MODEL ACQUISITION - Brief review of the contractual efforts to date to acquire and/or support the selected software estimating tools.
- IV. MODEL DISTRIBUTION & RIGHTS - Overview of AFCAA software estimating tool distribution activities. Will also include a discussion of the current status of government rights to the various tools and plans to expand government rights.
- V. MODEL DEVELOPMENT AND IMPROVEMENT - Specific information on existing efforts to improve the non-commercial software estimating tools. General information on proposed future enhancements to the selected tools, and possible acquisition and/or development of new tools.

Preliminary results on an AFCAA effort to recalibrate REVIC (COCOMO) will be represented if possible.

- VI. TRAINING & USER SUPPORT - Review of the perceived training requirements for Air Force personnel doing software estimating and specific plans for providing the necessary training.
- VII. DATA COLLECTION AND ANALYSIS - General discussion of the various data collection efforts required to support the various analyses being conducted, proposed or required.
- VII. ADDITIONAL EFFORTS - Review of some important secondary analytical efforts required to support the primary objectives.
- IX. CHALLENGES - Consideration of existing limitations and other potential difficulties or obstacles and possible methods to overcome them.

John B. Donald, Software Cost Analyst
Air Force Cost Analysis Agency

FINANCIAL ANALYSIS OF DEFENSE CONTRACTORS

WORKSHOP CHAIRPERSON

MS. DOROTHY BERNAY

Ms. Dorothy Bernay is the Team Chief for the Strategic Systems, Aircraft and Missiles ICE Division, Army Cost and Economic Analysis Center and is the National Treasurer for the Society of Cost Estimating and Analysis. Ms. Bernay has a BS degree in Mathematics and a MBA in Management and Organization. She is a graduate of the Army Comptrollership Program at Syracuse University. Prior to Ms. Bernay's current assignment, she held position as a Cost Analyst with the US Army Strategic Defense Command, the US Army Cost Economic Analysis Center, and as an Auditor for the Defense Contract Audit Agency. Ms. Bernay is a Certified Cost Estimator/Analyst and is currently the Treasurer of the National Society of Cost Estimating and Analysis (SCEA).

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

TQM: A SYSTEMATIC APPROACH

In a free enterprise system, quality should pay! The key question is whether TQM produces the efficiencies, savings, and profits that its advocates claim will result over the long-term. To answer this question we used the Compustat Database to perform a profitability analysis on those corporations which have won the Malcolm Baldrige National Quality Award for implementation of TQM.

Basically, TQM is a systematic approach to continuously improve business processes that requires an integrated team effort. Our review of past research has generally shown a positive linkage between TQM and profits. However, this past research was qualitative in nature and failed to report actual financial data. Past research also failed to compare profit results to industry averages to see if TQM leads to better profitability levels than industry averages. By comparing the financial ratios of Baldrige winners to their industry averages (cross sectional analysis) over time (trend analysis), we could see whether the company was performing better than its industry no matter what economic and competitive conditions the industry had encountered.

We performed a macroscopic profitability analysis on firms that had implemented TQM. Limiting the research to winners of the Baldrige National Quality Award established a sample of companies that had been rigorously determined to excel in Quality Management. The efficient use of resources is the focus of Quality Management. Therefore, we used the Return On Assets (ROA) ratio as our key measure of profitability. ROA relates profits to efficient asset use and to long-term growth of assets. We used graphical plots of company and industry average ROA which permit a simultaneous view of profit trends and comparisons to the industry average. Of the twelve companies studied, seven improved profits, four had declining profits, and one was unreported. Since the results are positive but mixed, we have concluded that TQM might be a necessary condition for survival in a competitive global economy but not a sufficient condition for profitability.

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**PROJECTING OVERHEAD RATES IN AN ENVIRONMENT
OF CHANGING CAPITALIZATION AND BUSINESS BASE**

Because of a diminishing business base, the cost efficiency of major defense contractors is threatened by burgeoning overhead rates.

Overhead costs contain a fixed and variable component. The fixed component depends on capital stock at the company and the variable component depends upon the company's business base. In forecasting total overhead costs, the influence of each component needs to be considered.

Using historical data, we have developed statistical models which forecast overhead rates for particular firms. The sensitivity of overhead rates to business base and to the level of capital assets is examined.

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FINANCIAL ANALYSIS OF DEFENSE CONTRACTORS
"ARMY CONTRACTORS: FINANCIALLY SOUND OR HEADED FOR TROUBLE?"

This paper explains the methodology, uses, and limitations of corporate financial reviews within the Army decision making structure. It details the automated sources, analytical measures, and indicators used to evaluate prospective contractors in the acquisition process. The paper addresses financial indicators of a given company, a comparison of those indicators to the respective industry, and when appropriate, comparisons under hypothetical conditions.

The paper relies upon the Army's Quarterly Financial Bulletin, which reviews five principal Army contractors and then details one of the five. Associated with the paper is a presentation illustrating definitions, methodology, and application of the financial indicators. For the cost symposium, within the limits of hardware support, the Army's Directorate of Financial Analysis could provide a demonstration of the data base used for the analysis. The Standard and Poor's Compustat Database is used as the basis for the analysis. Additional sources reviewed include Value Line and Dun & Bradstreet's.

Attendees should have a general understanding of accounting terminology. Most calculations, though very detailed, are easily understood by those not concentrating in financial analysis. The bulletin, paper, and presentation are directed toward decision makers. The paper explains how a complex subject can be simplified without losing important content.

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FINANCIAL ANALYSIS OF DEFENSE CONTRACTORS

The financial strength of the Defense Contractor is important when evaluating the proposed product/service cost. The Financial Analysis must be a timely, dynamic, on going analytical tool to determine if the contractor is financially sound. Department of Defense must know whether we are working with a going concern. Via the Financial Analysis Defense must position itself to track and predict (to a high degree) corporate failure.

The bottom line of the Financial Analysis of the Defense Contractor is to predict that the contractor can meet program objectives with the least amount of risk to the Government. This paper will develop the smart way to use current in-place procurement strategies with independent objective financial data bases to provide a meaningful Financial Analysis.

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INNOVATIVE APPROACHES TO COST ESTIMATING

WORKSHOP CHAIRPERSON

NORMAN DRAPER

Responsible for the overall accomplishment of the Tactical Wheeled Vehicle Team and the Armored Gun System (AGS). Manages work assignments to meet requirements for staffing, completeness, and timeliness. Reports significant problems with recommendation for action based on analysis and evaluation. Prepares performance standards, appraisals and individual development plans for assigned team members. Establishes, reviews and revises policies and procedures for cost analysis products such as Independent Cost Estimates (ICE's), Baseline Cost Estimates (BCE's), and the Army Cost Position (ACP). Prepares ICEs for the Tactical Wheeled Vehicle Program and the AGS. Briefs the ICE and ACP to HQDA staff and OSD.

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Undergraduate - BA, Economic and Political Science, 1965.

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Sep 90 - Present	Team Chief, Vehicles, Electronics, and Ammunition Division, USACEAC
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Sep 72 - Sep 84	Economist, HQAMC
Sep 69 - Aug 72	Budget Analyst, Computer Systems Command
Aug 68 - Aug 69	Budget Analyst, HQAMC
Jun 65 - Jul 68	Comptroller Career Intern

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

**USING THE ANALYTIC HIERARCHY PROCESS
TO PRODUCE A ROM ESTIMATE**

Groups or individuals are increasingly confronted with situations in which they must produce Rough Order of Magnitude (ROM) estimates to support decisions without enough time to conduct a full investigation into the relevant sources of information to support the Estimate. In these cases decision makers rely on expert judgment and the best information they can gather within the time or resource constraints under their control. TASC has developed an approach that integrates group facilitation techniques using linkage analysis and a powerful automated decision support tool (Expert Choice) to assist decision makers in creating the best ROM estimate possible with the information and time available.

Our approach involves working with small groups of experts to concentrate the expertise and judgment of the group on the issue at hand. Key cost drivers are identified and a WBS map of the Estimate is created thus modeling the ROM. Using the Analytic Hierarchy approach, pairwise comparisons are made to set the weight of various cost categories and sub categories. The weights represent the portion of the total estimate "normally" accounted for by the various elements of cost. The subject to be estimated is compared at the lowest level of the decision hierarchy with known systems. The result of our session is a relative ranking of the decomposed parts of the estimate. When the elements are rolled up and assembled according to the element weights, a relative ranking of the subject systems is presented with the known systems. Since the system is registered with known costs, a simple calculation is used to produce the Knowledge based ROM.

This approach has been used on large Government systems and has successfully produced credible results with minimum expenditure of time and resources. In the current environment of rapid change this approach could prove useful to organizations and individuals in need of very quick turn ROMs.

I propose a workshop in which the concepts of AHP and the Application of those concepts to creating a ROM estimate are presented and demonstrated to the group. The presentation would include the audience in structuring a decision hierarchy for an Estimate, making judgments about the historical nature of the cost element weighting, and comparing a proposed system to known systems to produce a relative ROM.

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THE JAVELIN-BASED COST ENGINEERING INTEGRATION TOOL

The United States Space Systems Division located at the Los Angeles Air Force Base in California, together with SAIC, and others are currently integrating System Engineering and Cost Estimating using a PC-based Cost Engineering Integrated Tool (CEIT) that is proving to be a milestone in the Cost Estimating and Cost Engineering arena.

What is a Cost Engineering Model? (CEIT)

The CEIT is an off-the-shelf cost and engineering design tool that can perform quantifiable modeling analysis. It is currently run on a software program called Javelin. It is very easy to learn. Within a few hours first-time users can freely move throughout the interdependencies of the model, viewing and analyzing the step-by-step logical flow of all CER and performance equations from their base root input to the final system cost or performance equation.

The benefits of using the CEIT are enormous. Because of new insight into performance parameters and drivers, cost estimators have some of the best insights into the effect of methodology changes. They can focus on cost research and can refine existing methodologies through the CEIT's higher fidelity application, which leads to better cost estimates. The CEIT benefits programs by giving insight into estimates and cost sensitivities. Management can now understand the effects design changes have on cost. We can quantify technology leverage and view how cost/performance is optimized. Using the CEIT makes program management feel confident they are delivering a credible, cost effective product.

It is a breakthrough to see both cost estimators and engineers come together as a very powerful team. Not only have we reached a milestone in Cost Engineering, but we're changing the way we do business.

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ON THE RELIABILITY OF INDICATORS OF LEARNING CURVE MODEL ACCURACY

This paper is a description of research in process, to be completed during the next couple of months.

Cost analysts, operations analysts, purchasing managers, among others, frequently use learning curve models to estimate future costs. Typically models are fit to available data, model parameters estimated and then forecasts are made based on the fitted model. Typically measures of goodness of fit such as r^2 , F or standard error are seen as indicators of how well the model may be expected to forecast future costs. This paper investigates whether such "ex ante" indicators do describe actual model forecast accuracy. Are there conditions when such indicators can be trusted to reliably inform analysts concerning the predictive quality of the model? Are there conditions when the same indicators may be misleading? Should analysts pay attention to certain indicators in some situations and different ones in other situations? These questions are addressed by simulating series of cost data under varying conditions, estimating learning curve models from the data, and then comparing the ex ante indicators of model fit with actual after-the-fact measures of model forecast accuracy. The degree to which ex ante indicators appropriately signal actual model accuracy under varying conditions is assessed.

This paper currently describes the research questions, the research approach, variable, measures, data and the planned analysis. No results are reported.

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**APPLYING TRADITIONAL COST ESTIMATING METHODS
TO NON-TRADITIONAL DEFENSE PROGRAMS**

The projected budget reductions are causing an adjustment of DOD activities. The typical DOD Cost Analyst has been predominately concerned with cost estimating for traditional weapons systems. The requirement for this type of analysis is changing and defense cost analysts must apply their skills to similar but diverse cost analysis projects. SAIC has recently completed several interesting cost analyses which are not predominately weapon systems analyses. The analyses include:

- o A life cycle cost estimate of the program to destroy the defense arsenal of chemical munitions including construction, processing, and clean up activities.

- o An acquisition cost estimate for major components of the Super-conduction Super Colider (SSC) program including state-of-the-art technologies and one of a kind components.

- o An assessment of the Economic Cost of a Nuclear Attack on a US city (the impact of a leak in the strategic defense network) which included property and economic damage and the economic cost of human life.

Each of these projects utilized cost estimating and analysis skills developed in the weapon systems analysis process. This paper discusses the transfer of cost estimating skill from typical DOD Weapon System projects to larger DOD programs.

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COST ARCHIVE AND RETRIEVAL SYSTEM (COSTARS)

OVERVIEW: Given the present uncertain defense environment and the probable increased reliance on technologically advanced weapon systems, fast and accurate cost estimating relationship (CER) development is crucial. The COSTARS is a complete software package designed to aid cost analysts in CER development process.

CONTENT: The COSTARS is a compiled, object-oriented, mixed language (Clipper 90 percent; Microsoft C & Microsoft Macro Assembler 10 percent) relational database application which accesses dBASE compatible databases containing synopsized cost studies with their associated CERs and data. Since a cost study may contain zero or more CERs, a database is maintained for document specific information, and another is maintained for CER specific information. The COSTARS two major modules.

1. The first module has a database search option on key fields such as title, author, abstract, P-92 element, and methodology. A dual browse object with a hot key toggle allows the user to simultaneously browse the document and CER databases. The user can add and edit studies using a full screen editor and has access to a built in text editor for long memo fields such as abstract of methodology. Additionally, selected studies can be moved between the hard drive database and floppy diskettes. Any combination of fields can be written to a printer or an ASCII file. All these features combine to allow easy database maintenance and retrieval of information useful for the CER developer.
2. The second module is a complete regression analysis package used to update and validate existing CERs in the database to develop new CERs. Features include data transformations to linearize the data, high resolution scatter plots and residual analysis, simple and multiple regression, and calculation of the table and test values F and T statistics for any confidence level and degrees of freedom. Thus hypothesis testing for goodness of model and regression parameters is performed automatically for the user. Bonferonni joint confidence intervals for the regression parameters are also calculated. It will be shown that the probability density functions for the F and T statistics can be related to the incomplete beta function. A Taylor's series expansion of the incomplete beta function renders an infinite, rapidly converging series of complete beta functions. Thus the table values of the F and T statistics can be calculated quickly and accurately using only one mathematical library function. The regression module has been validated by ALMC faculty members.

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SIMULATING CORRELATED COST ELEMENTS WITH BOUNDED DOMAIN

This paper develops an algorithm to simulate vectors of correlated cost elements. The user is not assumed to provide a fully-specified joint distribution of costs. Rather, the user provides only the lower bound, upper bound, mean or mode, and possibly the variance of each cost element. The user also provides the matrix of correlations among the cost elements. The algorithm is demonstrated through two numerical examples. The first example uses triangular distributions for each cost element, and the second example uses beta distributions. In both cases, the means, variances, and correlations of the simulated values closely approximate the user-supplied values.

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HAZARDOUS MATERIAL MANAGEMENT LIFE CYCLE COST MODEL

In recent years the Department of Defense (DOD) has become seriously aware of the tremendous cost in using hazardous materials in weapon systems. In 1989, the Air Force Systems Command established the Acquisition Management of Hazardous Materials Program and created the Hazardous Materials Management Task Force to study and combat this problem.

In the fall of 1990, the Task Force contracted with The Analytic Sciences Corporation (TASC) to develop a Hazardous Materials Management Life Cycle Cost Model. This type of modeling effort has never before been attempted. The model will be used as an analytical tool by Systems Program Offices, contractors, and Logistics Centers to perform trade-off analyses in selecting alternative hazardous and nonhazardous materials. The ultimate goal is to reduce the use of hazardous materials in weapons systems and the processes that produce and support those systems. Application of the model has been expanded to include Army and Navy systems, as well as Air Force.

This Paper will trace the development of this one-of-a-kind model, discuss its capabilities and limitations, and review the algorithms and modeling methodology used. This model has DOD-wide application and should be of interest to anyone who has a concern for the environment.

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SPACE SYSTEMS DIVISION SATELLITE COST FACTORS

Space Systems Division (SSD) uses various technical tools, models, and methodological devices to facilitate cost estimating for satellite systems. It was necessary for SSD to develop simple heuristics or rules of thumb to perform cross checks and quick gross estimates of satellite costs. The heuristics were designed to be used by Independent Cost Estimate (ICE) team members, System Program Office (SPO) estimators, Program Managers, and anyone else interested in quickly computing a "sanity check" cost of satellites.

The paper will discuss the methodologies for developing SSD Satellite Cost Factors by using the database from SSD's Unmanned Space Vehicle Cost Model, Sixth Edition, November 1988. Statistical techniques applied for stratifying the database and the implications of tested statistical results will be discussed. The paper will also accomplish a simple quantitative factor analysis which will represent correlations between the data variables and certain hypothetical constructs: the "factors".

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26th ANNUAL DEPARTMENT OF DEFENSE COST ANALYSIS SYMPOSIUM

SPECIAL INTEREST SESSIONS

"COST ANALYSIS IN AN UNCERTAIN DEFENSE ENVIRONMENT"

ARMY AND AIR FORCE DEMONSTRATION OF ACE-IT & ACES

The U.S. Army Cost and Economic Analysis Center (USACEAC) and the Air Force's Electronic Systems Division (ESD) are jointly developing a version of the existing PC version of Automated Cost Estimating - Integrated Tools (ACE-IT). This updated version of ACE-IT will permit the production of cost estimates and documentation to meet Army reporting requirements. For the Army, this version will be called Army Cost Estimating System (ACES) and it will be part of a more comprehensive system with modules for use by both cost analysts and business managers. The overall system will include ACES with automated tools for cost estimating (with ACE-IT as the core estimating tool), to support analysts producing both Baseline Cost Estimates (BCEs) and Independent Cost Estimates (ICES); tools for economic analysts producing Economic Analyses (EAs) for MAISRCs and cost tradeoff studies; tools to help business managers track contracts; and tools to help business managers prepare budgets. ACES and the overall system will also have automated linkages to the USACEAC Information Architecture which contains data from past development, production and operational weapons and material systems. ACES will also include features which were part of or planned for the system, developed by the Army Material Command, such as: a CER development module with a built in statistical package for regression analysis and the ability for a user to develop a documentable BCE/ICE using an automated structured approach, or develop a BCE/ICE without being led through the structure of a fully documented BCE/ICE. The existing and planned features of the overall system will be discussed, with specific demonstrations of both ACES and ACE-IT provided.

This development effort represents an approach that maximizes the use of existing technology and permits available techniques developed by the Air Force to be used and improved by the Army, which will in turn benefit the Air Force. This is an example of a joint-Service/CIM initiative and may result in a candidate for a DoD-wide cost and economic analysis system for use by all DoD cost analysts, program managers and PEO business managers.

Sponsor:

US Army (USACEAC)

US Air Force (AFCAA/OS)

ECONOMIC TRENDS

Overview

As the Department of Defense begins to drawdown from its cold war expenditure levels almost all areas of defense spending will be affected. This workshop will focus on the impact these reductions will have on the U.S. economy, the nation's workforce, and our future national competitiveness.

Current Economic Conditions

The discussion will present a comprehensive assessment of the current status of the U.S. economy, including a discussion of the recent recession and a comparison of this downturn to that of the recession of 1981-82.

Historic Trends

In order to develop a basis for analyzing the impacts of reduce defense spending on the U.S. economy, the presentation will consider recent trends in defense spending, projected levels of expenditure (including a comparison of alternative spending paths) and trends in defense employment.

Short-term Macroeconomic Impacts of Reduce Defense Expenditures

Using two highly respected models, the workshop will include a discussion of the impacts reduced levels of defense expenditures will have on the U.S. economy. This is considered both in terms of effects on growth in Gross National Product and on national employment levels. Additionally, this phase of the workshop discusses how Defense cuts will affect individual industries in terms of defense related market share and employment levels.

Long-term Impacts on Savings, Investment, and Growth

The presentation concludes by considering the long-term impacts of defense costs on savings, investments, and growth. Also discussed is the impacts of a growing deficit on investment and national competitiveness.

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REPORT DOCUMENTATION PAGE			Form Approved DAB No. 0704-0122	
Public reporting burden for this report is estimated to be 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Project, (0704-0122), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE 9 Sept 1992	3. REPORT TYPE AND DATES COVERED Final 9-11 Sept 1992		
4. TITLE AND SUBTITLE Cost Analysis in an Uncertain Defense Environment		5. FUNDING NUMBERS		
6. AUTHOR(S) Robert E. Lee ,et all				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Center for Cost Analysis NCA-1 Pentagon, Room 4A538 Washington, DC 20350-1100		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) OSD(PA&E) The Pentagon Room 2D278 Washington, DC 20350 (26th ADODCAS)		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES N/A				
12a. DISTRIBUTION AVAILABILITY STATEMENT Approved for Public Release; Distribution is unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This document includes over 100 abstracts of the papers presented at the 26th Annual Department of Defense Cost Analysis Symposium (ADODCAS) on 9-11 September 1992 at the International Training Center in Leesburg, VA. There were fourteen workshops covering the following subjects: Acquisition Strategy; ADP Cost Estimating; Affordability; Contractor Cost Data Analysis; COEAs; Defense Business Operating Funds Issues; O&S Cost Estimating; Parametric Cost Estimating Relationships; R&D Cost Estimating; Risk Analysis; Software Cost Estimating; Financial Analysis of Defense Contractors; Innovative Approaches to Cost Estimating; ACE-IT/ACES; and Economic Trends. The abstracts include the point of contact for each lecture given at the three day training sessions which included cost analysts from the three services plus several foreign countries.				
14. SUBJECT TERMS Cost Estimating; COEAs; Software Costing; Risk Analysis; CCDRs; CERs; Affordability		15. NUMBER OF PAGES 174		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL	