Description of document:	25th Annual DoD Cost Analysis Symposium, Cost Analysis: A Quarter Century of Progress - Challenges for the Future, 1991
Requested date:	08-June-2016
Released date:	22-August-2016
Posted date:	31-October-2016
Source of document:	U.S. Army Freedom of Information Office Casey Building, Suite 150 ATTN: AAHS-RDF 7701 Telegraph Road Alexandria, VA 22315-3905 Fax: (703) 428-6522 E-mail: usarmy.belvoir.hqda-oaa-ahs.mbx.rmda-foia@mail.mil Online form

DEPARTMENT OF THE ARMY
ASSISTANT SECRETARY OF THE ARMY
FINANCIAL MANAGEMENT AND COMPTROLLER
109 ARMY PENTAGON
WASHINGTON DC 20310-0109

August 22, 2016

Enclosed you will find a copy of the 25th Annual DoD Cost Analysis Symposium as you requested. Please note that the Army Cost Analysis does not have an electronic version per your request as this conference was put on well over 20-years ago, and the current copy was too large to send via email, so we are providing you a hard copy for your use.

Point of contact for the approval for release of this copy is Mr. Morteza Anvari, SES, ASA (FM&C), Cost and Analysis Directorate, (703) 692-7410.

Telisa R. Combs
ASA(FM&C)/DCS G-8 Freedom of Information and Privacy Officer

FP-16-023660
FA-16-1555

DEPARTMENT OF DEFENSE
OFFICE OF FREEDOM OF INFORMATION
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155

JUL 15 2016

Ref: 16-F-1154

MEMORANDUM FOR DEPARTMENT OF THE ARMY
ATTN: AHRC-PDD-FP
FREEDOM OF INFORMATION AND PRIVACY ACTS DIVISION
7701 TELEGRAPH ROAD
ALEXANDRIA, VA 22315-3860

SUBJECT: Freedom of Information Act Request Referral

The attached FOIA request, submitted on June 8, 2016, was received in this office on June 14, 2016 and assigned case number 16-F-1154. The requester seeks a copy of the "Annual DoD Cost Analysis Symposium (25th). Cost Analysis: A Quarter Century of Progress – Challenges for the Future."

The Defense Technical Information Center forwarded the responsive record to our office. As there are pages of the document with your letterhead, we are referring the responsive document for your review and direct response to the requester. Please note that the Office of Cost Assessment and Program Evaluation reviewed the responsive record and recommended that it should be disclosed in full.

A copy of the initial request is attached for your information. The requester was informed of this referral to your office. If you have any additional questions, please contact the action officer assigned to this request, Irina Tsiklik, at Irina.tsiklik.civ@mail.mil or (571) 372-0465.

for Stephanie L. Carr
Chief

Attachments:
As stated

DEPARTMENT OF DEFENSE
OFFICE OF FREEDOM OF INFORMATION
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155

Ref: 16-F-1154

This is the final response to your enclosed June 8, 2016 Freedom of Information Act (FOIA) request for a copy of the of the "Annual DoD Cost Analysis Symposium (25th). Cost Analysis: A Quarter Century of Progress – Challenges for the Future." Your request was received in this office on June 14, 2016 and assigned FOIA case number 16-F-1154.

The Defense Technical Information Center forwarded responsive information to this office. After a review of the information, we have determined the information is under the cognizance of the Department of the Army. As the Army operates its own FOIA office, your request and the information have been further referred to the Army for review and direct response to you. If you should have any questions regarding the processing of this document, you may contact the Army directly at the following address:

Department of the Army
ATTN: AHRC-PDD-FP
Freedom of Information and Privacy Acts Division
7701 Telegraph Road
Alexandria, VA 22315-3860

Your request is now closed in this office. There are no assessable fees associated with this response.

Sincerely,

for Stephanie L. Carr
Chief

Enclosure:
As stated

25th Annual DoD Cost Analysis Symposium

Cost Analysis: A Quarter Century of Progress - Challenges for the Future

Silver *Anniversary*

25TH ANNUAL DoD COST ANALYSIS SYMPOSIUM

SCHEDULE

TUESDAY, 3 SEPTEMBER 1991

Registration/Check In	1400-2100	Lobby
Hour of Renewed Acquaintance	*1900-2100*	*Red Commons*

WEDNESDAY, 4 SEPTEMBER 1991

Daily/Late Registration	0700-1200	Lobby
Breakfast	0700-0800	
Service Session	0800-0930	Army - 3460/3462 Air Force - 3464/3466 Navy - 4460
Break	0930-1000	
Opening/Keynote Speaker	**1000-1130**	**Dr. David S. C. Chu** **Room 3471**
Lunch	1130-1300	
Special Topic ***Earned Value***	**1300-1530**	**Mr. Gary Christle** **Room 3471**
Session I	1300-1400	
Break	1400-1410	
Session II	1410-1510	
Break	1510-1530	
Session III	1530-1630	
Mixer	***1630-1900***	

25TH ANNUAL DoD COST ANALYSIS SYMPOSIUM

SCHEDULE

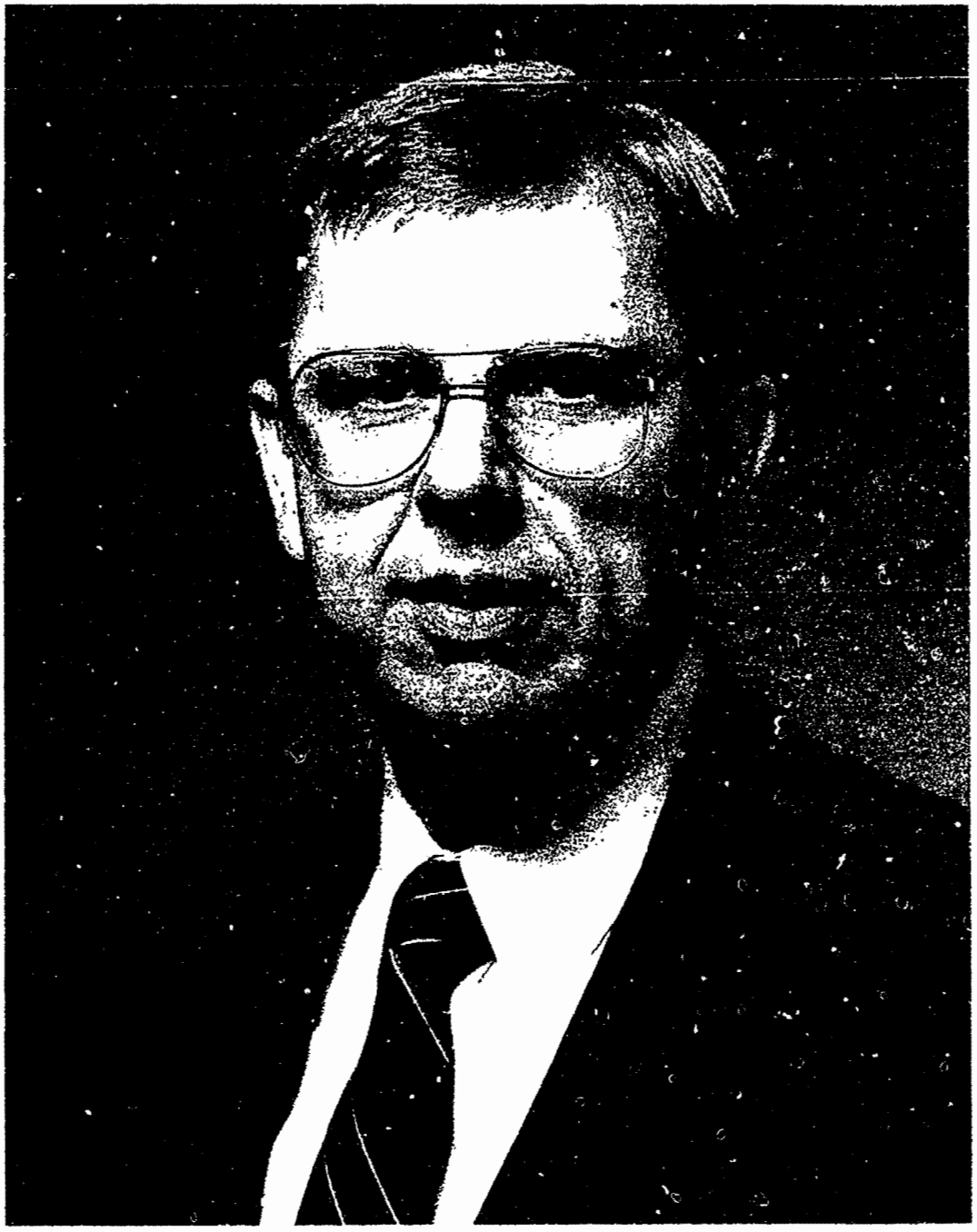
THURSDAY, 5 SEPTEMBER 1991

Daily Registration	0700-0900	Lobby
Breakfast	0700-0800	
General Session **Cost Growth**	**0800-0900**	**Dr. David L. McNicol** **Room 3471**
Break	0900-0910	
Special Panel ***Innovative Approaches***	**0910-1130**	**Dr. David Lee** **Room 3471**
Session IV	0910-1010	
Break	1010-1030	
Session V	1030-1130	
Lunch	1130-1300	
Session VI	1300-1400	
Break	1400-1410	
Session VII	1410-1510	
Break	1510-1530	
Session VIII	1530-1630	
Banquet	***1800-2130***	***Holiday Inn Dulles***
Dance	***2130-0100***	***Main Ballroom***

FRIDAY, 6 SEPTEMBER 1991

Daily Registration	0700-0900	Lobby
Breakfast	0700-0800	
General Session **Military Force Structure Changes**	**0800-0900**	**Dr. John Morgan** **Room 3471**
Session IX	0910-1010	
Break	1010-1030	
Session X	1030-1130	
Lunch	1130-1300	
Closing Session	**1300-1400**	**Dr. David Lee** **Room 3471**
Hotel Check Out		

Each session is devoted to workshops. See workshop schedule for complete details.



ROBERT W. YOUNG

DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
WASHINGTON, DC 20310-0103

September 4, 1991

Welcome to the Silver Anniversary of the Annual DoD Cost Analysis Symposium!

Our theme this year is **"Cost Analysis - A Quarter Century of Progress - Challenges for the Future."** As your Army host, we and your Service's committee representative have worked diligently over the past year to make this Silver Anniversary Symposium a truly memorable event. This year we have obtained excellent general session speakers, received a record number of outstanding professional papers, arranged for 16 workshops and included a number of special events designed to make this Symposium both an enjoyable and an educational experience.

I look forward to meeting you and I encourage you to be an active participant in all the Symposium events.

Robert W. Young
Deputy for Cost Analysis
OASA(FM)

25TH DOD COST ANALYSIS SYMPOSIUM

KEYNOTE ADDRESS
WEDNESDAY 4 SEPTEMBER 1991, 1000-1130

Dr. David S. C. Chu
Assistant Secretary of Defense (Program Analysis and Evaluation)

David S. C. Chu was born in New York City on May 28, 1944, and was educated at Yale University. He received his BA in Economics and Mathematics in 1964 and his Ph.D. in Economics in 1972.

Dr. Chu was appointed Assistant Secretary of Defense (Program Analysis and Evaluation) in July 1988. He had earlier served as Director, Program Analysis and Evaluation (1981-88)

Prior to his Pentagon appointment, Dr. Chu was the Assistant Director of the Congressional Budget Office for National Security and International Affairs (1978-81). He had earlier served as an economist with the Rand Corporation (1970-78), and was also the Associate Head of the Economics Department (1975-78). Dr. Chu served in the U.S. Army from 1968-70.

Among the Honors Dr. Chu has received are: Phi Beta Kappa, Honorary Woodrow Wilson Fellow, National Science Foundation Fellow, and Foreign Area Fellowship Program Fellow. He has been awarded the Department of Defense Medal for Distinguished Public Service with Bronze Palm and the National Public Service Award of the National Academy of Public Administration, of which he is a Fellow.

25TH DOD COST ANALYSIS SYMPOSIUM
GENERAL SESSION SPEAKERS

Dr. David L. McNicol

Dr. David McNicol has served as Deputy Assistant Secretary of Defense for Resource Analysis and Chairman of the Cost Analysis Improvement Group since February, 1988. Dr. McNicol joined the Office of the Secretary of Defense in February, 1982, and was Director of the Economics and Resource Planning Division with the Office of Program Analysis and Evaluation before assuming his present position. Prior to coming to the Department of Defense, Dr. McNicol held positions with the Department of Energy, the Treasury Department and the President's Council of Economic Advisors, and was earlier a member of the faculties at the University of Pennsylvania and the California Institute of Technology. He was educated at Harvard University and the Massachusetts Institute of Technology, for which he received a Doctorate in Economics and Finance in 1973. His published works include studies of public utility regulation, international commodities markets and energy policy.

Dr. John Morgan

Dr. John Morgan is Director, Force Structure and Support Cost Analysis Division, Office, Assistant Secretary of Defense (Program Analysis and Evaluation). Previously, he was a member of the research staff, Institute for Defense Analysis; Director of Cost Analysis, Headquarters, U.S. Air Force; and, Deputy Comptroller, Air Force Logistics Command. Dr. Morgan is a graduate of the University of Kansas and received his MBA from Columbia University and Ph.D. in Economics from Georgetown University. He also attended the Industrial College of the Armed Forces

Dr. David Lee is the Innovative Approaches to Cost Estimating Workshop Chairperson. His photograph and detailed biography can be found in the workshop chairpersons section.

25TH DOD COST ANALYSIS SYMPOSIUM

GENERAL SESSION - COST GROWTH
THURSDAY 5 SEPTEMBER 1991, 0800-0900

Dr. David McNicol, Deputy Assistant Secretary of Defense for Resource Analysis and Chairman of the Cost Analysis Improvement Group

Dr. McNicol will present a commentary on data (assembled by The Rand Corporation) that compare cost estimates made at Milestone II with subsequently realized cost. Conclusions offered speak to the accuracy of DoD resource estimates as would be perceived by The Congress, and to the relative importance of different causes of cost growth.

GENERAL SESSION - MILITARY FORCE STRUCTURE CHANGES
THURSDAY 5 SEPTEMBER 1991, 0800-0900

Dr. John Morgan, Director, Force Structure and Support Cost Analysis Division, Office of the Assistant Secretary of Defense (Program Analysis and Evaluation)

Dr. Morgan will discuss activities and problems associated with analysis of the costs of military force structure changes. This area of cost analysis has become increasingly important as the Department of Defense has moved forward in the build-down phase in response to the reduction in the threat. The presentation will discuss the background for force structure changes, categories of these changes and future plans to enhance DoD capabilities to compute rapidly, changes in resource requirements consistent with adjustments in forces.

GENERAL SESSION - CLOSING
FRIDAY 6 SEPTEMBER 1991, 1300-1400

Dr. David A. Lee, Director of the Research and Development/Procurement Cost Analysis Division

Dr. Lee will review and summarize the symposium's activities.

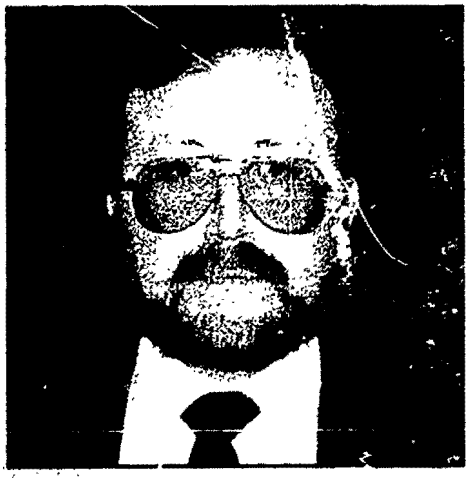
25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Risk Analysis

Workshop Chairperson: Ms Dorothy Bernay

Ms Dorothy Bernay is the Team Chief for the Strategic Systems, Aircraft and Missiles ICE Division, U.S. 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 positions as a Cost Analyst with the U.S. Army Strategic Defense Command, the U.S. Army Cost and Economic Analysis Center, and as an Auditor for the Defense Contract Audit Agency. Ms Bernay is a Certified Cost Estimator/Analyst.

Weapons Systems Costing



Workshop Chairperson: Mr. Albert Fitzgerald

Mr. Albert J. Fitzgerald is the head of the Research, Methods and Data Section in the Cost Analysis Division at Headquarters, Naval Air Systems Command, Washington, DC. He has a BS in Mathematics and a MBA in Management. His responsibilities include CCDR cost data collection, escalation indices, WBS development and ADP support to the Division.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

The DAB Process: A Case Study Workshop

Workshop Chairperson: Mr. John D. Fleck

Mr. John D. Fleck is the Business Manager for the Common chassis and Block III Tank Program Office, within the PEO for Armored Systems Modernization. In addition to an extensive PEO/PM experience, he has served in a variety of capacities interfacing with both the material developer and combat developer communities. He has a BS and MA in Mathematics and a JD in law.

Cost Considerations in COEAs

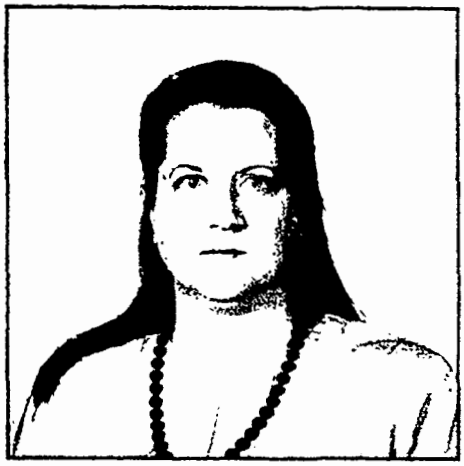
Workshop Chairperson: Ms Mary A. Henry

Ms Mary A. Henry is an Operations Research Analyst, Training Development and Analysis Directorate, Office of the Deputy Chief of Staff for Training (ODCST), HQ, U.S. Army Training and Doctrine Command (TRADOC). Ms Henry has a BS in Mathematics from Iowa State University and a MSA in Quantitative Analysis for Decision Making from George Washington University. Ms Henry reviews all of TRADOC's training cost studies for the ODCST and performs cost analysis for the Joint Computer Based Instruction System.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Training and Professional Development Workshop

Workshop Chairperson: Ms Peggy Hombs



Ms Peggy Hombs is the Chief, Cost/Risk Analysis Committee, Decision Sciences Department, School of Logistics Science, U.S. Army Logistics Management College, Ft Lee, VA. Ms Hombs has a BS in Ed and an MA in Economics from Miami University, Oxford, Ohio, and additional graduate work in public administration from George Washington University. Ms Hombs has been in cost and economic analysis positions in the Department of Defense for twenty years.

Communications, Command and Control

Workshop Chairperson: Ms Kathleen A. Jones

Ms Kathleen Jones is a Senior Operations Research Analyst in the Cost Directorate at Electronic Systems Division, Hanscom Air Force Base, MA. The Division is the Air Force Center of expertise for the development and acquisition of command, control and communication systems. Ms Jones has a BS degree from Merrimack College, completed a graduate program in Management from Harvard University and received her MBA from Western New England College. Ms Jones recently completed the Professional Military Comptroller School. Professional memberships include ASMC and ISPA. Ms Jones is also the treasurer for the New England Chapter of SCEA. Her current assignment is ICA team chief for the Cheyenne Mountain Upgrade Program.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Automated Information Systems

Workshop Chairperson: Captain Charles K. Kapaku

Captain Charles K. Kapaku is the lead Communications-Computer Systems Cost Analyst at the Air Force Cost Analysis Agency. Captain Kapaku is the primary focal point for all Air Force Major Automated Information Systems (MAIS) cost estimates. He co-authored the AF MAIS Cost Estimating and Reference Guide. Captain Kapaku is a 1980 Air Force Academy Graduate. He completed the Defense Systems Management College Program Manager's Course in December 1985.

Innovative Approaches to Cost Estimating

Workshop Chairperson: Dr. David A. Lee

Dr. David Lee is Director of the Research and Development/Procurement Cost Analysis Division in the Office of the Assistant Secretary of Defense, Program Analysis and Evaluation. Dr. Lee earned his bachelor's degree in electrical engineering at the University of Missouri-Columbia, his Sc. M. in applied mathematics at Brown University and his Ph. D. in mechanics at the Illinois Institute of Technology. He was a Woodrow Wilson Fellow and a Danforth Fellow. In 1983, Dr. Lee participated in the Senior Executive Fellows Program at Harvard's Kennedy School of Government. Dr. Lee served in the U.S. Air Force Aerospace Research Laboratories, as a research mathematician, group leader, and Director of Applied Mathematics Research Laboratory. From June 1975 to November 1985, he was Head of the Department of Mathematics and Computer Science at the Air Force Institute of Technology. In 1969-70, Dr. Lee was a visiting professor in the von Karman Institute for Fluid Dynamics, a NATO facility near Brussels. Dr. Lee is the author or co-author of more the thirty publications in applied mathematics. He has been recognized with the Air Force Commendation Medal, the Air Force Award Meritorious Civilian Service, Secretary of Defense Medal for Meritorious Civilian Service, and the Faculty-Alumni Award of the University of Missouri-Columbia.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Contractor Cost Performance Measurements

Workshop Chairperson: Ms Virginia Lustre

Ms Virginia Lustre is a cost estimator for the SSN-688, SSN-21, and SSBN class submarines in the Cost Estimating and Analysis Division of the Naval Sea Systems Command. Ms Lustre was involved in the preparation of cost estimates for the FY 90 Major Warship Review and was a member of the source selection team for the SSN-21 lead ship. She has a BS in Industrial Engineering and Operations Research.

BASOPS/Commercial Activities

Workshop Chairperson: Ms Lyla Moore

Ms Lyla Moore is the Base Operations Support, Planning, Programming and Budgeting System Branch Head, Naval Facilities Engineering Command Headquarters located in Alexandria, VA and is a staff office to the Base Operations Programs and Budgets under the Chief of Naval Operations. Ms Moore has a BA in Public Administration from the University of San Francisco and a Masters in Public Financial Management from American University. Ms Moore has received a Scholarship to the Naval Postgraduate School and has completed her command's Executive Management Development Programs. Ms Moore has held various budget and analytical positions within the Naval Facilities Engineering Command, including Financial/Administration Officer, Collateral Equipment Manager and Military Construction Branch Head.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Tactical Systems Workshop

Workshop Chairperson: Dr. Daniel Nussbaum

Dr. Nussbaum is the Director of Weapons Division, Naval Center for Cost Analysis. He has a B.A. in Mathematics from Columbia University, a Ph.D. from Michigan State University and Post Doctoral work in Econometrics and Operations Research from Washington State University. Dr. Nussbaum is currently the President of the Washington, D.C. Chapter of SCEA and is a Certified Cost Analyst/Estimator. He is the Co-editor of Cost Analysis: Tools and Techniques, Springer-Verlag (1990) and the co-author of monograph on Effects of Competitive Procurement. Dr. Nussbaum has held a variety of positions in the Operations Research and Cost Analysis fields.

Data Base Management Systems

Workshop Chairperson: Mr. Bobby Paterson

Mr. Bobby Paterson heads the Research, Methods and Data Branch of the Cost Analysis Division, Naval Air Systems Command. A former Naval officer, Mr. Paterson served as Airborne Combat information Center Officer in Airborne Early Warning Squadron Eleven. He subsequently completed a year of graduate study under a Navy Fellowship in Procurement and Contracting and served as Head, Advanced Concepts and Alternatives Branch in the Naval Air Cost Analysis Division. He is a graduate of the Defense Systems Management College Program Managers Course and has a Masters Degree in Mathematics.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Operating and Support Workshop I

Workshop Chairperson: Ms Nancy A. Perez

Ms Nancy A. Perez joined the Operations Analysis Directorate, U.S. Army Combined Arms Support Command, Ft Lee, VA in 1985. Ms Perez serves as Project Officer for a variety of studies including the conduct of cost and economic analysis for tactical information systems, material systems, and training effectiveness analysis. Ms Perez has a BS in Management Information Systems.

Operating and Support Workshop II

Workshop Chairperson: Mr. John Pulice, Jr.

Mr. John Pulice, Jr. is currently assigned to the U.S. Army Cost and Economic Analysis Center as the Operating and Support Team Chief. Mr. Pulice is a graduate of West Virginia University with a BS in Industrial Engineering with honors and a M.S.I.E. He began his Federal career in 1975 with the Federal Energy Administration, Office of Synfuels, Solar and Geothermal Energy. He then worked for the Department of Energy upon its creation in 1976. In 1982, Mr. Pulice started working for the Comptroller of the Army, Directorate of Cost Analysis.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP CHAIRPERSONS

Software Costing

Workshop Chairperson: Mr. Wallace Riggins

Mr Riggins is an Operations Research Analyst in the Office of the Assistant Secretary of the Army for Financial Operations. Mr. Riggins has twenty years of government experience and has held positions as a supervisory mathematician and supervisory computer specialist. Prior to his current assignment, he was a team chief at the U.S. Army Cost and Economic Analysis Center. Mr. Riggins is a member of the American Society of Military Comptrollers. He has B.S. degree in Mathematics from Elizabeth City State University and is a graduate of the Armed Forces Staff College.

Acquisition Strategy

Workshop Chairperson: Ms Paula Spinner

Ms Paula Spinner is a cost analyst at the Air Force Cost Analysis Agency. Ms Spinner's current areas of responsibility are diverse. She prepares cost related computer based training for the Air Force Financial Management Community and is currently working as an Independent Cost Analysis Team Member on Information Systems. Ms Spinner is actively involved in the American Society of Military Comptrollers/Washington Chapter and is a member of the Society of Cost Estimating and Analysis and Senior Professional Women's Association. Ms Spinner has a B.A. in Education from University of Texas and a M.B.A. from Marymount University.

25th DoD Cost Analysis Symposium

NOTES

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION I, WEDNESDAY 4 SEPTEMBER 1991, 1300-1400

SPECIAL TOPIC: Mr. Gary Christle, Room 3471

Earned Value

Automated Information Systems: Room 3460

Cost Analysis for Major Automated Information Systems

Author: Mr. William H. Richardson

This paper discusses one or more of the four different MAISRC cost products required at each milestone review and includes a discussion of what they are and when each is required.

The DAB Process: Room 3461

An OSD and Tri-Service overview of the DAB process. This is part one of a four part discussion of the DAB process as seen by OSD and the services.

Software Costing: Room 3462

Software Cost Estimating for Automated Information Systems: Comparing Actual to Estimated Effort

Author: Mr. Larry Robertson

This paper will show the actual software development effort, measured in labor months, for several Army AISs and will then compare these actuals to the estimated obtained from four software models.

Weapon Systems Costing: Room 3463

Life Cycle Cost Estimating for Non-Developmental Items (LCCE-NDI)

Author: Mr. William Washington

This model represents an attempt to determine Life Cycle Cost Estimates (LCCE's) for inexpensive Non-developmental items (NDI's), given limited system information. It does this based on historical relationships from prior Test Measurement and Diagnostic Equipment (TMDE) NDI procurements.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION I, WEDNESDAY 4 SEPTEMBER 1991, 1300-1400

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

The Naval Center for Cost Analysis' Naval Aircraft Operating and Support (O&S) Cost Estimating Models: Recent Updates and Applications

Authors: CDR John Repicky, CDR Robert Altizer and Mrs. Kathy Allen

The paper describes how NCA's Fixed Wing and Rotary Wing O&S Cost Estimating Models have been updated to reflect changes in Navy policy and funding. It relates how past and present forms of the models have been used to generate independent cost estimates (ICEs) for the Office of the Secretary of Defense (OSD) Cost Analysis Improvement Group (CAIG) reviews and provide ad hoc support for the Chief of Naval Operations. the updated Fixed Wing O&S Cost Estimating Model is illustrated using F-14A inputs and results.

Operating and Support Cost Analysis Workshop II: Room 3466

HAWK Operating and Support Cost Reduction Program

Authors: Mr. Jim Hinkle and Mr. Martin Atchinson

This paper describes the history of the HAWK Air Defense Missile System product improvement programs and their impact on reducing the Operating and Support costs of the system. The conclusions of the analysis were that $4.8 billion dollars will be saved through these efforts while at the same time improving the performance and supportability of the missile system.

Tactical Systems Workshop: Room 3473

Development of Deployment Cost Factors for Operation DESERT SHIELD

Author: Mr. Richard M. West

This paper discusses methods used to collect, allocate, and calculate personnel and equipment cost factors based on DESERT SHIELD deployment at Fort Hood, Texas.

Innovative Approaches to Cost Estimating: Room 3477

Applying Engineering Problem Solving Approach to Cost Estimating and Analysis

Author: Mr. Daniel Galorath

This paper shows how engineering problem solving approaches can be applied as a methodology to the process of cost estimation.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION I, WEDNESDAY 4 SEPTEMBER 1991, 1300-1400

Continued

BASOPS/Commercial Activities Workshop: Room 4460

Force Structure Costing - The Drawdown Side

Author: Captain Eugene O. Johnson

This paper introduces USAFE's methodology for computing force structure drawdown cost estimating. It explains the tools required to do the job, the limitations of existing software, the functional experts needed for consultation, and the importance of a strong budget interface in USAFE's overseas environment.

Acquisition Strategy Workshop: Room 4462

Introduction to Scheduling and Schedule Analysis: A Course of Instruction

Author: Ms Denise Clough

This paper discusses the Scheduling Initiative initiated by the Aeronautical Systems Division at Wright-Patterson AFB. As a result of this initiative, a course of instruction was created to teach scheduling as a sole subject rather than one small aspect of another subject, such as its use as a management tool within the acquisition process.

Cost Considerations in COEAs: Room 4464

Misleading Costs in TIA's/CTEA's

Authors: Ms Mary H. Henry and Mr. Wilbur Hogan

This paper will discuss how most TIA's and CTEA's are costed and how they should be costed, and why. It will focus on the ability of the cost analysis to support the decision made.

Communications, Command and Control Workshop: Room 4466

A "Chip" on DoD's Shoulder: How to Improve Communications-Computer Cost Management

Author: Ms Nita M. Cary

The Corporate Information Management Initiative, reduced defense funding, and the need to streamline its operations have forced the Department of Defense to improve management of its communications-computer system (C-CS) resources. Cost Analysis can improve financial management of C-CS assets through a three-pronged program of review, training and regulation.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION II, WEDNESDAY 4 SEPTEMBER 1991, 1410-1510

Automated Information Systems: Room 3460

Utilizing Off-the-Shelf Software to Write Organizational Specific Programs for Local Area Network Applications

Authors: Mr. William Smallman and Mr. Richard M. West

This paper discusses a project that developed LAN capable multi-user office programs using Nantucket's Clipper compiler.

The DAB Process: Room 3461

An OSD and Tri-Service overview of the DAB process. This is part two of a four part discussion of the DAB process as seen by OSD and the services.

Software Costing: Room 3462

LCurve Software

Authors: Mr. Arthur Kluge and Mr. Walt Hosey

LCURVE is a computer program for fitting learning curves to cost data and for cost estimation. LCURVE combines the most desirable features of previously-developed learning curve programs with newly-developed capabilities into one easy-to-use package.

Weapon Systems Costing: Room 3463

Guided Weapon Cost Estimating Problems: A Little Knowledge May Be a Dangerous Thing

Author: Mr. Alan V. G. Deller

To celebrate the 25th Annual Symposium, this paper looks back at the limited number of small to medium sized weapon system developed during that period and considers the impact of small data bases on the predictive capabilities of parametric cost estimates for future weapon systems.

Operating and Support Cost Analysis Workshop I: Room 3464

A CER Approach to Estimating Aircraft Integration Costs

Author: Mr. William H. Richardson

This paper presents the results of four CER studies which collectively constitute a complete model for estimating the cost of integrating new avionics subsystems into existing aircraft.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION II, WEDNESDAY 4 SEPTEMBER 1991, 1410-1510

Continued

Operating and Support Cost Analysis Workshop II: Room 3466

Defining the Force Structure Cost Problem

Author: Mr. Michael Shanley

The goal of this research was to establish a set of generic guidelines to assist the cost analyst in establishing a full problem scope before turning to the application of a cost methodology and other details of the cost analysis . The method used was case studies; the guidelines were derived from an examination of actual force structure change proposals that recently arose in the PPBS process.

Tactical Systems Workshop: Room 3473

Aggregate Cost of Tactical Systems

Author: Mr. Dan C. Boger

This paper analyzes trends for each category in deflated dollar terms as well as trends for each category relative to total DoD procurement, total DoD budget, and total federal budget authority. Appropriate statistical hypothesis are tested, conclusions are drawn, and predictions are made.

Innovative Approaches to Cost Estimating: Room 3477

GERM: Generalized-Error Regression Model

Author: Mr. P. H. Young (Presented by Mr. Stephen Book)

Ordinary Least Squares (OLS) regression, either linear or nonlinear, is commonly applied to historical-cost data in order to derive cost estimating relationships (CERs). A fundamental assumption of OLS regression is that the error model upon which it is based be additive. More precisely, each observed value of the dependent variable is a function of the independent variable plus an error term. A case in point is where the values of the observed dependent variable change by several orders of magnitude as a function of the independent variable. In this case it is often more representative to assume a multiplicative error model. It is useful to have a general least squares methodology that can treat not only additive, but also multiplicative, error models. The generalized error regression model (GERM) is designed to meet this need.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION II, WEDNESDAY 4 SEPTEMBER 1991, 1410-1510

Continued

BASOPS/Commercial Activities Workshop: Room 4460

Base Operations Resource Estimation/Allocation Model

Author: Dr. Les Eder and Dr. David Koehn

Because of the consolidations and concurrent troop strength reductions within U.S. Army Europe, the historical allocations of resources used on the old UMC/community structure is no longer adequate. Consequently, there is a need for a consistent methodology to provide a bench-mark for the re-baselining of USAREUR Base Operations Resources. One approach to meeting this need has been the development of a Base Operations Resource Estimation/Allocation model. It is a computer based LOTUS Spreadsheet model using cost and manpower estimating relationships (CERs and MERs) and MDEP allocations developed from historical community Base Operations data collected by HQ, USAREUR over the last three years.

Acquisition Strategy Workshop: Room 4462

A Schedule Assessment Tool for UnManned Spacecraft Acquisition Programs

Authors: Mr. Bruce Harmon and Mr. Neang Om

This paper reports the results of an effort to develop a schedule assessment tools to be used in the review of unmanned spacecraft acquisition programs associated with the Strategic Defense System.

Cost Considerations in COEAs: Room 4464

Why Not Just a Baseline Cost Estimate

Author: Ms Leslie Mitchell

A discussion of why the Life Cycle Cost Estimate contained in the Baseline Cost Estimate is not always sufficient for use in Cost and Operational Effectiveness (COEA) type studies. Recent and on going Forward Area Air Defense System (FAADS) studies used to illustrate required modifications. Most useful to those unfamiliar with or new to COEAs.

Communications, Command and Control Workshop: Room 4466

Electronic Technology and Cost Estimating Techniques for Weapon Systems

Author: Mr. Tom Dickman and Mr. Grant Lawless

New technology is becoming available for avionics systems. Very High Speed Integrated Circuit (VHSIC) technology as well as gallium arsenide technology is advancing. The Air Force's Advanced Tactical Fighter (ATF) is utilizing Line Replaceable Modules (LRMs) versus Shop Replaceable Units (SRUs) and Line Replaceable Units (LRUs). Avionics Suites utilizing LRMs like Integrated Communication, Navigation, Identification, Avionics (ICNIA) from the AF Wright Laboratory is a new trend. Cost concepts and cost estimating techniques including parametrics, analogy, and grass roots estimating of SRUs, LRUs, and LRMs will be discussed. The parametric models including PRICE-M, PRICE-H, and Fast E will be critiqued. The main emphasis of this paper is on estimating acquisition cost, primarily in the production phase.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION III, WEDNESDAY 4 SEPTEMBER 1991, 1530-1630

Automated Information Systems: Room 3460

Software Process Acquisition Network Simulation (SPANS) Model Improvements

Author: Mr. Charles A. Graver

The SPANS model permits a cost analyst to simultaneously estimate the schedule and cost of software development. Model improvements, which include function point based estimates in addition to COCOMO, have been recently completed. The presentation will describe the model with emphasis on improvements.

The DAB Process: Room 3461

An OSD and Tri-Service overview of the DAB process. This is part three of a four part discussion of the DAB process as seen by OSD and the services.

Software Costing: Room 3462

Modeling System for Estimating Software (MOSES)

Author: Mr. Chris Messick

MOSES is an interactive PC based system which allows the user to estimate software costs using the COCOMO, REVIC, Ada-COCOMO, and Jensen cost models simultaneously. The system provides detailed help support, model calibration, and a system for comparing the estimates produced by the four models.

Weapon Systems Costing: Room 3463

Life Cycle Cost Model: TOP Level Cost Model

Authors: Herr K. Wickel and Herr P. Hein

The TOP Level Cost Model (TOPCOM) is a standardized cost model, applicable to all kinds of military systems without modification. The objective of TOPCOM is to provide the governmental system planning management with a transparent, aggregated and comparable presentation of the LCC of planning alternatives in standard formats, produced by governmental authorities and/or industry or consulting companies.

Operating and Support Cost Analysis Workshop I: Room 3464

The Material Science of Operating and Support Cost

Author: Mr. Curtis M. Low

This paper provides an overview of operating and support cost demand data and related material science problems.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION III, WEDNESDAY 4 SEPTEMBER 1991, 1530-1630

Continued

Operating and Support Cost Analysis Workshop II: Room 3466

The Art of Force Structure Costing

Author: Mr. Robert Suchan

This paper discusses Force Costing in the Army today which includes how different force structure options are envisioned including activation/acquisition, operations, reorganization, relocation, inactivation and conversion. Further, a description of the Army's data base and models will be discussed.

Tactical Systems Workshop: Room 3473

The New Competition of the '90's: A Quest for Scarce Systems Acquisition Funds

Author: Mr. Michael N. Beltramo

The continuing evolution of DoD systems acquisition policies and contractor strategies suggests that the defense marketplace will undergo dramatic changes during the '90's. The historical growth of DoD Total Obligation Authority is compare to recent reductions in DoD RDT&E and procurement budgets. Factors that influence DoD Budget levels are also identified and briefly discussed. These issues provide a context for understanding changes that are occurring.

Innovative Approaches to Cost Estimating: Room 3477

Application of the Analytical Hierarchy Process in a Mathematical Programming Problem

Author: Dr. Leslie E. Eder and Dr. David J. Koehn

This paper discusses the use of linear programming methodology as applied to the current USAREUR reduction planning process which includes returning some U.S. installations to the German government. The process requires selecting installations for disposal on the basis of several objective and subjective factors of different relative importance. The mathematical programming formulation is a linear integer model, where the objective is to retain the most effective combination of installations subject to total dollar and force level constraints.

BASOPS/Commercial Activities Workshop: Room 4460

The Application of Soldier Survey Information to Project Socio-economics Impacts Resulting from Operation QUICKSILVER

Author: Mr. Richard West

This paper discusses the validation and extrapolation of survey data to project population and economic losses due to the inactivation of the 2nd Armored Division at Fort Hood, Texas

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION III, WEDNESDAY 4 SEPTEMBER 1991, 1530-1630

Continued

Acquisition Strategy Workshop: Room 4462

Prototyping in Major Acquisition Programs

Authors: Ms Karen W. Tyson, Mr. D. Calvin Gogerty, Mr. Bruce Harmon, Mr. J. R. Nelson and Mr. Alec Salerno

In the new defense environment of constrained budgets, prototyping is receiving increased attention. The objective of this paper is to examine the cost and schedule outcomes of programs with and without prototyping and to suggest guidelines for prototyping. Cost growth and schedule slip are examined for prototyped and non-prototyped programs.

Cost Considerations in COEAs: Room 4464

Cost Analysis Methodology and Results used in the Close Combat Tactical Trainer (CCTT) and Cost and Training Effectiveness Analysis (CTEA)

Author: Mr Douglas R. Johnson

The Close Combat Tactical Trainer (CCTT) Cost and Training Effectiveness Analysis (CTEA) addressed the training capabilities, estimated the life cycle cost and potential cost paybacks of the proposed CCTT. The CCTT has the potential to be a cost and training effective addition to the Army's training program. The analysis was conducted in support of a milestone I/II ASARC decision on CCTT.

Communications, Command and Control Workshop: Room 4466

A Case for Electronics Modernization: The Navy's SRC-16 Shipboard Communication Central

Author: Ms Deborah Wigler

This paper demonstrates key factors in selecting a candidate system for modernization and discusses the economics of electronics modernization through a case study of a proposed technology insertion in the Navy's AM/SRC-16 Shipboard Communications Central. A demonstration of the expected life cycle cost savings due to modernization is presented, along with discussion on the lessons learned about evaluating weapon system modernization.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION IV, THURSDAY 5 SEPTEMBER 1991, 0910-1010

SPECIAL PANEL: Dr. David Lee, Moderator, Room 3471

Innovative Approaches

Automated Information Systems: Room 3460

Assumptions in Estimating Post Deployment Software Support Requirements

Author: Mr. Edmundo O. Acosta

This paper lists and explores categories of non-standard assumptions which are often ignored in PDSS estimating. A generic example will demonstrate that varying the assumptions (regarding, for example, "productivity" and "organic vs. contractor logistics support") can exert enormous impacts on the ranges of PDSS estimates.

The DAB Process: Room 3461

An OSD and Tri-Service overview of the DAB process. This is part four of a four part discussion of the DAB process as seen by OSD and the services.

Software Costing: Room 3462

Calibration of Software Cost Models for DoD Acquisitions

Author: Ms Audrey E. Traub

This paper discusses recent efforts to improve the software cost prediction capabilities of the Cost Analysis Technical Center through an extensive statistical analysis of our software database, including the calibration of software cost and schedule models to a database containing information on approximately 34 independent software developments, primarily command, control and communications applications. We calibrated models that predict software development effort as a function of developed lines of code, and software development schedule as a function of development effort.

Weapon Systems Costing: Room 3463

HELO-MIICOM: An Automated Model to Estimate Avionics Related Modification Integration and Installation Costs for Helicopters

Authors: Mr. T. Bernard Fox and Mr. Scott M. Allard

This paper will present the results of the analysis of the costs associated with modifying helicopter's avionics suites to incorporate new technology electronics systems. This paper derives a comprehensive suite of cost estimating techniques from actual cost and technical data which can be used to estimate modification costs. They will describe the data base used to develop the estimating techniques, present several cost estimating relationships, and describe the resulting automated model which houses the cost estimating relationships.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION IV, THURSDAY 5 SEPTEMBER 1991, 0910-1010

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

AMC White Paper - Operating And Support Cost Reduction

Author: Mr. Dan Marks

This paper discusses six processes which have been identified to reduce O&S costs through management action and through insertion of technology at relevant points in the system's life cycle.

Operating and Support Cost Analysis Workshop II: Room 3466

Force Structure Costing for the 90's and Beyond

Author: Ms Karen M. Nolan

This paper describes several models available for decision makers to evaluate future force structures. If offers and overview of the output to determine the size of an affordable force, the best mix of Active Component and Reserve Component, and a optimal stationing (basing) plan.

BASOPS/Commercial Activities Workshop: Room 4460

Determining the Cost to the United States of NATO Infrastructure Projects

Author: Captain James E. Pugh

A U.S. Air Forces, Europe (USAFE) developed model that converts currents-year NATO estimates in the currency of the host nation to then-year dollars. The paper discusses the USAFE model, the NATO infrastructure program and estimating process, and explains how the model was used to analyze cost for the planned NATO air base near Crotone, Italy.

Acquisition Strategy Workshop: Room 4462

An Acquisition Strategy for Reducing Cost Overruns

Authors: Mr. Bernard H. Rudwick, P.E.

Over the past years the author has been analyzing the problems of cost overruns of system acquisition program, there causes, and what could have been done to reduce such overruns. This paper will discuss a systemic method which can aid in this objective.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION IV, THURSDAY 5 SEPTEMBER 1991, 0910-1010

Continued

Cost Considerations in COEAs: Room 4464

Information System Cost and Economic Analysis in TRADOC

Author: Mr. L. I. Seim

This paper discusses the Information System cost and Economic Analysis report, how it is prepared and how it is used to provide cost information to the decision maker.

Communications, Command and Control Workshop: Room 4466

Application of Expert System Technology

Author: Mr. Timothy Cargle, Sr

This research explored the concept of applying expert system technology to avionic cost estimating. A primary objective was to provide an introductory guide to expert system development to the Aeronautical System Division's (ASD) Comptroller community.

25th Annual DoD Cost Analysis Symposium

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION V, THURSDAY 5 SEPTEMBER 1991, 1030-1130

Automated Information Systems: Room 3460

Enhancing the Adaptability of Imagery Technology (IT) for Increased Productivity in the Office Environment

Author: First Lieutenant Delcy M. Palk

Imagery Technology (IT) encompasses the latest development for use with automated information systems. The appropriate integration of IT in systems design enhances work productivity and quality control. Cost realizations can result through the immediate productivity gains and decreased error rates created by IT usage.

The DAB Process: A Case Study: Room 3461

The Evolution of ASM's Tailored Acquisition Strategy

Authors: Mr. Tom Lazenby and Mr. Walt Storres

Discusses the process of structuring a Program Strategy that optimizes the combination of technical performance, schedule and cost, while mitigating risk. The focus is on analysis tools/models, the role of the cost analyst, planning for change, and cost implications.

Software Costing: Room 3462

A Practical Approach to Maintenance of Cost Estimating Software

Authors: Mr. Ronald D. Hayostek and Mr. Lawrence H. Delaney

Maintenance of cost estimating software is often either overlooked or under estimated. To get the proper return on the initial investment of human resources, used in the development of the software, the maintenance of that software must be addressed. This paper will take a practical approach, for the cost estimators point of view, to software maintenance based on the Multi-System Cost Model (MSCM).

Weapon Systems Costing: Room 3463

Using Ridge Regression to Analyze Production Learn/Rate Costs

Author: Mr. J. E. Blair

The paper describes the use of ridge regression to analyze production cost learn and rate slopes when there is excessive colinearity in the cost data.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION V, THURSDAY 5 SEPTEMBER 1991, 1030-1130

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

Operating and Support Cost Reduction

Author: Captain Bobby Claiborne

The operating and support costs of materiel systems and training needed to reduce future investments in Research, Development, and Acquisition. To arrive at this goal, we suggest initially starting with a Best-In-Class (BIC) pamphlet for the user and industry.

Operating and Support Cost Analysis Workshop II: Room 3466

Determining P-2 Mission Cost Factors in a Period of Instability

Author: LTC James Engoglia

This paper illustrates how changes in supply and maintenance systems effect the capacity of the three moving average to accurately forecast requirements. The purpose is not to provide a complete solution but instead identify the source of distortion that requires remedies.

Tactical Systems Workshop: Room 3473

Cost Considerations in Training Simulation Arenas

Author: Mr Edmundo O. Acosta

This paper advocates more extensive use of simulators...especially for Sustainment Training. Arenas such as live fire gunnery, collective training, and training strategies are explored for plausible major savings through more simulation.

BASOPS/Commercial Activities Workshop: Room 4460

Costing Plant Closures

Author: Mr. Robert A. McLure

The costing of base closures and realignments is the challenge for the cost analysis community in the 90's. The closing of the ABRAMS production facilities will be the basis for the information, discussing the methodology for determining the cost of layaway of GOCO facilities and COCO facilities.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION V, THURSDAY 5 SEPTEMBER 1991, 1030-1130

Continued

Acquisition Strategy Workshop: Room 4462

The Major Warship Review from a Cost Analyst's Perspective

Authors: Mr. John J. Mowad and Ms Lisa M. Ransom

The Major Warship Review (MSR) was requested by the Secretary of Defense as a comprehensive analysis of various ship type alternatives. Naval Sea Systems Command, Cost Estimating and Analysis was responsible for providing cost estimates based on the requirements identified by the OSD CAIG, the Assistant Secretary of the Navy (Research, Development and Acquisition), and Program Managers. This paper will present the background of the MWR, discuss the planning process and methodology for developing and presenting the cost estimates, and discuss applications.

Cost Considerations in COEAs: Room 4464

Cost Analysis in Support of the Milestone II Light Helicopter

Author: Mr. Timothy O. Blumfelder

The Secretary of Defense directed the Army to perform the Light Helicopter Cost and Operational Effectiveness Analysis (COEA) to support POM issue resolution and a Milestone II decision. TRAC-WSMR was given responsibility for the overall cost analysis in the COEA. In support of this cost analysis, life cycle cost estimates were required for each helicopter system which make up the study alternatives. This paper presents the mechanisms involved in providing the Cost Analysis portion of the LH COEA.

Communications, Command and Control Workshop: Room 4466

The Systems Integration Cost Analysis Model (SICAM)

Author: Captain Dimitri M. Yallourakis

The intent of this presentation is to explain the unique procedures discovered to collect data from the Air Logistics Centers, the documentation guide under consideration by the Cost Research Division at Space Systems Division, and the possibilities associated with the expansion of the model.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VI, THURSDAY 5 SEPTEMBER 1991, 1300-1400

Automated Information Systems: Room 3460

Automated Information Programs within HQ, Air Force Reserve

Author: Ms Glenda Scheiner

Automation is changing the way that cost/management analysts in HQ Air Force Reserve provide information to aid executives. Utilizing current technology, we strive to provide executives the best information available in the most easily accessible way. Toward this end, two automated systems have been developed. Both the Commander's Information Program and the Point Paper Manger provide timely key information to managers in HQ, AFRES.

The DAB Process: A Case Study: Room 3461

Financial Aspects of Tailored Acquisition Planning

Authors: Mr. James Schwartz and Mr. Walt Storres

Overviews the turbulent effects on Programmatics, of external events (Congressional interests, media attention, defense budget decisions, events in Eastern Europe and the world). The lessons learned extend to the financial impacts of, and the actual results of the Services' responses to these incursions.

Software Costing: Room 3462

A Process View of Software Estimation

Author: Major (Reserve) Raymond Kile

In this paper an eight phase process is proposed to meet the Software Engineering Institute's Process Maturity requirements for a formal process of estimating software size, cost, an schedule. The process emphasizes separation of estimating and bidding activities and provides built-in support for risk identification, assessment and mitigation planning in an environment that supports designing-to-constraints.

Weapon Systems Costing: Room 3463

Non-Linear Optimization of a Cost Analysis Problem

Author: Mr. Sherman J. O'Neill

A frequently occurring problem is cost analysis is: given a series of time periods, say fiscal years, the quantities of end items procured in each year, and the cost of the annual batch, what first unit cost and learning rate account for the data. The usual method involves passing to the logarithms of the variables, which linearizes the problem, then applying standard linear regression techniques. This paper makes a beginning in the exploration of optimizing by defining the deviations as differences between the variables themselves rather than logarithms of the variables.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VI, THURSDAY 5 SEPTEMBER 1991, 1300-1400

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

Technology Insertion Operating and Support Cost Modeling

Author: Mr. Patrick Nunez

This paper provides a cursory overview of Operating and Support Cost Reduction (OSCR) programs, and a comprehensive discussion of Technology Insertion (TI) and the cost estimates that are involved in analyzing a TI Proposal.

Operating and Support Cost Analysis Workshop II: Room 3466

Development of Spares and Repair Parts Cost Factors in Support of the P-2 Resource Models

Authors: Mr. Jeffery Lloyd and Mr. Patrick Hite

OPTEMPO cost factors are developed to support the various resource models that are used within Headquarters, Department of the Army. These factors are an integral part of the PPBES process and are critical to the top down approach used by Army leadership for resourcing. The cost factors reflect the manner in which the Army trains and maintains its equipment. Included in the factors are the policy and guidance reflected in DMRDs and other efficiency enhancing initiatives.

Tactical Systems Workshop: Room 3473

Resource Trade-offs for Aviation Combined Arms Tactical Trainer (AVCATT)

Author: Mr. Alan R. Keller

Three approaches to determining resource trade-offs are extracted from the AVCATT cost and training effectiveness analysis, the Aviation Combined Arms Tactical Training, Training Development Study (TDS). The TDS cost analysis for the Budget Constraint Approach reflects that AVCATT could pay for itself in 10 years of device life with an Operating Tempo (OPTEMPO) trade-off of only one-half hour in the aircraft for 31 hours of AVCATT availability per crew per month. Three approaches to a cost effective cockpit are discussed, and the Aviation Officers Advanced Course/AIRNET Experiments are highlighted.

Innovative Approaches to Cost Estimating: Room 3477

Application of Lemke's Algorithm to Optimize ASM Production Schedules

Author: Mr. Dennis S. Bjoraker and Mr. Mark A. Weiss

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VI, THURSDAY 5 SEPTEMBER 1991, 1300-1400

Continued

BASOPS/Commercial Activities Workshop: Room 4460

HQ, Military Airlift Command Formal Training Course Cost Report (FTCCR) Small Computer Model Demonstration

Author: Mrs Jennifer A. Dennis

This paper provides an overview of HQ Military Airlift Command (MAC) small computer model developed to estimate academic and/or flying training course costs. This menu driven model decreased HQ MACs FTCCR report processing time by 50 percent and it is estimated to reduce data entry errors by 75 percent. A demonstration of the model will be given.

Acquisition Strategy Workshop: Room 4462

Financial Analysis of Competing Teams

Author: Mr. Morteza Anvari

This paper introduces two innovative techniques developed and used for the financial analysis of the Army's Light Helicopter contractor teams. The team financial indicators and team ranking methodologies are the focus of this presentation.

Cost Considerations in COEAs: Room 4464

Training Resource Analysis Method

Author: Ms. Susan Way-Smith

This paper documents a methodology for estimating the costs of changing approaches for providing individual training in the Army. The methodology uses a systems analysis framework and adds operational principles to provide a systemic and structured accounting system for analyzing training changes.

Communications, Command and Control Workshop: Room 4466

Estimating the Cost of Communication Satellites

Author: Mr. James Bui

The Institute for Defense Analysis used regression analysis to develop cost estimating relationships for communications satellites. Cost were also forecasted to the year 2000 and beyond for spacecraft subsystems, communications payload components, and software. The analysis showed that satellite capabilities has been increasing for the past twenty years and decreasing costs for some subsystems were also found.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VII, THURSDAY 5 SEPTEMBER 1991, 1410-1510

Automated Information Systems: Room 3460

Commercial Mainframe Computer Processor Cost Analysis

Author: Mr. Lowell E. Blagmon

In this cost study, processing speed (millions of instructions executions per second (MIPS)) and memory capacity (megabytes) of several commercial mainframe computer processors were used as independent variables in CERs to estimate the purchase price of mainframe computer processors. The study developed CER which resulted in a hedonic function based on speed, capacity and time.

The DAB Process: A Case Study: Room 3461

Contractual Effects of a Delayed Program Decision

Author: Mr. Dave Jackson

This paper studies the domino effects on prime contractors, subcontractors, and management support contractors, as well as government contract evaluators, flowing out of major program slips directed by higher headquarters and Congress. These include burdens to both industry and government: financial, manpower, management and programmatic.

Software Costing: Room 3462

Cost Modeling Air Force Software Manpower

Author: Michael C. Savoy

This paper documents research to construct a reliable manpower validation methodology for costing software development and maintenance requirements. Research stated with a feasibility study to determine if software development and maintenance are measurable functions and, if so, how to measure them. Our conclusions indicate the REVIC cost model meets the criteria we looked for, and we recommend its use as a software management and manpower requirements validation costing tool for Air Force wide application.

Weapon Systems Costing: Room 3463

Modeling Experience in the Flight Test Environment

Author: Ms Linda Ingram

This paper presents a discussion of recent developments in cost estimating methodologies in the aircraft flight test and evaluation (T&E) environment. The Air Force Test Center embarked on a research program to develop a resource and cost estimating methodology. The resulting Resource Estimating Model was designed to meet two requirements: 1) to provide a summary level cost estimate for budget purposes; and 2) to provide a detailed level estimate of the products, services, and consequent resources necessary to perform in the test and evaluation of the aircraft system.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VII, THURSDAY 5 SEPTEMBER 1991, 1410-1510

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

Composite Wing Force Structure Considerations in Estimating the Costs

Author: Mr. C. Fred McNitt

This paper examines what should be considered when developing an estimate on the composite wing concept. It provides some ideas on what models to use and where to obtain the appropriate information.

Operating and Support Cost Analysis Workshop II: Room 3466

Development of Division Level Cost Factors for U.S. Army Europe

Authors: Dr. David Koehn, Mr. John Sincavage, Mr. Robert Mann, LTC James Engoglia

This paper describes the development of cost factors for a division level cost element structure. The structure and supporting cost factors are designed to support budget estimating for the major cost categories of Direct OPTEMPO, Indirect OPTEMPO, Other Training Support and Civilian Personnel.

Tactical Systems Workshop: Room 3473

Long-Term Fleet Cost Analysis

Author: Mr. Ron DiCesare

This paper is to demonstrate a methodology for evaluating the cost effectiveness of various long-term fleet planning policies. Particular attention is paid to the rate at which new vehicles are procured, and the resulting cost incurred. The effect of service life extension programs are also considered.

Innovative Approaches to Cost Estimating: Room 3477

Heuristics as a Design Tool in Cost Engineering Integration (or Cost Engineering Integration - Practices and Applications Continued)

Author: Mr. Nelson E. King

This paper describes the role of cost engineering in relationship to the architecting process. The use of selective modeling to explore the largest trade space provides the most information.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VII, THURSDAY 5 SEPTEMBER 1991, 1410-1510

Continued

BASOPS/Commercial Activities Workshop: Room 4460

Automated Systems for Monitoring Commercial Activities' Functions after Completion of A-76 Competition

Author: Ms Kathyrn L. Sparks

Addressing the Commercial Activities program or A-76, as it is popularly known, the Department of Defense Inspector General completed an audit on the procedures and internal controls associated with monitoring commercial activities contracts. As a result of this audit, HQ AFRES/ACCC developed two automated systems for monitoring these contracts. Both the AC BOS Cost Analysis System and the PWS Tracking systems provide local financial management personnel with tools for monitoring contracted out functions.

Acquisition Strategy Workshop: Room 4462

Overhead Allocation and Incentives for Cost Minimization in Defense Procurement

Author: Dr. William P. Rogerson

This paper argues that current regulatory practices create a significant incentive for defense firms to choose inefficient production methods in order to manipulate the way that costs are allocated between products.

Cost Considerations in COEAs: Room 4464

Cost Effectiveness Ratios and Preference Functions

Author: Dr. Patrick D. Cassady

This paper discusses the representation of preferences by functions and some general properties of preference. It is shown that ranking by cost-effectiveness ratios requires the following property of a decision maker's preferences: At a fixed level of effectiveness as cost increases the decision maker will pay more for a fixed increase in effectiveness.

Risk Analysis Workshop: Room 4466

Using Risk-Impact Drivers to Form WBS-Element Cost Means and Variances

Authors: Mr. Phillip H. Young and Mr. R. L. Abramson (Presented by Mr. Stephen Book)

This paper presents a logical method for computing the mean and variance of the cost of each WBS element for a given project, taking into consideration the uncertainty in high-end cost due to technical risks. Using these means and variances, a cumulative distribution of total project cost can be established, so 50th, 70th, 90th and other cost percentiles can be read off its graph.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VIII, THURSDAY 5 SEPTEMBER 1991, 1530-1630

Automated Information Systems: Room 3460

Software Development Effort: ADA vs. Other Higher Order Languages

Author: Mr. Neal J. Brenner

This paper presents an analysis of recent Ada effort, duration, and size data. This analysis results in new Ada effort and duration models.

The DAB Process: A Case Study: Room 3461

Common Chassis/Block III Tank Strategic Cost Management

Authors: Ms Michelle C. Stuart and Mr. Louis A. Kratz

This paper discusses a structured process employed by the PM to proactively monitor, forecast, reduce and control costs. The process includes early identification of "indicators", risk management, and both qualitative and quantitative assessment of initiatives via an integrated Government/Industry team.

Software Costing: Room 3462

The Complete COCOMO Model

Author: Mr. Ronnie E. Cooper

This paper will help the reader discover the complete COCOMO model. It outlines changes to the model since its first publication in 1981 and discusses methods to use the new changes effectively

Database Management Systems Workshop: Room 3463

The Handy Dandy Cost Slicer Dicer

Author: Mr. Curtis M. Low

Have you ever had your boss suddenly want a new cost table? You have all the data in your database but are not setup to produce that table. This paper contains a procedure for slicing data into tables and dicing data into subsets for output that when configured to the set of eleven P-92 tables could produce more than one million different tables for output.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VIII, THURSDAY 5 SEPTEMBER 1991, 1530-1630

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

Estimating Cost Savings for Technology Insertion in Stock Funded Items

Author: Ms Faith Teitelbaum

This paper will focus on the effort to establish a methodology for estimating cost savings and calculating a return on investment in the operating and sustainment areas when Technology Insertion is applied.

Operating and Support Cost Analysis Workshop II: Room 3466

The Army Manpower Cost System

Author: Ms Judith Matthews

This paper describes the Army Manpower Cost System (AMCOS) procedures for manpower costing associated with weapon systems, are required in the "Instructions for Reformatting the Baseline Cost Estimate (BCE)/Independent Cost Estimate (ICE), DCA-P-92.

Tactical Systems Workshop: Room 3473

Economic/Military Life of Army Material Systems

Author: Mr. Bob Hunt and Mr. Bob Currie

This paper will provide a complete review of all historical and existing scientific methodologies and algorithms concerning the determination of "Economic/Useful" Life of tactical wheeled vehicles.

Innovative Approaches to Cost Estimating: Room 3477

Cost Engineering Integration - Practices and Applications

The cost engineering integration tool is a framework linking algorithms and relationships that immediately show the user the engineering and cost impacts of changes to mission requirements or design assumptions. The approach allows engineers and system architects to understand cost implications of concept and hardware decisions made during design process. This approach allows for earlier identification of more cost effective system architectures.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION VIII, THURSDAY 5 SEPTEMBER 1991, 1530-1630

Continued

BASOPS/Commercial Activities Workshop: Room 4460

The Military Construction (MILCON) Program and Privatization: A Comparative Analysis

Author: Captain Andrew Pope

This study investigated the difference between military construction and privatization/commercial projects. Specifically, the study examined four areas of possible incongruity which impact cost: administrative requirements, construction standards, contract clauses and the Davis Bacon Act. Data gathered indicated that all four areas do cause costs to be higher on Military Construction projects accomplished in the commercial sector.

Training and Professional Development Workshop: Room 4462

Assessing Impressions of Total Quality Management in U.S. Army Europe

Authors: Dr. David Koehn, Ms Cindy Quinn and Ms Susan Catanaoso

Department of Defense has adopted the concept of Total Quality Management (TQM). The purpose of this research is twofold: 1) to provide insights into the perceptions of resource management personnel regarding managerial processes and work environment factors related to TQM; and 2) to discuss the utility of ordinal vs ratio scales of survey measurement of TQM.

Cost Considerations in COEAs: Room 4464

Tube-Launched, Optically-Tracked, Wire-Guided (TOW) Sight Improvement Program (TSIP) Cost Effectiveness Analysis

Author: Mr. Richard D. Woppert, Jr.

The objective of this analysis was to determine which of several TSIP procurement strategies would be most cost beneficial to the Army. Peacetime life cycle cost and combat costs were integrated with item level performance results for the various TOW weapon system configurations to derive estimates of weapon system cost per kill. The cost per kill estimates were used as a measure of worth to rank order the cost effectiveness of the alternative TSIP procurement strategies relative to one another.

Risk Analysis Workshop: Room 4466

Learning Curve and Rate Adjustment Models: An Analysis of Accuracy and Bias

Author: Mr. O. Douglas Moses

Considerable research has investigated augmenting the traditional learning curve model with the addition of a production rate variable, creating a rate adjustment model. This study compares the accuracy and bias of the learning curve model and the rate adjustment model in predicting future cost. A simulation methodology is used to vary conditions along seven dimensions. Forecast errors are analyzed and compared under the various simulated conditions.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION IX, FRIDAY 6 SEPTEMBER 1991, 0910-1010

Automated Information Systems: Room 3460

Establishing A Formal Estimation Process in an R&D Environment

Author: Mr. Gordon Wright

The Software Engineering Process (SEPO) was formed at the Naval Ocean Systems Center (NOSC), a U.S. Navy R&D laboratory, in late 1988. SEPO's charter is to improve the software development processes from a Level 1 on the Software Engineering Institute's (SEI) Maturity Model to a Level 3 and above. Since that time, SEPO has concentrated heavily in establishing a formal software estimation process at NOSC. This presentation describes SEPOs progress in establishing such a process and a brief description of the process.

The DAB Process: A Case Study: Room 3461

Cost and Schedule Performance, A New Approach

Authors: Mr. Mike Merlo and Ms Kathy Whitehead

Utilizes a Quality Functional Deployment philosophy to interweave the Technical Performance Measurement process into the product oriented C/SCS management process. This yields a means of optimizing system effectiveness/performance while meeting cost, schedule, supportability and technical objectives.

Software Costing: Room 3462

Software Model Calibration Or, Why Did You Collect all that Data

Authors: Ms Sherry Stukes and Captain Dale Martin

This paper describes the use of a systematically developed data base to calibrate three commercially available software cost estimating models. The effort emphasizes the importance of model calibration, provides a step-by-step procedure for calibrating each model and furnishes valuable lessons learned. The calibration is oriented toward space platforms, but avionics and ground systems calibration values are also provided.

Database Management Systems Workshop: Room 3463

Standard Resource Budgetary and Control System (STARBUCS): A Performance Oriented Database System

Authors: Dr. David Koehn, Mr. John Sincavage and Mr. John Q. Adams

This paper describes the STARBUCS database and its supporting modules which perform various data management, administrative, system interface, and analysis functions. Emphasis is placed on the analysis functions imbedded within STARBUCS. It is shown how the analysis functions can support the resource manager in identifying issues and targeting his/her attention to critical areas during a variability analysis.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION IX, FRIDAY 6 SEPTEMBER 1991, 0910-1010

Continued

Operating and Support Cost Analysis Workshop I: Room 3464

Air Reserve Cost, Analysis, and Planning System (ARCAPS)

Authors: Ms Barbara Polk and Mr. John J. Coleman

In this paper, we will discuss the Air Force program, especially differences between Active duty military personnel and Reserve personnel, in terms of differences which impact formulation of Reserve personnel cost factors. We will also discuss the characteristics of ARCAPS, especially hardware and software, how the systems operates, and what the system achieves.

Operating and Support Cost Analysis Workshop II: Room 3466

Operating and Support Costs in Support of Desert Shield and Desert Storm

Authors: Mr. John Pulice and Mr. Les Zavecz

This paper describes the effects of Desert Shield and Desert Storm on Class IX Spares and Repair Parts. The costs associated with each deployed U.S. Army Division were compared against normal peacetime training costs to determine the cost of the operation. Significant increases are apparent for the M1 tanks, NBC related equipment, water purification apparatus.

BASOPS/Commercial Activities Workshop: Room 4460

A Business Case for Electronic Commerce

Author: Mr. Thomas P. Hardcastle

This paper describes and applies a methodology for estimating the benefits and cost of implementing Electronic Commerce techniques in the Department of Defense. It considers direct cost savings (those that results for replacing manual processing of documents with electronic transmission) and indirect cost savings (those that result from improved business practices made possible by EDI). For an $80 million investment cost, DoD can conservatively expect $1.2 billion in cost savings from Electronic Commerce.

Contractor Cost Performance Measurements: Room 4462

Ship Construction Cost Modeling Using DAES

Authors: Mr. Bob Venus and Mr. Peter Antaya

This paper discusses a statistical analysis that analyzes the cost performance for the CG-47, FFG-7 and SSN-688 class ships.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION IX, FRIDAY 6 SEPTEMBER 1991, 0910-1010

Continued

Cost Considerations in COEAs: Room 4464

Accounting for Residual Value and the Probability of War When Estimating Cost-to-Effectiveness Ratios for Evaluating Alternative Military Weapon Systems

Author: Mr. David Wollover

This paper is concerned with Cost Effectiveness studies that contrast weapon system candidates for specific mission within the within the context of a simulated broader war scenario. The following two issues are examined: (1) The concept of a weapon system's Residual Value for inclusion to calculating cost-effectiveness ratios, and (2) Introduction of the influence of the Probability of War upon how the cost of war is counted toward cost-effectiveness study results.

Risk Analysis Workshop: Room 4466

Software Risk Abatement in a Department of Defense Environment

Author: Mr. Angelo Barone

Some easy to use and relatively inexpensive means of assessing and managing software risk are discussed for the source selection, development, and support phases of the software acquisition cycle. Cost, Schedule, performance (technical), and support risk are addressed for the support and development phases.

25th Annual DoD Cost Analysis Symposium

Innovative Approaches to Cost Estimating

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

Applying Engineering Problem Solving Approaches to Cost Estimation and Analysis

This paper shows how engineering problem solving approaches can be applied as a methodology to the process of cost estimation. Such a methodology ensures estimates that are reasonable, rational, documented, bounded, and understandable. Tools such as automated cost models or spreadsheets by themselves do not provide methodology. Without proven methods for applying tools, standard sanity checks, procedures, definitions, and even rules of thumb, cost analysts may be working out of control, producing estimates that are not properly justified, documented, or even repeatable. The cost engineering life cycle is shown as a series of steps, each with defined inputs and outputs, just like software or hardware development life cycles. Software cost analysis will be emphasized, however, the principals are appropriate for any costing

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GERM: GENERALIZED-ERROR REGRESSION MODEL

Ordinary least-squares (OLS) regression, either linear or nonlinear, is commonly applied to historical-cost data in order to derive cost-estimating relationships (CERs). A fundamental assumption of OLS regression is that the error model upon which it is based be additive. More precisely, each observed value of the dependent variable is a function of the independent variable plus an error term. Unfortunately, this assumption is not always valid. A case in point is where the values of the observed dependent variable change by several orders of magnitude as a function of the independent variable. In this case it is often more representative to assume a multiplicative error model. This type of situation is often dealt with by taking logarithms of both sides and then applying additive-error linear regression, but this procedure unnecessarily binds one to a specific class of regression-equation forms. It is useful to have a general least-squares methodology that can treat not only additive, but also multiplicative, error models.

The generalized-error regression model (GERM) is designed to meet this need. It allows the user to specify along with the historical-cost data whether an additive or multiplicative error model is to be used in deriving the least-squares CERs. In this paper both error models will be discussed, along with the least-squares problem appropriate for each. An example will be given that illustrates both the additive model and the multiplicative model, showing the consequences of each in terms of the least-squares CER derived.

Author: P. H. Young, Resource Analysis Department, The Aerospace Corporation, P.O. Box 92957, Los Angeles, CA 90009-2957, (213) 336-5602. To be presented by S. A. Book, Director, Resource Analysis, The Aerospace Corporation, (213) 336-8655.

APPLICATION OF THE ANALYTICAL HIERARCHY PROCESS IN A MATHEMATICAL PROGRAMMING PROBLEM

ABSTRACT

Analyses involving numerous potential alternatives can be extremely complex since the details of all the alternatives must be compiled and evaluated. In addition, the human mind has a limited capacity for holding information needed for rational decision making. Thus mathematical programming is especially valuable in these circumstances, and can help keep decision makers focused on the critical issues, allowing for better intuitive decision making. In addition, it can be used for 'what if' exercises where the impacts of changes in some, or all, of the resource constraints can be analyzed.

In the linear programming methodology objectives and constraints are expressed as linear mathematical functions of decision variables. In numerous cases the required coefficients of the decision variables in the objective function are not readily quantified. In many of these cases, however, it may be possible to employ the Expert Choice software to provide genuine quantitative ratio measures for use in the mathematical programming process.

An example where this methodology could be applied is in the current USAREUR reduction planning process which includes returning some U.S. installations to the German government. The process requires selecting installations for disposal on the basis of several objective and subjective factors of different relative importance. The mathematical programming formulation is a linear integer model, where the objective is to retain the most effective combination of installations subject to total dollar and force level constraints.

The coefficients in the objective function are determined from the Expert Choice model by assigning a rating to each installation for each selection criteria; the Expert Choice program then synthesizes the individual ratings to produce total installation ratio scale ratings. The LINDO mathematical programming computer system was used to determine solutions to specific problems. In addition to the status quo, illustrations of solutions to reduced dollar and force level problems were examined, and the candidate installations for retention and disposal were identified.

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25th Annual DoD Cost Analysis Symposium

Tactical Systems

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

Development of Deployment Cost Factors for Operation DESERT SHIELD

On 2 August 1990, the Iraqi Army invaded Kuwait. In response to this aggression, the President of the United States deployed infantry, armor, and support units to protect Saudi Arabia from invasion and provide a deterrent to further Iraqi aggression. The III Corps at Fort Hood deployed the 1st Cavalry Division, the 13th Corps Support Command, and elements of the 2nd Armored Division to Operation DESERT SHIELD.

This deployment provided the unique opportunity to study the cost impacts to the installation, develop personnel and equipment deployment cost factors, and analyze the effects to the supply system for non-POMCUS (Prepositioned Organizational Materiel, Configured to Unit Sets) scenarios. Mobilization cost factors developed in this study can be used as a decision making tool by higher headquarters to estimate costs for future non-POMCUS deployments.

This paper describes the extensive data collection process which exploited several data sources and several computer systems to extract the necessary data for the study. An explanation of the download and conversion process into PC compatible file structures is included. The paper discusses the methods employed to allocate costs utilizing budget and Class IX repair part requisition codes into personnel and equipment costs and cost factors. An assessment of the accuracy and significance of the assumptions and process is presented. Provided is a listing of the developed equipment and personnel deployment cost factors. The impact and analysis of demands on the supply system, including the most frequent and most costly requisitions by unit, is discussed. Lastly, the proper use and application of the developed factors is presented.

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Aggregate Cost of Tactical Systems

This paper examines relative and absolute trends over time of the budget authority for procurement of tactical systems within the Department of Defense. Tactical systems are primarily defined as those included in the following eight procurement accounts: aircraft procurement, Army; missile procurement, Army; weapons and tracked combat vehicle procurement, Army; aircraft procurement, Navy; weapons procurement, Navy (less ballistic missiles); shipbuilding and conversion, Navy (less fleet ballistic missile ships); aircraft procurement, Air Force; and missile procurement, Air Force (less ballistic missiles). Actual current appropriations data for these accounts were gathered for the years 1970, 1975, 1980, and 1985-1990; estimated (as of January 199) current appropriations data for 1991-1992 were also gathered. Data for the same time periods were obtained for four secondary accounts, communications and electronics equipment procurement for Army, Navy, Marine Corps, and Air Force. These data provide a reasonable, but not perfect, approximation to the total appropriations for tactical systems over this time period.

The paper analyzes trends for each category in deflated dollar terms as well as trends for each category relative to total DoD procurement, total DoD budget, and total federal budget authority. Appropriate statistical hypotheses are tested, conclusions are drawn, and predictions are made.

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The New Competition of the '90's: A Quest for Scarce Systems Acquisition Funds

The continuing evolution of DoD systems acquisition polices and contractor strategies suggests that the defense marketplace will undergo dramatic changes during the '90's. The historical growth of DoD Total Obligational Authority is compared to recent reductions in DoD RDT&E and procurement budgets. Factors that influence DoD Budget levels are also identified and briefly discussed. These issues provide a context for understanding changes that are occurring.

Based upon considerations derived in part from the above analyses, key elements that have characterized the DoD systems acquisition process before and during the '80's are noted and trends for the '90's and beyond are projected. Probable trends lead to the conclusion that cost analysis must play an enhanced role in supporting both government and contractor decision makers to achieve program success by avoiding cancellations and defaults.

An overview of aircraft programs begun during the Reagan defense buildup provides a striking illustration of the need for greater attention to cost. And, the changing fortunes of missile system contractors demonstrates how incentives that drive defense contractors may be changing.

Finally, suggestions are made regarding the broad range of potential cost avoidance strategies that are available to defense firms and the steps required to analyze their cost implications are reviewed.

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COST CONSIDERATIONS
in
TRAINING SIMULATION ARENAS

This paper advocates more extensive use of simulators...especially for Sustainment Training.

Within **Resident Training** communities of the Department of Defense, it is widely recognized that simulators allow pilots, drivers, and gunners to learn to operate their systems much less expensively than on the actual vehicles. However, in the **Sustainment Training** community, it is not nearly as widely accepted that simulators can save or avoid costs.

This paper first compares costs of simulator hours to costs of platform operating hours in Sustainment Training environments. This paper then identifies and explores specific sustainment areas in which simulators can plausibly achieve major cost savings:

Live Fire Gunnery
Collective Training
Training Strategies

Resistance to the idea of more extensive use of simulators will also be explored.

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July 1991

RESOURCE TRADE-OFFS FOR

AVIATION COMBINED ARMS TACTICAL TRAINER (AVCATT)

ABSTRACT

Three approaches to determining resource trade-offs are extracted from the AVCATT cost and training effectiveness analysis for a nonsystem training device, the Aviation Combined Arms Tactical Training, Training Development Study (TDS). The TDS will support the AVCATT acquisition milestone decision review (MDR) I and II. The three approaches are the Augment Approach, Futuristic Approach, and Budget Constraint Approach.

The Budget Constraint Approach provides a method to determine resource trade-offs from a cost and training effectiveness point of view. The AVCATT Collective Flying Hour Trade-off Model is presented in this approach. This mathematical model aids the commander in determining the best combination of AVCATT hours and actual flying hours to perform collective training. It uses a hypothetical example based on an actual study of the Apache equipped 2d/229th Attack Helicopter Battalion (ATKHB). The 2d/229th trained on the AIRNET networked simulator at Fort Rucker and had great success in "Operation Desert Storm."

The TDS cost analysis for the Budget Constraint Approach reflects that AVCATT could pay for itself in 10 years of device life with an Operating Tempo (OPTEMPO) trade-off of only one-half hour in the aircraft for 31 hours of AVCATT availability per crew per month.

Three approaches to the AVCATT cockpit seating configuration are discussed. The Reconfigurable Seating Approach is probably the most cost effective. The AVCATT is recommended for acquisition.

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Long-Term Fleet Cost Analysis

The purpose of this paper is to demonstrate a methodology for evaluating the cost effectiveness of various long-term fleet planning policies. Particular attention is paid to the rate at which new vehicles are procured, and the resulting costs incurred. The effect of service life extension programs are also considered.

To examine the cost effects of various new vehicle procurement rates, the paper assumes the rates will be sustained indefinitely. Discounting is used to account for lost investment potential. In this way the long-term ramifications of various procurement rates can be compared directly to each other.

CUCV (Commercial Utility Cargo Vehicle) data was used as an example to show the cost effects of various new vehicle procurement rates. The example showed that waiting longer between new CUCV procurement was more cost effective than the more frequent procurement, in spite of rising operating and sustainment costs.

Another CUCV example shows the cost effects of implementing a service life extension program. This example shows the relationship between the service life extension cost and the total CUCV-related costs. Thus, depending upon the service life extension cost, it can be determined whether or not it is cost effective to implement such a program.

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Economic/Military Life of Army Materiel Systems

The U.S. Army Tank & Automotive Command Fleet (TACOM), Fleet Planning Office (FPO) is actively involved with developing the analytical and methodological approach towards a overall fleet modernization plan for the Army's Tactical Wheeled Vehicle fleet. Army planners are continuously and presently adjusting the fleet's composition, procurement strategy and spending plan between 1992 and 1994 under the highly visible truck modernization plan. Funding cutbacks and a restructuring effort towards a favored light truck fleet are indicative of the Army's desire to manage the readily observable upward trend in operating and maintenance costs of the current light and heavy fleet. Given this background, the SAIC is seeking to improve it's ability to provide the Army with accurate and defendable fleet modernization objectives, schedules and cost estimates. This paper will provide a complete review of all historical and existing scientific methodologies and algorithms concerning the determination of "Economic/Useful" life of tactical wheeled vehicles. The purpose of developing this overview is to establish a baseline. This baseline provides a starting point from which to develop new ideas and techniques for the practical applications of economic theory and operational realism into the determination of and utility for a vehicle "Economic/Useful" life concept. In addition, this paper investigates the concept of determining the need and practical use for a "Military Useful" life methodology.

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Heuristics as a Design Tool in Cost Engineering Integration (or Cost Engineering Integration - Practices and Applications Continued

Cost engineering has been incorporated into the approach for defining the Brilliant Eyes element of the Strategic Defense System. The role of cost engineering in relationship to the architecting process is described. The use of selective modeling to explore the largest trade space provides the most information. Heuristics are some of the non-quantitative tools used to focus on the cost drivers. The design tensions facing the cost engineer make estimating a difficult assignment.

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Cost Engineering Integration - Practices and Applications

The current architectural and design trade techniques often carry unaffordable alternatives late into the decision process. This detracts from identification and consideration of more affordable choices.

The cost engineering integration tool is a framework linking algorithms and relationships that immediately show the user the engineering and cost impacts of changes to mission requirements or design assumptions. The approach allows engineers and system architects to understand cost implications of concept and hardware decisions made during design process. This approach allows for earlier identification of more cost effective system architectures.

The cost engineering process demands close teamwork from the engineers and cost analysts at the system definition level. Engineers and cost analysts must work together to construct appropriate design and cost algorithms and relationships from the early stages of design. The use of cost engineering, with its early emphasis on cost, leads the engineering and cost communities to take mutual ownership of the design and its costs.

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25th Annual DoD Cost Analysis Symposium
BASOPS/Commercial Activities

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

ABSTRACT

FORCE STRUCTURE COSTING - THE DRAWDOWN SIDE

This paper introduces USAFE's methodology for computing force structure drawdown cost estimating. It explains the tools required to do the job, the limitations of existing software, the functional experts needed for consultation, and the importance of a strong budget interface in USAFE's overseas environment. It takes a new look at the unique problems which face an overseas command in the midst of a drawdown as USAFE is no longer in a force structure "build situation." The key difference between a drawdown scenario and a force structure build situation is real time funding impacts. The USAFE challenge is to develop tools to better approximate the impact of closure/beddown on USAFE bases. Air Staff developed models ignore European unique costs such as: severance pay, foreign inflation, foreign currency fluctuations, host nation status of forces/Memorandum of Understanding related obligations, host nation residual value, and civil engineering cost associated with returning the facility to the host nation. This article focuses on the need for sophisticated menu driven software to address the real world issues which challenge USAFE. It explains the type of tools, the scenarios, and the source of expertise needed to "get the job done." It embodies the USAFE Comptroller's goal of being proactive.

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BASE OPERATIONS RESOURCE ESTIMATION/ALLOCATION MODEL

ABSTRACT

USAREUR is consolidating its Base Operations functions within a new Area Support Group (ASG) structure. Because of these consolidations and concurrent troop strength reductions, the historical allocations of resources based on the old UMC/community structure is no longer adequate. Consequently, there is a need for a consistent methodology to provided a bench-mark for the re-baselining of USAREUR Base Operations resources. One approach to meeting this need has been the development of a Base Operations Resource Estimation/Allocation model. It is a computer based LOTUS spreadsheet model using cost and manpower estimating relationships (CERs and MERs) and MDEP allocations developed from historical community Base Operations data collected by HQ USAREUR over the last three years. The parameter driving the CERs and MERs is total military population supported. The model can either be used in the estimation mode to build-up resource requirements, or it can be used to allocate a given amount of resources. Historical parameters used to allocate re-baselined resources to MDEP can be modified to reflect new guidance, and "what if" exercises can be run quickly by changing population counts or other specific model parameters. Printouts provide Base Operations (BOS(-) and RPMA) cost and manpower estimates for each proposed Area Support Group. These values are broken out by MDEP and lettered account. In addition, analysis of the data in terms of cost and manpower categories are presented.

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The Application of Soldier Survey Information to Project Socio-economic Impacts Resulting from Operation QUICKSILVER

Due to the recent changes in the international climate, especially those in the Soviet Union And Eastern Bloc nations, the Army developed a plan to reduce its forces world-wide to create a smaller yet more capable military force. The implementation of this reduction which involved the inactivation of several units, including divisions world-wide, was named QUICKSILVER. The 2nd Armored Division (2AD) at Fort Hood was one of those divisions selected to be inactivated. This action would reduce the military force at Fort Hood by approximately 33%.

In 1969, the National Environmental Policy Act (NEPA) was enacted by Congress to eliminate damage to the human environment. The act requires federal agencies to consider environmental effects of any proposed actions through an established procedure. An Environmental Assessment (EA) was required to determine the impacts of the inactivation on the local environment. Although not required by law, the Environmental Assessment Team (EAT) deemed it appropriate to provide an assessment of the inactivation on the local communities as well. To evaluate the impact, a survey was designed to extract pertinent socio-economic information from 2AD personnel. Survey data was then used to project changes in local population strata, in public school enrollments, in consumer trends, and in the local housing and rental markets.

This paper describes the overall approach of projecting survey data on local area population due to the inactivation of the 2AD. Techniques used to create, conduct, input, and analyze the survey are discussed. A brief overview of the methods used to project the survey results on the area population is included along with a discussion of the various population statistics generated from the survey analysis. The statistical validation of the survey results are presented. Study projections are shown along with a discussion of the long range effects on the local communities. Secondary and tertiary effects due to the inactivation are also discussed,

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ABSTRACT

DETERMINING THE COST TO THE UNITED STATES OF
NATO INFRASTRUCTURE PROJECTS

Decreased defense outlays in upcoming years will result in increased scrutiny for all DoD programs. This will require accurate cost estimates, both in current and then-year dollars. One area that until recently was exempt from Congressional scrutiny is funding for NATO infrastructure projects. For years, NATO members have contributed to a cost sharing method of constructing and maintaining facilities without any single nation placing restrictions on the cost of an individual program.

During the planning phase of NATO infrastructure projects, estimates are prepared by the host nation and then thoroughly reviewed and scrubbed. While this process has resulted in realistic estimates, the estimates are in current-year units of the host nation. Congress and senior DoD leadership require then-year estimates in US dollars to make decisions. Estimating the then-year cost of NATO infrastructure projects is a complex process. Besides the uncertainties that exist in all estimates, the estimate must consider the collective and individual economies of 14 nations over the length of the program.

NATO uses a notional currency, the Infrastructure Accounting Unit (IAU), to standardize impacts of inflation and currency fluctuations. The value of the IAU in comparison to national currencies is recalculated every six months. Since NATO does not forecast future IAU-to-currency rates, the model uses linear regression to determine the future IAU to national currency exchange rates. By applying these forecasted rates, USAFE developed a computer spreadsheet model that converts the current year estimate in the currency of the host nation to a then-year estimate in US dollars.

The model first transforms the current-year estimate to a then-year by applying inflation rates. This estimate is then converted from the currency of the host nation to IAUs and from IAUs to US dollars by use of forecasted exchange rates.

This paper discusses the need for a model, the NATO infrastructure program and estimating process, and the mechanics of the model. As a practical application, the paper explains how the model was used to analyze the cost for the planned NATO beddown of the USAF's 401 TFW near Crotone, Italy.

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Costing Plant Closures

One of the areas the cost analysis community must address in the 90's is the closing down of government facilities. The Secretary of Defense Mr. Chenney currently has a list of base closings that consist of many different types of government installations: base closings, command closings, and production facilities closings. The cost analysis community must learn how to accurately cost these base closing for the government.

This paper will focus on one aspect of base closings, the closing of production facilities. The ABRAMS Production Base Closure will be the basis for the information, discussing the methodology for determining the cost of layaway of GOCO (government owned contractor operated) facilities and COCO (contractor owned contractor operated) facilities.

Most laymen think it is a minor cost to close a facility. This is not true, it requires a large outlay of funds up front that must be analyzed by the government. Some of these areas are plant equipment removal/layaway, facilities rehabilitations, human resources, EPA clean up, maintenance/caretaker, closure penalties, etc.

There are also costs that the contractor will incur that the government is not contractually liable for. These range from absorbtion of fixed overhead and lost profit, to human resources not covered under contract. The government should know what cost they are and are not contractually and legally responsible for. The cost analyst should be able to do an independent estimate separate from what the contractor has determined to provide a logic and sanity check.

The government must prepare for the new types of base closure analyses that must be performed in the near future. The contractor's information that is provided to the government will be the worst case scenario. After all what the government is really asking the contractor is how much does it cost me to put you out of business? Therefore, the cost analyst must be aware of the areas of cost that the government is contractually and legally bound to. Not what the contractor would like the government to believe they are responsible for. After all does it seem logical that it costs nearly as much to shut down a production facility as it does to start it up?

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HQ Military Airlift Command (MAC) Formal Training Course Cost Report (FTCCR) Small Computer Model Demonstration

BACKGROUND: AFR 173-7 requires each major command to submit formal training course costs annually.

PURPOSE: To provide instructions to use HQ MAC's FTCCR model to estimate course costs for academic training and/or flying training courses.

DISCUSSION: The FTCCR model is a menu driven program that is designed to be used on a Zenith Z-248 or other IBM compatible computers. The FTCCR can be prepared in its entirety on a headquarters system or in part on a base subsystem. Data may be entered into the base subsystem at the training site and uploaded into the main headquarters system where it is merged with the most current AFR 173-13 factors. The reports are designed to be printed on most printers. System Installation, Navigation, files used, and functional procedures are discussed.

CONCLUSION: The model decreased HQ MAC's FY90 FTCCR processing time by 50 percent and it is estimated to reduce data entry errors by 75 percent.

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AUTOMATED SYSTEMS FOR MONITORING

COMMERCIAL ACTIVITIES FUNCTIONS AFTER COMPLETION OF A-76 COMPETITION

1. The Commercial Activities program or A-76, as it is popularly known, has inspired many actions and reactions. An emotional and highly-charged issue before and during the preaward phase of A-76, once the final determination is made, A-76 seems to fade away in the minds of those not directly affected. But what happens after an organization is reviewed and contracted out? In many ways the work just begins because of the monitoring required on the contract. Addressing this issue, the Department of Defense Inspector General completed an audit on the procedures and internal controls associated with monitoring commercial activities contracts.

As a result of this audit, HQ AFRES/ACCC developed two automated systems for monitoring these contracts. Both the **AC BOS Cost Analysis System** and the **PWS Tracking System** provide local financial management personnel with tools for monitoring contracted-out functions. The major points of the paper are:

- ***The effect the audit had on designing the systems.*** Findings indicate that commercial activities were not being tracked either financially or through workload after award of the contract. According to the report, even though guidelines were unclear concerning the monitoring methods, local management should have been monitoring to preclude possible overexpenditures.

- ***The design of the automated systems.*** Both systems are menu-driven, dBASE III Plus applications that easily adapt to any commercial activities contract. Directly interfacing with both standard Air Force systems and nonstandard local systems, using a database allows for greater freedom in defining, storing, accessing, and sorting information concerning the contract.

2. In many instances, financial managers do not always have the required visibility over the contract costs or the PWS workloads associated with commercial activities contracts, especially when there is increased activity in the functional area. Because the data used to monitor the commercial activities contract comes from various sources, locating and analyzing the data can become a major task. While not designed to provide insight into all aspects of commercial activities contracts, both the AC BOS Cost Analysis System and the PWS Tracking System allow management to review the A-76 areas more effectively and efficiently. With the increased emphasis on reducing budget requirements and the ever decreasing workforce, these automated systems provide a viable management service for those monitoring commercial activities functions.

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The Military Construction (MILCON) Program and Privatization: A Comparative Analysis

This study investigated the difference between military construction (MILCON) and privatization/commercial projects. Specifically, this study examined four areas of possible incongruity which impact cost: administrative requirements; construction standards; contract clauses; and the Davis-Bacon Act. Interviews were conducted with representatives from government and industry. Data gathered indicated that all four areas do cause costs to be higher on MILCON projects accomplished in the commercial sector.

The most significant findings resulted in the Davis-Bacon Act area. the Davis-Bacon Act requires that prevailing wages, as determined by the Department of Labor, be paid on all federal construction contracts over $2500. Data gathered in the Dayton, Ohio area indicated that prevailing wages exceeded commercial sector wages by 37 to 149 percent. The excessive wages cause federal government and military facilities to be substantially higher in cost compared to the commercial sector.

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ABSTRACT SUBMISSION FOR THE 25TH ANNUAL DoD COST ANALYSIS SYMPOSIUM

Title: A Business Case for Electronic Commerce

Abstract:

In a May 1988 policy memorandum, the Deputy Secretary of Defense directed DoD components to make "maximum use of electronic data interchange (EDI) for the paperless processing of all business-related transactions." His goal was to establish within DoD an Electronic Commerce business environment, building upon EDI technologies, by the early 1990s. The Defense Logistics Agency, designated DoD's Executive Agent for EDI and Data Protection, was assigned responsibility for establishing compliance with DoD policies and EDI industry standards, coordinating EDI software and hardware requirements, and representing DoD's interests before EDI standards and industry groups.

One of the Executive Agent's first initiatives was to prepare a business case for Electronic Commerce, which includes EDI and other forms of electronic transmission such as bulletin boards, electronic funds transfer, and electronic mail. The business case showed that DoD, over a 10-year period, could achieve almost $1.2 billion in cost savings by electronically processing 16 documents. Those documents include several that are traditionally targeted for EDI in the private sector - purchase orders, invoices, bills of lading, requests for quotations, and inspection reports. To achieve those savings, DoD would need to invest approximately $80 million in new systems and procedures.

To capitalize upon the benefits identified in the business case, the Executive Agent formulated a strategic plan to focus and establish priorities for DoD's Electronic Commerce investments. That plan recommended a detailed assessment of Electronic Commerce opportunities at the Defense Finance and Accounting Service - Columbus Center and development of a broad strategy to implement Electronic Commerce in DoD procurement.

The Business Case considers two categories of cost savings in detail: direct cost savings (those that result from replacing manual processing of documents with electronic transmissions) and indirect cost savings (those which result from using improved business practices made possible by EDI). Savings and investment costs are calculated over an expected 10-year project life cycle. Internal rate of return and net present value are used to evaluate the potential yield of DoD's investment in EDI.

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25th Annual DoD Cost Analysis Symposium

Acquisition Strategy

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

INTRODUCTION TO SCHEDULING AND SCHEDULE ANALYSIS
A COURSE OF INSTRUCTION

In early 1989, the Comptroller for Aeronautical Systems Division (ASD) at Wright-Patterson Air Force Base in Ohio began a Scheduling Initiative. It was the result of the Comptroller's commitment to provide to ASD Program Managers the optimum level of scheduling suport needed to plan and schedule the weapons development and acquisition accomplished at ASD. This optimum level of support, however, must be accomplished within the limited resources available. Among the results of that effort are indications that a need exists for a distinct course on scheduling which is designed to teach scheduling as its sole subject matter rather than one small aspect of another subject, such as its use as a management tool within the acquisition process.

Consequently, this research was done to accomplish three objectives:

1. Determine whether or not there is a perceived need for an introductory level course on scheduling and schedule analysis.
2. Identify the appropriate content for such a course if it were created.
3. Provide a manual for a qualified instructor's use when presenting an Introduction to Scheduling and Schedule Analysis course.

After examining various sources on the subject to determine likely topics, a survey was created and randomly distributed among 100 Program Managers and Comptroller personnel responsible for accomplishing program scheduling. These surveys sought to determine the perceived need for an introductory level course, its ideal content, and the desire of these individuals to attend such a course if it were created. The unexpectedly high interest and highly favorable responses to the surveys provide the basis for the course that has been developed.

Since the need has been established and the appropriate course content determined, a qualified instructor's manual was created. It contains charts which an instructor could use over a four-day period of time and suggested words which the instructor might use during the presentation of the charts and other materials provided. Topics include Scheduling Techniques, Networking, Cost/Schedule Control Systems Criteria, Analysis Techniques, Data Item Descriptions, Risk Analysis, Reading Contractor's Submittals and Building Integrated Program Schedules. The material is designed for presentation to Program Analysts, Management Analysts, Program Managers, and anyone else who is expected to provide scheduling support or schedule analysis support. It provides examples, practice exercises and some case work for hands-on practice. It could be tailored for managers who must understand the elements, without needing the technician's degree of expertise. The intent is to provide a strong foundation of knowledge and some experiential opportunitites for students.

The Comptroller at ASD is presently pursuing the inclusion of this course in the Air Force Institute of Technology's curriculum. Meanwhile it is being presented at ASD and student feedback has been favorable.

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A Schedule Assessment Tool for UnManned Spacecraft Acquisition Programs

This paper reports the results of an effort to develop a schedule assessment tool to be used in the review of unmanned spacecraft acquisition programs associated with the Strategic Defense System (SDS).

Data were collected for sixteen satellite programs. We also review past IDA Schedule Estimating work on missiles, including relevant air-launched missile research. We analyzed schedule intervals for each program and developed time estimating relationships. For missile programs, four schedule intervals, Time to First Guided Launch, Flight Test, Initial Production, and Overall Full Scale Development Program, were examined. Technical and performance characteristics were found to be good predictors of these intervals. For satellite programs, only time to first delivery (months from development start to the delivery of the first flight-model satellite) was examined. Our study shows that technical variables such as beginning of life power and satellite type (navigation, sensor, communication) are good schedule predictors for satellite programs. The customer type also improves the satellite model fit. We demonstrated both the satellite and missile models by estimating the schedule of a Brilliant-Pebbles-type space-based interceptor.

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Prototyping in Major Acquisition Programs

In the new defense environment of constrained budgets, prototyping is receiving increased attention. Prototyping seems to be counter-cyclical with the defense budget--when budgets are tight, more prototyping is done. Prototyping can be used to demonstrate new technologies, to reduce technical and cost uncertainty, and to get better information for source selection early in a major weapons program. However, the conventional wisdom suggests that it delays programs.

The objective of the paper is to examine the cost and schedule outcomes of programs with and without prototyping and to suggest guidelines for prototyping. The paper develops a framework for examining the level and purpose of prototypes.

Cost growth and schedule slip are examined for 52 programs, including non-prototypes and prototypes of various levels and purposes. Results indicate that prototyping helps to make program cost, particularly development costs, more predictable. Evidence regarding program schedules is also examined. Aircraft and tactical munitions have followed different prototyping strategies, with aircraft prototyping programs with technology in hand, and tactical munitions prototyping programs with evolving technology. The analysis provides the basis for prototyping guidelines.

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AN ACQUISITION STRATEGY FOR REDUCING COST OVERRUNS

ABSTRACT

Over the past years the author has been analvzing the problems of cos overruns of system acquisition programs, their causes, and what could have been done to reduce such overruns. This paper will discuss a systematic method which can aid in this objective.

This method utilizes the Draft RFP as a vehicle for obtaining planning information which can aid the government in better matching their final Statement of Work to the budget available. This approach as been discussed with a number of contractors and government contracting personnel and appears to have merit as an improvement in acquisition strategy.

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The Major Warship Review from a Cost Analyst's Perspective

The purpose of this paper is to discuss the Major Warship Review (MWR) from a cost analyst's perspective. The MWR was requested by The Secretary of Defense as a comprehensive analysis of various ship type alternatives. The Office of the Secretary of Defense Cost Analysis Improvement Group (OSD CAIG) tasked the Navy to provide cost analysis support. Naval Sea Systems Command, Cost Estimating and Analysis (NAVSEA 017) was responsible for providing cost estimates based on the requirements identified by the OSD CAIG, The Assistant Secretary of the Navy: Research, Development, and Acquisition (ASN RD&A), and Program Managers (PMs). To demonstrate the scope of the Major Warship Review its background will be presented. The planning process for developing and presenting the cost estimates will be discussed. Then the methodology used in developing the various types of estimates will be presented. Finally, there will be a short discussion on applications.

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Financial Analysis of Competing Teams

As a result of the recent economic trends and reduction in the defense spending, more emphasis has been placed on the financial status of DoD contractors than ever before. The objective of these analyses is to identify the financially distressed firms prior to award of a contract and consequently improve risk management and dispersing the limited available resources.

Several standard techniques are available for the analysis of a single contractor. Ratio analysis allows the comparative analysis of contractors with their own industry norm in the areas of solvency, asset management and profitability. The Distress model known as Z-score is a composite indicator of overall financial health of the subject firm. The results of standard financial analysis are sufficient to identify financially stronger firms, from others, when several contractors are competing for a contract individually. However when different contractor teams are competing for a contract, the focus of financial analysis should shift to identification of the weak links in each team and the overall financial indicators for each team.

This paper introduces two innovative techniques developed and used for the financial analysis of the Light Helicopter (LH) contractor teams competing for the full scale engineering development contract in support of the source selection process. Team financial ratios are developed by using a simplified additive weighting method technique. This allows each contractor to impact the team financial ratios proportional to their financial responsibility in the project as well as the technical and schedule risks associated with that portion of the project. Contractor's financial ranking within each team is achieved by introducing a generic financial index which incorporates all financial indicators.

In addition to team financial ratio and team ranking, industrial norm analysis is presented. This is particularly important when members of contracting firms are from diverse ranges of standard industry classification (SIC) codes.

This paper also describes the requirement for automating the financial analysis of competing teams using the Compustat financial data base as an object oriented decision tool such as the object vision.

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Overhead Allocation and Incentives for Cost Minimization in Defense Procurement

This paper argues that current regulatory practices create a significant incentive for defense firms to choose inefficient production methods in order to manipulate the way that costs are allocated between products. In particular, firms will have the incentive to over-use direct labor on non-competitive contracts where revenues are highly cost-based and under-use direct labor on more competitive contracts where revenues are less cost-based. This incentive may result in pure waste of direct labor expenditures as well as in inefficient input substitution decisions. Empirically testable predictions regarding direct labor usage, automation and the amount of subcontracting in competitive vs noncompetitive contracts are developed. The magnitude of the incentive is estimated and shown to be large using data from four large aerospace contractors.

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25th Annual DoD Cost Analysis Symposium

Cost Considerations in COEAs

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

Misleading Costs in TIAs/CTEAs

by

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ABSTRACT

A Training Impact Analysis is a sub-analysis of a COEA or other comparative study of a major or important system. The TIA considers the impact on training, and on training costs, of a decision between alternatives. A Cost and Training Effectiveness Analysis is a stand-alone comparison of different methods of training, their costs and their effectiveness, to produce qualified people for the preferred alternative. A CTEA is a required supporting analysis for a COEA. Historically, the analyses have costed the training base. This results in distorted values which, at best, do not help a decision and, at worst can lead to a wrong decision. This paper will discuss how most TIAs and CTEAs are costed and how they should be costed, and why. It will focus on the ability of the cost analysis to support the decision to be made.

WHY NOT JUST THE BASELINE COST ESTIMATE?

Purpose: To explain why and what modifications must be made to the Life Cycle Cost Estimate (LCCE) contained in the Baseline Cost Estimate (BCE) in order to support the objectives of a Cost and Operational Effectiveness Analysis (COEA) or COEA-like study.

Method: Recent and ongoing Forward Area Air Defense System (FAADS) studies were used to illustrate required modifications.

Conclusion: LCCEs from system BCEs cannot be used in COEA-type studies without modification. Quantities or configurations may be different. Costs may be attributable to more than one system. Sunk and military personnel costs must be removed. BCEs may not contain relevant non-system costs.

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COST CONSIDERATIONS IN COEAS

TITLE: Cost analysis methodology and results used in the Close Combat Tactical Trainer (CCTT) Cost and Training Effectiveness Analysis (CTEA).

ABSTRACT: The Close Combat Tractical Trainer (CCTT) Cost and Training Effectiveness Analysis (CTEA) addressed the training capabilities, estimated the life cycle costs and potential cost paybacks of the proposed CCTT. The CCTT has the potential to be a cost and training effective addition to the Army's training program. The analysis was conducted in support of a milestone I/II ASARC decision on CCTT.

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Information System Cost and Economic Analyses in TRADOC

We must provide tactical information systems at an affordable cost to support the fast paced, high technology battlefield. "Cost" includes both military manpower and decision related dollars. Congress explicitly controls both Army end strength and dollars. Army personnel are an asset, possibly more valuable than their budgetary cost, and are susceptible to specific analysis. For this reason the Army Training and Doctrine Command (TRADOC) Information System Cost and Economic Analyses (ISCEAs) usually show two costs of resources, military manpower and total dollars (less military pay).

The Program Executive Officer (PEO) and/or the Army Materiel Command (AMC) provide materiel systems costs for Cost and Operational Effectiveness Analyses (COEAs). The PEO for Standard Tactical Army Management Information Systems (PEO-STAMIS) provides Automated Information Systems (AIS) costs. These costs are the Life Cycle Cost Estimates (LCCE). Other costs incurred because of the decision to field the AIS are added to the LCCE (less military pay) to determine total Decision Costs. These added costs include costs for continuing operations of the Base Case (status quo) until it is phased out by replacement with the system under consideration.

We make a distinction between costs and benefits. Costs pertain to obtaining and operating a system. Benefits (positive and negative) pertain to the usefulness of information coming from the system. AIS analyses consider benefits rather than operational effectiveness, which is the prime consideration of COEAs. A data processing van, computer, peripheral equipment, utilities, and supplies are costs. The value of the information from data processing to the user of the information is a benefit. Benefits, as are costs, are shown in military spaces or in fractional man years, and in dollars (not including military pay); and in all other categories discovered during the study. Examples would be information accuracy and timeliness. Benefits are quantified whenever possible; and stated as dollars when appropriate.

The purpose of the ISCEA report is to support a decision maker. The body of the report contains data pertinent to a decision. Appendices contain supporting data and data of interest to special groups. ISCEAs, like COEAs, display sunk costs, decision costs and benefits in constant and current dollars. Appendices also contain the Life Cycle Cost Estimate (LCCE), discounted dollars, and Return on Investment. ISCEAs and COEAs are similar in that both have Executive Summaries, Scope, Assumptions, Alternatives, Summary Findings and Conclusions.

We in TRADOC perform Materiel systems COEAs under detailed guidance of TRADOC Reg 11-8 and TRADOC Pam 11-8. ISCEAs generally follow the same guidance; but further follow a Letter of Instruction (LOI) from the Assistant Secretary of the Army for Financial Management (ASA-FM). Portions of a recent AIS ISCEA are used as a Notional Automated Information System (NAIS) to illustrate LOI procedures in the ISCEA process.

The LOI requires a single, integrated document. The executive summary, report, and appendices make a large document. We suggest that making the LCCE and ISCEA separate reports would be an improvement for both the user and analyst.

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Cost Analysis In Support of the Milestone II Light Helicopter

The Deputy Secretary of Defense directed the Army to perform the Light Helicopter (LH) Cost and Operational Effectiveness Analysis (COEA) to Support POM issue resolution and a Milestone II (full scale development) decision. TRAC-WSMR was given responsibility for the overall cost analysis in the COEA. In support of this cost analysis, life cycle cost estimates (LCCE's) were required for each helicopter system which make up the study alternatives. This paper presents the mechanisms involved in providing the Cost Analysis portion of the LH COEA.

Initial contact between HQDA, HQ AMC, TRAC-WSMR, and AVSCOM took place 14 December 1988. Further close contact between TRAC-WSMR and AVSCOM resulted in identification of alternatives and agreements in general methodology, ground rules and assumptions, time constraints and responsibilities. In general LCCE's were required for the following aircraft systems:

a. AH-1 COBRA (models E, F, P, S)

b. AH-64 (models A, PIPED, LONGBOW, and LH-MEP)

c. OH-58 (models A, C, D, and D Armed)

d. LH (Army Best Technical Approach and full ROC Compliant configuration)

Teams were organized to perform LCCE's on the specific aircraft, with each team responsible for the total LCCE to include variations in quantities and configurations that would invariably occur as the COEA progressed.

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Estimating the Costs of Changes in Army Individual Training

Army policymakers are considering a number of initiatives, in place of traditional methods that are thought to be more costly, which could fundamentally change the ways in which the Army currently conducts individual training. Because these changes could have far-reaching effects on Army costs and capabilities, analytical tools are needed which estimate the costs and savings that might be achieved by changing training approaches.

This paper documents a methodology for estimating the costs of changing approaches for providing individual training in the Army. The methodology uses a systems analysis framework and adds operational principles to provide a systematic and structured accounting system for analyzing training changes. Three major operational principles underlie the training cost methodology described in this paper: 1) *thorough specification of current training and proposed alternatives*, 2) *detailed tracking of changes in training resources* required by proposed alternatives, using an approach that is similar to an accounting balance sheet, 3) *integration into a balance sheet* of the changes in training resources. The goal of the training cost estimation methodology presented in this paper is to calculate the difference between the cost of the alternatives and the base case, the present course.

We applied the methodology to a hypothetical example of transferring a training event from a school to TO&E units. We considered two alternative means for implementing this change in training. The two alternative strategies resulted in significantly different costs and savings. The range of savings and costs was so wide that additional alternatives could easily be generated within the spectrum of these two alternative implementations.

We also found that the changes in training affected not only the organizations directly involved with the change, but other organizations, in this example, other organizations (e.g., other courses and their training departments, and other TO&E units that have to assume additional support responsibilities) experienced a "ripple" effect as a result of changing the training strategy . These changes resulted in additional costs that need to be part of the analysis. Total Army costs need to be considered--not just the costs to the organizations directly affected by the change.

The methodology also exposes the broader consequences of a training change--those beyond economic costs--such as the impact on individual proficiency and unit capability. The decisionmaker needs to have the costs or savings put in a context that identifies the trade-offs of the alternatives. In our illustration, if additional resources are not made available to the units implementing this training, there are important consequences for unit readiness. In this example, essential unit collective training exercises might have to be traded for the additional individual training that results from the transfer of driver training.

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COST-EFFECTIVENESS RATIOS AND PREFERENCE FUNCTIONS

The analysts have finally estimated both effectiveness and cost for each alternative of the Cost and Operational Effectiveness Analysis (COEA). Their next task is to rank order the alternatives. Some ranking methods use ratios of effectiveness to cost or their reciprocals (e.g., kills/dollar or dollars/kill). The implicit assumption is that ranking by such ratios would represent the preferences of a rational decision maker. In the context of measure theory this paper discusses the representation of preferences by functions and some general properties of preference. It is shown that ranking by cost-effectiveness ratios requires the following property of a decision maker's preferences:

> At a fixed level of effectiveness as cost increases the decision maker will pay more for a fixed increase in effectiveness.

It is also shown that if the decision maker's preferences satisfy a simple linearity property, ratios of differences can be used to rank the alternatives. This result might be useful in cases where the cost assessment technique or the effectiveness assessment technique provide only differences between alternatives rather than actual values.

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TOW Sight Improvement Program (TSIP) Cost Effectiveness Analysis

The Tube-Launched, Wire-Guided, Optically-Tracked (TOW) missile system is an anti-tank guided missile system designed to defeat threat armored targets. There are several variations of the TOW missile system currently in the Army inventory. The primary variant is the TOW2 missile system. The Basic TOW is the older variant which preceded the TOW2. The objective of the TSIP is to modify/replace the current TOW sight hardware on the Bradley Fighting Vehicle System (BFVS) and the High Mobility Multi-Purpose Wheeled Vehicle (HMMWV). The TSIP hardware will allow for target detection and engagement with increased clarity at greater ranges. It should also perform much better than the current sight hardware under conditions of reduced visibility. The currently planned TSIP strategy calls for the Army to product improve only 1094 of the 6724 BFVS/TOW and BFVS/TOW2 systems along with all of it's 993 HMMWV/TOW2 systems. During a TSIP Integrated Logistics Support Review, the Chairperson from the Department of the Army (DA) Office of the Deputy Chief of Staff for Logistics requested that the TOW Project Manager's Office (PMO) quantify the expected reductions in TOW sustainment costs attributable to TSIP. The U.S. Army Material Systems Analysis Activity (AMSAA) was tasked to participate in this sustainment cost study by using the estimates generated to determine whether it would be of greater benefit to the Army to upgrade all current BFVS and HMMWV TOW sights in the Army inventory with TSIP.

A cost effectiveness analysis of alternative TSIP production quantities was performed as a means of evaluating the possible decision to expand the TSIP to include all the BFVS/HMMWV TOW systems. The cost effectiveness analysis integrates peacetime life cycle cost and combat cost estimates with potential item level effectiveness results to derive estimates of weapon system cost per kill. These cost per kill estimates are used as a measure of worth to rank order the cost benefit of the alternative TSIP procurement strategies relative to one another. The results of the analysis using the Army Cost Position TOW/TSIP peacetime cost estimates and AMSAA GROUNDWARS model item level performance results show that it would be cost effective for the Army to increase the quantity of TSIP upgrades to include the entire fleet of BFVS and HMMWV TOW systems. For the combined BFVS/HMMWV TOW fleet on Southwest Asia (SWA) terrain subjected to threat artillery, overall effectiveness (i.e. the number of threat armored systems killed) increased from 16 percent to 47 percent, depending on the level of battlefield obscuration, when the entire fleet was outfitted with the TSIP hardware. If the Army decided to upgrade the entire BFVS TOW fleet of 6,724 vehicles with TSIP along with the 993 HMMWV TOW systems, an estimated additional $1.5 billion in procurement funding would be required above the current program level. This $1.5 billion increase in procurement funding requirements for BFVS TOW system upgrades is the largest obstacle the Army faces in implementing the increased TSIP procurement strategy. It is more cost effective to upgrade the entire BFVS and HMMWV TOW fleet with TSIP rather than the partial upgrade which is currently planned. This is because the increases in BFVS/HMMWV TOW fleet effectiveness outweigh the added cost of converting the entire fleet to the TSIP configuration. For the combined BFVS/HMMWV TOW fleet on SWA terrain subjected to threat artillery, estimates of fleet cost per kill were reduced from 13 percent to 31 percent, depending upon the level of battlefield obscuration, when the entire fleet was outfitted with the TSIP. The results of this analysis were briefed to key decision makers in Headquarters DA prior to the TSIP Pre-Army Systems Acquisition Review Committee meeting.

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Accounting for Residual Value and the Probability of War When Estimating Cost-to-Effectiveness Ratios for Evaluating Alternative Military Weapon Systems

This paper is concerned with Cost Effectiveness studies that contrast weapon system candidates for specific missions within the context of a simulated broader war scenario. The following two issues are examined: (1) The concept of a weapon system's Residual Value for inclusion to calculating cost-effectiveness ratios, and (2) Introduction of the influence of the Probability of War upon how the cost of war is counted toward cost-effectiveness study results. The conclusion of this paper is that cost-effectiveness modelling should consider both the most probable war scenario which will occur if deterrence fails as well as a sustained peacetime. It is hoped that this paper will invite beneficial debate surrounding the alternatives for linking cost and effectiveness indices.

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25th Annual DoD Cost Analysis Symposium

Communications, Command and Control

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

A "Chip" on DOD's Shoulder: How to Improve Communications-Computer Cost Management

Background: The explosion of communications-computer technology --with its accompanying price tag--presents a unique problem for the DoD as we shrink forces and focus on modernization. How do we modernize our command, control and communications (C3) systems and automated information systems within current austere funding levels? Given the ceiling on automated data processing equipment (ADPE) spending, threatened across-the-board cuts in C3 funding, and streamlining actions resulting from the Corporate Information Management (CIM) initiative, DoD must improve its financial management of communications-computer assets, or face capability shortfalls. DODD 7740.1 and associated service regulations provide a framework for managing our information resources, a framework which relies heavily on technological expertise; within that framework lie ample opportunities for cost analysts to improve resource management through estimating expertise. To illustrate our opportunities, this paper will focus on the beginning of the Air Force requirements process: Communications-Computer Systems Requirements Document (CSRD) development.

Discussion: For the Air Force, the process begins with definition of a technological solution, which is costed and justified in a CSRD, reviewed by the Communications-Computer Systems Working Group (CSWG), then approved or disapproved by the Communications-Computer Systems Requirements Board (CSRB). How, then, can Cost Analysis become involved? Through a three-pronged program of review, training, and regulation.

a. Review. Request the requirements office to include the Cost Analysis office in the coordination process for CSRD development, as a technical advisor and reviewer. Explain how Cost Analysis has the models, methods and databases to improve estimates for all phases of the life-cycle. Offer a quality estimate with a quick turn-around.

b. Training. We cannot offer assistance unless we can handle the workload, so it is important to train analysts prior to instituting CSRD review. Analysts must develop technical fluency through course and conference attendance, as well as through reading professional publications. Internally-developed review checklists targeting problem areas and ensuring completeness of costs, as well as instructional briefings, can be used to train analysts [included].

c. Regulation. Our overall goal must be to formalize Cost Analysis participation in command directives, such as Operating Instructions, regulation supplements, etc. If we aren't officially "in the loop," our participation is at the whim of current management.

Conclusion: Thorough cost estimating by analysts participating early in the requirements process will result in better financial management of our communications-computer resources. The opportunities for Cost Analysis are bountiful; it is up to us to pursue them.

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Electronic Technology and Cost Estimating Techniques for Weapon Systems

New technology is becoming available for avionics systems. Very High Speed Integrated Circuit (VHSIC) technology as well as gallium arsenide technology is advancing. The Air Force's Advanced Tactical Fighter (ATF) is utilizing Line Replacement Modules (LRMs) versus Shop Replaceable Units (SRUs) and Line Replaceable Units (LRUs). Avionics Suites utilizing LRMs like Integrated Communication, Navigation, Identification, Avionics (ICNIA) from the AF Wright Laboratory is a new trend.

Cost concepts and cost estimating techniques including parametrics, analogy, and grass roots estimating of SRUs, LRUs, and LRMs will be discussed. The parametric models including PRICE-M, PRICE-H, and Fast E will be critiqued. The main emphasis of this paper is on estimating acquisition cost, primarily in the production phase. Cost estimating is a vital part of any weapon system program.

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A Case for Electronics Modernization: The Navy's SRC-16 Shipboard Communication Central

This paper discusses the economics of electronics modernization and demonstrates key factors in selecting a system for modernization through examples chosen from systems under the cognizance of the Space and Naval Warfare System Command's (SPAWAR) Information Transfer Directorate (PD-50). The purpose of this study is to show the cost and benefits of modernizing electronics equipment through technology insertion. To this end, a method is developed for selecting electronic systems candidates for modernization and evaluating modernization alternatives using cost-benefits analysis. The estimated cost of the modernization plan is compared to the life cycle cost savings that would be realized through improved reliability and self-test, in addition to increased functional capability.

There are many criteria by which electronics equipment may be judged to be most appropriate for modernization: (1) the equipment is not meeting the requirement for operational availability, (2) the equipment is relatively expensive to operate and support, (3) the equipment is relatively burdensome on the maintenance and material supply system, (4) the equipment is old, and (5) there is relevant new technology available for insertion. Based on several of these criteria, the AN/SRC-16 was chosen as the best candidate for electronics modernization.

The AN/SRC-16 is a large, complex high-frequency (HF) communications system that transmits and receives RF signals between Link-11 data terminal equipment. The system is a complete self-contained shipboard communications central in that it includes all necessary transmitters, power amplifiers, receivers, couplers, patch panels, power supplies, and monitoring equipment within its five cabinets.

The AN/SRC-16 was built solely by the Collins Radio Company (now Rockwell Collins) and introduced into the fleet in 1959. No significant change has occurred in the operational environment since that time. The system construction reflects the technology of the time: vacuum tubes used throughout the system and mechanical components performing functions that are now commonly done by solid state devices. These are low-reliability components, and many suffer additionally from low availability, because they are no longer commercially produced to military specifications.

This paper discusses a proposal for technology insertion for the AN/SRC-16 and its sister equipment, the AN/SRC-23, which replaces vacuum tube technology in the receiver, transmitter, and power amplifier components with solid state technology. A demonstration of the expected life cycle cost savings due to modernization is presented, along with discussion on the lessons learned about evaluating weapon system modernization.

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The Application of Expert System Technology to Avionic Cost Estimating

The power of new technology can provide exciting and riveting changes in our business environment. One such new technology is expert systems. An expert system is an advanced computer program that can accomplish various tasks at a high level of proficiency. This is accomplished by using knowledge of the techniques, information, heuristics (rules of thumb), and problem solving processes which human experts employ in everyday life. My research explored the concept of applying expert system technology to avionic cost estimating. My initial objective was to provide an introductory guide to expert system development to the Aeronautical Systems Division's (ASD) Comptroller community. The second aspect of the research investigated the feasibility of integrating an expert system with the Automated Cost Estimating Integrated Tool (ACE-IT). I also "pulsed" senior and mid level managers concerning their awareness of this technology and willingness to participate in an exercise to help build an expert system for avionic cost estimating. Lastly, the objective was to query "sister" organizations with the Air Force Systems Command (AFSC) concerning their use of expert systems to accomplish avionic cost estimates.

My approach in conducting this research consisted of gathering data from published books, magazines articles, periodicals, and interviews with various experts in the field of artificial intelligence/expert systems (AI/ES). I also interviewed senior and mid-level managers (i.e., ASD Comptroller personnel and AFSC product divisions cost directorates.)

The interviews conducted with AI/ES "experts" indicated:

- Expert systems can be developed and implemented for avionics cost estimating
- Expert system shells can be integrated with existing cost models

From interviews with ASD comptroller managers and AFSC product division managers, I obtained the following results:

- 76% are familiar with Artificial Intelligence (ASD)
- 53% have heard of Expert Systems (ASD)
- 100% are willing to participate in expert system design (ASD)
- Only 1 out of 9 AFSC product division cost directorates is currently using expert system technology.

Expert system technology is here to stay, and a moderate but cautious use of its features may render invaluable benefits. The use of this technology is providing measurable productivity to those in the engineering, manufacturing, financial, and contracting communities. The results from the research imply that the comptroller community has moved very slowly in using this technology. Also, additional research is needed in the areas of expert system design and integrating expert system shells with existing cost models. There is also a need for expert system awareness and development training to cost personnel.

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The Systems Integration Cost Analysis Model (SICAM)

The Global Positioning System Joint Program Office (GPS JPO) identified a need for a tool which could provide cost estimates for the integration and installation of GPS user equipment into Air Force host vehicles.

The task itself seemed relatively routine. The real challenges were in the collection of actual cost data. The Air Force team distinguished itself over and over again in meeting these challenges.

At the completion of the task, procedures for collecting actual cost and technical information had been established for all five Air Logistics Centers (ALCs). The procedures are different for each ALC.

The documentation associated with SICAM is also unique. Through the efforts of the Cost Research Staff at Space Systems Division and Dr. Richard Murphy from the Air Force Institute of Technology, a cost model documentation guide was created. This guide is under consideration for all future cost research task reporting at Space Systems Division. If used, the documentation guide will be incorporated in the Statement Of Work to ensure compliance with support contractors.

The completed model was validated by the Air Force Cost Center and the methodology was approved by a recent Independent Cost Analysis team which reviewed the GPS program office estimate.

The GPS JPO intends to expand the current applicability of SICAM to include Navy aircraft and Army helicopters. The potential applications of this model touch all services and could include any type of avionics or electrical integration into existing and future weapon systems. The intent of this presentation is to explain the unique procedures discovered to collect data from the Air Logistics Centers, the documentation guide under consideration by the Cost Research Division at Space Systems Division, and the possibilities associated with the expansion of the model.

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ESTIMATING THE COSTS OF COMMUNICATIONS SATELLITES

The past decade has seen explosive growth in the Department of Defense (DoD) expenditures on space systems. The vital role played by space-based reconnaissance systems in Operation Desert Storm was highly publicized. Less visible but still important has been the growth of expenditures on navigation, mapping, weather, and communications satellites by a number of DoD organizations. At the same time, the performance requirements for these satellites have increased significantly. Satellites today not only cost more but are also required to do a great deal more than their predecessors.

The Defense Communications Agency (DCA) is responsible for conducting capability assessments and affordability analyses of future space-based communications systems. Affordability analyses is another term for assessing how much it will cost to achieve a given level of capability. Assessing the cost and operational impact of satellites and emerging technologies is an important task at DCA.

Understanding the relationships between costs and emerging technologies that will have an impact on future communications systems is essential to perform these affordability analyses. Knowledge of these relationships not only aid in the performance of these affordability analyses but also DCA's ability to develop and assess master plans and architectures which define the nation's military communications system.

The Institute for Defense Analyses (IDA) was asked to identify and quantify the relationships between costs and the technical characteristics of selected satellite systems. In particular, IDA was tasked to concentrate on identifying those technical, performance, or mission requirement characteristics that have or will in the future influence the cost of communications satellites. Specifically, IDA forecasted the costs of satellite subsystems over the next ten years by developing cost estimating relationships using the U.S. Air Force Space Systems Division Unmanned Spacecraft Cost Model Sixth Edition database.

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25th DoD Cost Analysis Symposium

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The DAB Process: A Case Study

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

THE EVOLUTION OF ASM'S TAILORED ACQUISITION STRATEGY

This is the first in a series of presentations that will trace the evolution of the Armored Systems Modernization (ASM) program. An outline of this session is as follows

A. Introduction
B. Acquisition Tailoring
C. Cost Analysis Considerations
D. ASM Case Study
E. Conclusions

As an introduction, the attendees; will be presented with an overview of the workshop, will become acquainted with ASM, and will be introduced to the topic covered in this session. The introductory remarks will be brief but will help set the stage for the other sessions within the workshop.

Acquisition tailoring refers to the process of defining the development and procurement phases to meet the unique needs of an individual program. This portion of the presentation will initially discuss the topic in general terms and then move to ASM specifics. Concepts such as the integration of tech base efforts, the number/type of development phases, the level of competition, and commonality considerations will be discussed in the context of acquisition tailoring. The ASM strategy will then be described in detail.

The intent of acquisition tailoring is to structure a program that will optimize the combination of technical performance, schedule, and cost. In order to do this various strategies have to be defined and evaluated. This portion of the presentation will focus upon the cost analysis function by covering topics such as; cost analysis tools/models, the role of the cost analyst, planning for change, and cost implications related to technical risk.

Once the foundation has been laid, the focus of the session will turn to the application of the above concepts. The evolution of the ASM strategy will be traced, with an emphasis of how cost analysis played a key role. Some of the key studies that helped define the acquisition strategy will then be discussed in detail.

Following a short summary, time will be available for questions and answers.

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Financial Aspects of Tailored Acquisition Planning

This is the second in a series of presentations which describe the evolution of the Armored Systems Modernization (ASM) program within the Defense Acquisition Board (DAB) process. This presentation describes various agents which can influence and impact the financial structure of a major acquisition program. The Block III Tank will be our case study. An outline of the session is as follows:

A. Introduction
B. Elements of Financial Turbulence
C. Actual Impacts and Turbulence Experienced
D. Lessons Learned

The introduction will cover: a brief overview of the combat systems which comprise the ASM program, rationale behind the establishment of the PEO structure, basic elements of the DAB process and aspects of the Block III Tank tailored acquisition strategy.

An adequate and stable funding stream is crucial to meeting technical, cost and schedule program goals. However, funding is an increasingly scarce commodity and is susceptible to impact from multiple sources. The budget deficit and social needs prompt Congress to scrutinize every requirement and defense appropriations are a natural place to start. Congress and the committees that address defense funding have priorities (e.g. build a strong technology base) which often change over time. Network television and public opinion can impact funding. An expose on 20/20 showing that an armored system has a pressing deficiency may cause an urgent R&D requirement to mushroom overnight--and another system(s) currently in R&D may pay the bill. The results can be devastating. Events in Eastern Europe, which reduce certain immediate threats impact budgets and schedules adversely. The outstanding success of a current system in Operation Desert Storm can delay the development, production and fielding of its successor. The Department of Defense, Department of the Army, the Office of Management and Budget, the Training and Doctrine Command impact funding streams at certain review and decision points.

With the need to resource shortfalls, OSD has determined that higher disbursement rates indicate fiscal health. A program with low disbursements (bills paid) is perceived to be misaligned with incremental funding and will often be a billpayer.

PEO ASM programs have been affected by all of the above. The predictable results are often cost increases and program slippages.

Successful programs must be flexible, well documented, team oriented and must manage funds intensively.

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CONTRACTUAL EFFECTS OF A DELAYED PROGRAM DECISION

This paper discusses the impacts on the development contracts, and other contracts of the delayed DAB approval. Since award of the demonstration/validation contracts was contingent on DAB approval of the program as structured in the proposed award, there were no development contracts to effect by delaying the DAB. Therefore, the primary direct impacts of the delayed decision on the contracts was minimal, with the effects largely indirect. The following effects will be discussed in this paper:

A. Contract cost escalation
B. Prime and subcontractor confidence in the program
C. Increased proposal expenses for the contractors
D. Lengthy delay in releasing Government Source Selection Board evaluators
E. Effect on related contracts, eg. System Engineering Analysis Contractor
F. Effect on funding and disbursements

The contractual effects on the delayed decision were minimized for this program primarily because at the stage the program was in, ie., Concept Development, there were not existing contracts that would have been disrupted with a delay in the DAB.

Obviously, the delay in the DAB approval had the effect of moving out work to later, more expensive timeframes, causing an increase in the programs contract cost.

None of the contending prime contractors were being reimbursed for their proposal efforts. Fall-out of important subcontractors as the Government delayed award for months on end became a major risk.

The offers to the solicitation incurred many millions of dollars on proposal preparation. A significant concern developed as to whether a specific contractor would be able to continue, or would drop for lack of continued funding from corporate headquarters.

The SSEB needed to incur the large expense and disruption to home organizations of retaining key evaluators to analyze revised proposals necessitated by DAB program changes.

A SEA contractor has been hired to conduct analysis of the two competing contractors. An award delay meant this contractor had little to do.

Funding and disbursements are discussed briefly.

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Common Chassis/Block III Tank Strategic Cost Management

The development, production, and fielding of an affordable, technically superior armored force is crucial to U.S. and allied security. The paper describes a structured process, employed by the Common Chassis/Block III Tank Program Office, to continuously and actively reduce and control costs. The process includes early identification of key cost indicators, assessment of program risk elements, quantitative assessment of initiatives to reduce cost and risk, and a integrated Government/industry team to implement proactive cost reduction. The paper describes the above elements of the process and provides recent examples from the Common Chassis/Block III program.

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Cost and Schedule Performance A New Approach

In the past several decades mission requirements have become more complex and weapon systems required to defeat the threat have become highly interactive hardware/software systems pushing the forward edge of technology. Previously, the question asked was, "with this increase in complexity how is the government to manage the contractors performance?" In the past most program managers have used Cost\Schedule Control Systems (C\SCS) to assist in their management of cost and schedule but have not successfully integrated technical performance into their management process. The "New Approach" or, better put, "New Emphasis" is how to manage technical performance along with capturing cost and schedule performance. To achieve this objective it is critical to combine the Systems Engineering Process and its measurements of performance into C\SCS. The Systems Engineering Process attempts to transform operational needs into a description of system performance parameters and then into a system configuration. One of the objectives of this process is to optimize system effectiveness/performance while meeting cost, schedule, supportability, and technical performance objectives. This paper will discuss two different procedures for implementing this new emphasis. Both of these procedures borrow some of the tools developed in the Quality Functional Deployment (QFD) Philosophy.

The optimal C\SCS implementation would be to have companies reorganize into performance divisions rather than functional divisions and report the CPR format 2 based on their technical performance. This would involve considerable effort on the part of most corporations as well as the government surveillance teams. In most cases, this is not easily implemented. A second alternative is to use another tool of the Systems Engineering Process, Concurrent Engineering, which not only manage the functional interconnectivity, but also the technical relationships between hardware and software. The Concurrent Engineering team would establish milestones within each work package to access not only the traditional functional interrelationships but also the technical performance characteristics. This process could then be mapped by using major technical parameters as the "y" axis and the Contractor Work Breakdown Structure (CWBS) as the "x" axis. Along with either of these methods the thresholds for the variance analysis will be established using the Technical Performance Measurement (TPM) process identified within the Systems Engineering Process. This process identifies critical CWBS items that drive technical performance and assist in creating tolerance bands on technical, cost and schedule requirements. These techniques will give the program manager and decision makers information that captures all performance characteristics that are critical to a programs success.

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25th Annual DoD Cost Analysis Symposium

Risk Analysis

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

USING RISK-IMPACT DRIVERS TO FORM WBS-ELEMENT COST MEANS AND VARIANCES

Cost-risk analysis comprises a series of engineering assessments and mathematical techniques, whose joint goal is to measure the degree of confidence in which the "single best estimate" of project cost is held. The present paper enhances an existing and in-use logical structure within which the effects on cost of technical risks may be quantified.

In particular, the cost-estimation process often assigns "low", "best" and "high" cost estimates to each WBS element. This paper presents a logical method for computing the mean and variance of the cost of each WBS element for a given project, taking into consideration the uncertainty in high-end cost due to technical risks. Using these means and variances, a cumulative distribution of total project cost can be established, so 50th, 70th, 90th and other cost percentiles can be read off its graph.

The basic process can be outlined as follows: (1) Establish risk-impact drivers (see e.g., R. L. Abramson and S. A. Book, "A Quantification Structure for Assessing Risk-Impact Drivers", 24th Annual DoD Cost Symposium, Leesburg, VA, 5-7 September 1990) that define categories of technical risk together with risk levels (e.g., low, medium-low, medium, medium-high, high) for all categories; (2) Apply engineering judgment and informed analysis to construct, for each WBS element, a probability distribution over all risk levels that reflects the relative frequency that each risk level occurs for that WBS element; (3) At each risk level form a conditional triangular distribution of cost for the WBS element (the low and best-estimate costs are the same for all levels, but the high cost depends on risk level); and (4) Calculate the WBS element mean cost and cost variance from the conditional triangular distributions, weighted according to the relative frequencies. Means and variances of all WBS elements can then be combined analytically to form the cumulative distribution of total-project cost (e.g., R. L. Abramson and P. H. Young, "FRISKEM: Formal Risk Evaluation Methodology", ORSA/TIMS Bulletin Number 30, Operations Research Society of America and the Institute of Management Sciences, October 29-31, 1990). Thus, the ultimate objective of cost-risk analysis, the ability to read off percentiles of total-project cost, can be achieved.

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Alternative Cost Progress Models: An Analysis of Accuracy and Bias

Learning curve models have gained widespread acceptance as a technique for analyzing and forecasting the cost of items produced from a repetitive process. Considerable research has investigated augmenting the traditional learning curve model with the addition of a production rate variable, creating a rate adjustment model. This study compares the accuracy and bias of the learning curve model and the rate adjustment model in predicting future cost. A simulation methodology is used to vary conditions along seven dimensions. Forecast errors are analyzed and compared under the various simulated conditions.

ACCURACY: Overall results indicate that neither model is consistently more accurate; each is more accurate under some conditions. General tendencies are evident. Considering production rate in the analysis leads to reduction in prediction error and improved accuracy when

- The number of observations available for the analysis is relatively rich.
- The amount of fixed cost in total cost is relatively high.
- The production rate trend grows during the model estimation period.
- The period-to-period variability in production rate is relatively large.
- Random noise in cost due to unsystematic factors impacting cost is relatively low.
- Production volume is expected to be cutback in the future periods for which cost predictions are being made.

Numerous interacting impacts of combination of factors on prediction accuracy are also evident, but a broad "theme" is apparent in the interactions, suggesting a general conclusion:

- The greatest impact (of changes in the various conditions) on relative prediction accuracy occurs when cutbacks in future production are anticipated.

This means that researchers and cost analysts, attempting to predict future cost in an environment where future production volume is declining, will find the choice of an approach to be most critical. The relative accuracy of the learning curve approach or the rate adjustment approach is particularly sensitive to changes in data richness, fixed cost burden, production rate trend and stability, and cost noise when cutbacks are anticipated.

BIAS: Overall results indicate that the rate adjustment model is generally unbiased. In contrast the traditional learning curve model has a consistent bias toward underestimating future cost. This bias is present if the cost item being forecast contains any element that is not subject to learning. The degree of bias in the learning curve model depends on various factors. In general the findings indicate that bias increases when

- The proportion of fixed cost in total cost increases.
- Shifts in production rate occur.
- Relatively more observations are used to estimate learning curve parameters.
- The cost being forecast is relatively further into the future.

Additionally, a tendency was noted: bias toward underestimation tends to be greatest when the apparent learning rate is greatest. This suggests the ironic conclusion that when costs are expected to decline most rapidly, the probability of cost overruns is greatest.

The findings collectively indicate that accuracy and bias depend on the form of cost estimation model used and the conditions surrounding its use. Researchers or cost analysts, engaged in a cost estimation or cost analysis problem, may benefit from attending to such conditions when deciding on the form of model or analysis they might bring to bear.

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Software Risk Abatement in a Department of Defense Environment

Software development and support, as all other creative activities, are expensive. Costs get easily out of control, especially if the development is a large one, as is the case for most DoD programs. Several DoD initiatives to control these costs are now beginning to pay off, by providing decision-makers with easy to use management tools and methodologies. This paper describes some relatively simple but powerful software development and support management tools based on risk and sensitivity analyses.

In this paper, I have partitioned the software life cycle as follows:

- Source Selection Phase
- Software Development Phase, and
- Software Support Phase.

To assess and control risk in the Source Selection Phase, I introduce a methodology devised by the DoD's Software Engineering Institute (SEI) based on assessing the software development capability of contractors by means of their maturity level in the software process.

In the development phase, I address some techniques to manage cost, schedule, performance (or technical), and support risks, by examining the most important ones of the variables know to affect each type of risk.. Since management of software support risk during the development phase is affected by the type of software development used, I have addressed the three major approaches to software development in DoD: Normal Development (the software is created and turned over to the user), Evolutionary Development (the software is crated and fielded by a series of releases R(i) because requirements are not too well known or understood), and Pre-Planned Product Improvement Development.

Risk in the support phase of the software life cycle is affected by the same variables affecting development, and therefore the same management techniques and tools can be used in its abatement.

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Decision Making by Multivariate Analysis for Weapon System Costing

This paper discusses the application of hypothesis testing technique in mulitvariate analysis. Multivariate analysis is a tool which takes into account several decision criteria simultaneously. This technique is useful when the decision criteria requires the simultaneous evaluation of a multitude of variables. By using multiple variables in the hypotheses testing process, the technique produces a single statistical value for a final decision. That is, from any given set of variables data, the techniques enables us to evaluate the possibility of attaining certain desired values for the variables with a specific confidence level. Furthermore, if the desired values for the variables are unattainable from the data set, the technique can point out which variable contributes most to the unattainability of the desired values for the variables.

In this paper, the example identifies three performance criteria (distance, speed, accuracy) of an assumptive weapon system, and the data was obtained from the number of test results of the weapon system. Mulitvariate analysis was then applied to the data in order to determine if the weapon system met the specification requirements of the performance criteria. However, the same test can be applied for any data which contains many variables. For example, in a weapon system costing data, the variables may represent quantified values for completeness, consistency, reasonableness, documentation, and so on which are obtained from the different estimating methodologies. For a biochemistry testing data, the variables may represent human health criteria along with observed values within the control and experiment groups.

The advanced techniques of multivariate analysis has a wide range of applications for various types of research for management, marketing, military operations, weapon system engineering, medicine, biology, and behavioral science.

Statistical Analysis Systems (SAS) is the aiding software package which supports the development process of the statistical results in the paper. SAS has the capability to process a data matrix which contains up to thirty-five column variables of 8-digits with virtually no limit to the number of observations. This is, SAS can accomplish a multivariate analysis which requires a simultaneous evaluation of up to thirty-five variables.

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Database Management Systems

Cost Analysis:
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The Handy Dandy Cost Slicer Dicer

PURPOSE: Have you ever had your boss suddenly want a new cost table. You have all the data in your database but are not setup to produce that table. This paper contains a procedure for slicing data into tables and dicing data into subsets for output that when configured to the set of eleven P-92 tables could produce more than one million different tables for output.

OVERVIEW: Storing cost data with a set of descriptive integer pointers, enables maximum flexibility for slicing data into various tables for presentation or for dicing data into subsets for table presentation. This data storage procedure can be implemented either within a relational database or with a collection of flat files. One of the biggest problems most analysts have in designing data bases is properly dimensioning input and output tables to handle all user possibilities. The handy dandy cost slicer dicer eliminates those problems by storing both input and output tables as integer pointers. Some point to row position, some point to column position and some point to other things like is the data is input or output, constant or inflated, etc. Slicing to output a table can use any two sets of pointers one for the rows and one for the columns. Dicing involves slicing away some particular values of integer pointers and the remaining ones can then be sliced by selecting any two sets of integer pointers to present the diced data in table format.

CONTENT: This paper demonstrates the concept with a few simple tables. These tables are described with integer pointers and then mixed and matched to demonstrate flexibility. The advantages in data base design are presented. Input and output flexibility like the Army's P-92 tables and the Navy's Logistics Requirements Funding Plan Tables are shown. The usefullness of the integer pointers for regression analyses is also discussed. Both data base implementation procedures, (one with relational data bases and one for flat files), are explained and it is planned to distribute disks with the combination of flat files approach. The Handy Dandy Cost Slicer Dicer is not available in any retail store and can only be obtained from the author or by following the procedures detailed in this paper.

LIMITATIONS: The Handy Dandy Cost Slicer Dicer will not grate or shred vegetables and cannot be used with any vegetable product. For data bases where most of the combinations of rows and columns have stored cost data other than zeros, this approach uses more memory than the current approaches.

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Standard Resource Budgetary and Control System (STARBUCS) A Performance Oriented Database System

The Standard Resource Budgetary and Control System (STARBUCS) is the United States Army, Europe (USAREUR) standard resource management system designed specifically for resource analysis, cost analysis, budgeting, manpower analysis, accounting and management functions at the community and tactical unit Resource Management Office levels.

STARBUCS is a performance oriented database system that operates at the fund certification level with a roll-up capability to echelons of command above the community and division levels.

This paper describes the STARBUCS database and its supporting modules which perform various data management, administrative, system interface, and analysis functions. Emphasis is placed on the analysis functions imbedded within STARBUCS. These analysis functions distinguish STARBUCS from the six existing resource management systems which will be replaced in USAREUR by STARBUCS.

Within the Analysis Module three major functions are performed: Cost Estimating, Performance Evaluation, and Report Generation. Resource management within a tactical unit is used to illustrate the cost estimating and performance evaluation functions. The relationship of the STARBUCS database to the analysis functions is demonstrated within the process of developing cost factors, creating budgets, and conducting performance evaluation during budget execution. The paper demonstrates how the analysis functions can support the resource manager in identifying issues while targeting attention to critical areas during a variability analysis.

The uniqueness of STARBUCS lies in the cost analysis influence during the design of the database and its supporting methodologies (i.e., modules). Cost analysis can now be performed using official Army financial data that has been mapped to a construct that fully supports cost estimating and analysis.

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Contractor Cost Performance Measurements

Cost Analysis:
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Challenges for the Future

SHIP CONSTRUCTION COST MODELING USING DAES

The goal of the study was to develop an analytical tool that will quickly identify for management whether a program was being executed within budget. A small sample of contractor performance data for the FFG-7, CG-47 and the SSN-68 classes of ships were analyzed. The data was obtained from the 1/16/91 Defense Acquisition Summary Reports (DAES). The statistical analysis consisted of developing linear and multi-variable linear regression models to determine the best fit for each ship class. The equations with the best fit were then compared to a standard expenditure curve to determine the over run that occurred for each of the classes. The study explains how the variables were standardized with respect to time and cost.

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25th Annual DoD Cost Analysis Symposium

Training and Professional Development

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

Assessing Impressions of Total Quality Management in USAREUR

DOD has adopted the concept of TQM. The purpose of this research is twofold: 1) to provide insights into the perceptions of resource management personnel regarding managerial processes and work environment factors related to TQM; and 2) to discuss the utility of ordinal vs. ratio scales of survey measurement of TQM. The research strategy envisioned the use of an organizational effectiveness survey to measure the worker-held perceptions of TQM within USAREUR.

Surveys were distributed throughout USAREUR to ASMC Chapters to pass on to members. Two versions were disseminated, an ordinal scale and a ratio scale, in computer and hard copy format. Members were asked to complete the survey, code it with a random number, and return it directly to the Heidelberg Chapter. The results were then compiled and interpreted.

Generally, there were moderate disagreements on most parts of the survey. A lukewarm perspective to the tenets, philosophies, and methods surrounding TQM was reflected in the results. Due to the lack of ratio scale survey responses, no conclusions were drawn from this type of instrument. Based on the ordinal scale, it can be seen that either there is a lack of appreciation for what TQM has to offer USAREUR or a frustration that the tenets, philosophies, and methods are not reinforced. Because of the diverse background and limited number of personnel within USAREUR who completed the survey, one could not expect uniformity of responses among the different ASMC groups. As such, the scores could not be expected to be very directional either positively or negatively. So the scores reflect tendencies and not strong indications. Moreover, it would be unwise to generalize these results as being representative of all of USAREUR. However, one could, should he/she wish, review the impressions of those completing this survey and compare the results with his/her judgements/conclusions about the organization. Based on this analysis, one could determine whether or not to establish a baseline of performance and plan a corporate strategy for TQM execution.

The results of performing an organizational effectiveness survey can be significant in measuring key management behaviors which affect motivation and quality/productivity. Besides identifying current positives and negatives, an organizational effectiveness survey is a useful tool to help shape future efforts. The results of the survey can be used as a baseline to measure performance. With appropriate attention applied to the survey in combination with good management, successful implementation of action plans are likely to occur.

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DETERMINING TUITION RATES FOR TRAINING

Resources in the current training environment have become particularly constrained. Many other types of services have started "charging customers" for services provided. This paper looks at the impact of charging tuition for classes taught at the U.S. Army Logistics Management College (ALMC) and how to determine tuition rates for various courses.

A brief overview of current funding trends within DoD, along with the impacts of charging customers for training will be examined. Information obtained from several sources is used to provide insight into how ALMC might possibly operate in the future. Key assumptions will be addressed that will provide direction into determining tuition rates.

The actual financial model developed will be examined to show how tuition rates can be determined. Insights into a wide variety of costing issues, such as how to determine direct versus indirect costs, how to spread and assign indirect costs to courses, and how to use costs as a basis for developing tuition rates are discussed. Cost per output measure issues are also discussed. Insights into how such a model can be used for insight into tuition, costing, and course decisionmaking will be examined.

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25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION X, FRIDAY 6 SEPTEMBER 1991, 1030-1130

Automated Information Systems: Room 3460

Software Reuse Savings and Benefits

Authors: Major Alvin Nieder, Ms Joanne Piper, and Ms Ginny Parsons

This paper presents some of the statistical background impacting software reuse as a software development paradigm.

Software Costing: Room 3462

Software Reuse Economics Model (SREM)

Authors: Mr. George E. Raymond and Mr. David M. Hollis

SREM 1.0 will analyze the utility of a library of Ada reusable software. It will appraise the total cost, unit cost, cost reduction, and return on investment of reusable software. In an environment becoming more global and competitive, the reuse of software will play an increasingly important role in attaining and maintaining competitiveness, and achieving efficiency as resources are constrained.

Training and Professional Development Workshop: Room 3463

Determining Tuition Rates for Training

Authors: Mr. John N. Zauner and Ms Tammy S. Wellman

This presentation will focus on the impact of charging tuition for courses taught at the U.S. Army Logistics Management College. The first portion of the presentation will focus on issues associated with the impacts of charging for tuition. The second portion of the presentation will address the actual costing methodology for determining tuition rates, insight into costing issues addressed, and the use of cost measures to assist decision making.

Operating and Support Cost Analysis Workshop II: Room 3466

Cost Reductions for the Joint Computer Based Instructional System

Author: Ms Mary Henry

The Joint Computer Based Instructional System (JCBIS) is a networked set of Control Data Corporation Cyber computer systems that are used to distribute and administer computer based instruction throughout the government, using the Programmed Logic for Automated Teaching Operations (PLATO). I will show how cost reductions for the users can be realized in areas of contract consolidation, replacement of outdated communication equipment, network consolidation, and upgrade of computer equipment.

25TH DOD COST ANALYSIS SYMPOSIUM
WORKSHOP SESSION SCHEDULE

SESSION X, FRIDAY 6 SEPTEMBER 1991, 1030-1130

Continued

Contractor Cost Performance Measurements: Room 4462

Cost Performance Report Analysis in the Aftermath of the A-12 Incident: A Cost Analyst Perspective

Authors: Mr. Kevin Kane and Ms Vicki Bohanan

Risk Analysis Workshop: Room 4466

Multivariate Analysis Technique

Author: Mr Oan Y. Choi

This multivariate analysis technique treats the multi-criteria variables as a single decision criteria by simultaneously taking into account all of the variables together. The findings by multivariate analysis can be effectively used in the decision making process to determine the cost effectiveness of taking further action to improve a weapon system.

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Automated Information Systems

Cost Analysis:
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COST ESTIMATING FOR MAJOR AUTOMATED INFORMATION SYSTEMS

The MAISRC was established in 1978 but kept a low profile until the mid-1980's when Congress directed DoD to take a 'systems' approach to managing automated information systems. In implementing the congressional direction DoD provided an expanded role for OASD(PA&E) who, through the Cost/Benefit Review Group (CBRG), review all cost and benefit estimates. The CBRG is the principal advisory group to the MAISRC on matters related to AIS cost and benefits. Their role is similar to that of the Cost Analysis Improvement Group for the Defense Acquisition Board's review of weapon systems. Through their stringent review and validation of cost and benefit estimates, the CBRG hopes to promote its goal of improving the overall AIS management process.

The MAISRC process is a combination of reviews and approvals which continues throughout the entire life cycle. Major AIS programs are formally reviewed at key milestones and MAISRC approval is required before the program is allowed to proceed to the next phase. A total of six milestone reviews are conducted: four prior to deployment and two afterward.

One or more of the four different MAISRC cost products are required for each milestone review. The paper includes a discussion of what they are and when each is required. The review cycle, including preparation and interim reviews, can take up to seven months. Hastily prepared estimates will not withstand the degree of scrutiny imposed by the CBRG. Therefore, adequate preparation and review time is a must.

Weapon system estimators need to be aware of certain differences between estimating weapon system and AIS costs. For instance, it is common for AIS hardware component unit prices to actually <u>decrease</u>, rather than <u>increase</u>, over time. The extensive use of off-the-shelf hardware and software in AISs has some subtle impacts on estimating methodologies. Significant differences in the length of the useful life and in maintenance concepts makes for different cost drivers in the Operations Phase.

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Utilizing Off-the-Shelf Software to Write Organizational Specific Programs for Local Area Network Applications

In June 1989, the construction and the occupation of the new III Corps Headquarters building (NHB) at Fort Hood, Texas was completed. The building was equipped with a state-of-the-art LAN comprised of BANYAN hardware and the Virtual Network System (VINES) operating system. The file sharing capability in this system provided the opportunity to develop local programs that could share files thus furnishing personnel with real-time multiple access to work files.

A project proposal was presented to the Director of Resource Management, III Corps and Fort Hood, and approved that would assemble a development team to develop Local Area Network Application Programs (LANAPS). The LANAPS team chose the off-the-shelf compiler, Nantucket's Clipper Summer '87 Version, as the programming language because of its flexibility and ease of use. The project team was trained at a 3 day advanced dBase III course and further trained by the project's technical leader for another week. Five separate programs were developed in two and a half months that were LAN compatible and provided users with multi-access to files. One program developed in this effort, the Suspense System, earned an Honorable Mention in the Army's FY90 Command and Control Microcomputer User's Group (C2MUG) annual software contest.

This paper outlines the overall approach to the LANAPS charter and highlights the major phases in the software development. It describes the problems encountered in the development phase, action taken to resolve those problems, and lessons learned. Each program developed is discussed along with its benefits to the organization. Techniques used to standardize program menus and help facilities are also presented. Methods used to provide multi-access to files are listed along with examples of the respective program code.

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SOFTWARE PROCESS ACQUISITION NETWORK SIMULATION (SPANS) MODEL IMPROVEMENTS

The Software Program Acquisition Network Simulation (SPANS) model permits a cost analyst to estimate the schedule and cost of software development throughout the acquisition process. The original model was developed in 1988 for the USAF Standard Systems Center (SSC). Improvements have been completed and were delivered in February, 1991. The purpose of this presentation is to describe SPANS, with emphasis on model improvements.

The original model uses COCOMO to develop an initial estimate, spreads the resulting effort and duration estimates over activities in a standard software development process network, permits user interaction to further refine the estimate and network, and then conducts a stochastic risk analysis of the network. It permits the user to view the results at any point in a Gantt chart format, and produces various user selected reports of the results. The "project level" network can also be disaggregated into several working level networks, each representing the tasks being separately managed. Problems can be spotted early and effective corrective actions can be found by conducting stochastic, what if analysis. Upon project completion, the project history can be archived into a data base, using a standard WBS, which allows later use of the data point as an analogy.

Model improvements include the following:

1. Two new initial estimating models have been added. They both use function points, instead of lines of code as the major cost driver. One is calibrated on SSC data. The other makes use of user defined productivity inputs to estimate total time and effort. COCOMO can still be used if the user prefers. The inclusion of these new models also demonstrates the ability to add new initial estimator models to SPANS.

2. New output have been added. These include (1) cumulative distribution function (S-shaped curve) plots of activity time and cost, (2) Finish Date distributions plotted against planned milestone dates, and (3) a FYDP presentation of costs.

3. SPANS now has specific process networks for three different regulations; 2167A, 700 Series and 800 Series. It also has options for with and without IV & V.

4. SPANS user interface has been improved and an option to convert effort to cost has been provided.

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ASSUMPTIONS
in
ESTIMATING POST DEPLOYMENT SOFTWARE SUPPORT REQUIREMENTS

Analysts who estimate and evaluate requirements for Post-Deployment Software Support (PDSS) for major weapon systems may choose from several methodological approaches. Various "top-down" parametric tools are available; at the other end of the spectrum, detailed "bottoms-up" estimates may be constructed. Whichever approach is chosen, **assumptions--implicit and explicit**--will dominate the estimate.

This paper explores **non-standard** assumptions, grouped into the following categories:

Definitional
Estimating
Organic PDSS vs. Contractor Logistics Support
Productivity Rates

In addition, a **generic example** will demonstrate how these seemingly innocuous assumptions can exert enormous impacts on the range of a PDSS requirements estimate.

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Enhancing the Adaptability of Imagery Technology for Increased Productivity in the Office Environment

Imagery Technology (IT) is one of the latest developments for automated information systems. The use of IT is the beginning of the revolution to conducting business in a paperless environment. IT involves the implementation of computer graphics and imagery capabilities for use with popular software and utilities packages. IT allows for the storage of images designed for easy comprehension by personnel unfamiliar with computer utilization. Full benefits and utilization of IT can be realized if integrated into systems developments. The integration of IT will enhance work productivity by reducing training and adaptability time of newly installed automated information systems. IT allows the novice computer user to gain immediate systems usage through appropriately designed IT images and graphics. With the understanding and application of cognitive science, human physiological capabilities, and systems technology, the office environment can be easily integrated with IT. The basis of IT development is the acknowledgement of the human-systems interface design. Such designs take into account the capabilities and limitations of both the human and systems technology. Optimal utilization of IT can occur when this multi-dimensional nature of IT is acknowledged by system designers. Substantial cost realizations can result through immediate productivity gains and decreased error rates created by IT usage.

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AUTOMATED INFORMATION SYSTEMS WITHIN HEADQUARTERS AIR FORCE RESERVE DIRECTORATE OF COST ANALYSIS

1. Background: *The function of cost and management analysis in the 1990s can be effectively summarized in three words: aiding decision makers.* Management analysts in the Directorate of Cost Analysis at Headquarters Air Force Reserve (HQ AFRES) aid decision makers by supplying information to the executive staff. The information network, called the Commander's Information Program (CIP), is defined by management and generally represents summary data about critical AFRES programs and initiatives. Utilizing this information, management has the ability to make early identification and correction of adverse trends.

2. Automation is changing the way that cost and management analysts do business in the Air Force Reserve. Utilizing current technology, we strive to provide executives the best information available and, in turn, successfully accomplish our mission of aiding decision makers. Effective use of automation technology is one means for the cost/ management analyst to successfully meet the challenges of the '90s.

3. Discussion: This paper will specifically address two AFRES initiatives which illustrate how automation enhances the decision-making process. Those initiatives resulted in:

- **Enhancing the automated Air Force Reserve Commander's Information Program (CIP).** The CIP contains summary information from the various functional areas in the headquarters. It is designed specifically around the current commander's needs and wants. The enhancements have improved the types of information provided to management as well as the mode in which it is presented.

- **Applying technological solutions to paper storage problems by developing the HQ AFRES Point Paper Manager (PPM).** The PPM is a fully automated program which serves as a central repository for the command's point papers and allows instant storage and retrieval of point papers on the HQ AFRES LAN. There are three modes to the program:

  - **Read-only mode**
  - **Edit mode**
  - **System Administrator mode**

4. Through development of the CIP and PPM, information is now more easily accessible to our executives. In addition, the information is available to many more users. These two programs have allowed cost and management analysts in the Directorate of Cost Analysis at HQ AFRES more ably to perform their mission of *aiding decision makers.*

Glenda H. Scheiner/HQ AFRES/ACCI/Robins AFB GA 31098/DSN 468-2399

COMMERCIAL MAINFRAME COMPUTER PROCESSOR

COST ANALYSIS

The Navy has a continuing need for more efficient commercially available computers encompassing the latest technological advances for the most reasonable costs. There is a concomitant need for developing better cost estimating relationships (CERs) to estimate the cost of these powerful computer systems. This study is a follow-on to a study performed for the Naval Center for Cost Analysis (NCA) by the Information Spectrum, Inc., titled "Commercial Mainframe Computer Processor Database Development and Cost Analysis".

Processing speed and memory capacity of the processor have been shown to be excellent proxies for estimating the cost of computer hardware systems. In this cost study, processing speed (millions of instructions executions per second (MIPS)) and memory capacity (megabytes) of several commercial mainframe computer processors were used as independent variables in CERs to estimate the purchase price of mainframe computer processors. The study developed a cost estimating relationship (CER) which resulted in a hedonic function based on speed, capacity and time. This study updates CERs derived previously to include 1972-90 technology in the small to mid range computer processor.

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Software Development Effort: ADA vs. Other Higher Order Languages

This paper presents an analysis of recent Ada effort, duration, and size data. This analysis results in new Ada effort and duration models. The Ada model differs in functional form from a recent model derived from similar applications implemented in mature higher order languages (HOLs). This implies a different software development process.

The functional form of the Ada effort model is

$$\text{CSCI Development MM} = \text{Constant} + \text{Duration} + B*\text{Size}$$

where Duration is the number of months between the availability of the allocated baseline through the successful completion of a formal qualification test. Size is thousands of non-blank, non-comment Ada statements. B is a constant multiplier on size.

The constant represents the fixed costs that must be expended regardless of the CSCI's size. The Duration term represents the time-based recurring costs that must be expended regardless of the CSCIs size. The exponent on size is 1.0, meaning that there is no penalty for developing a large CSCI.

The Ada effort model's estimates are contrasted against the mature model's estimates to determine whether Ada and its software development methodologies are more efficient than the mature HOLs. This contrast also considers the possible size differences between Ada and the HOL implementation of the same function.

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ESTABLISHING A FORMAL ESTIMATION PROCESS IN AN R&D ENVIRONMENT

The Software Engineering Process Office (SEPO) was formed at the Naval Ocean Systems Center (NOSC), a U.S. Navy R&D laboratory, in late 1988. SEPO's charter is to improve the software development processes from a Level 1 on the Software Engineering Institute's (SEI) Maturity Model to a Level 3 and above. Since that time, SEPO has concentrated heavily in establishing a formal software estimation process at NOSC. This presentation describes SEPO's progress in establishing such a process and a brief description of the process.

The methods used to implement a formal estimation process include disseminating information about estimation tools, establishment of the Cost/Size/Schedule Estimation Process Working Group (CEPWG), sponsoring occasional one day, on-site symposiums for estimation tools, and some management mandated involvement by SEPO for key projects.

Major progress has been made in developing credible estimates through the use of estimation tools. SEPO has five tools, REVIC (REVised Intermediate COCOMO (COnstructive COst MOdel)), SEER (System Evaluation and Estimation Resources), SASET (Software Architecture, Sizing, and Estimating Tool), SLIM (Software Life Cycle Management) and SoftCost-Ada. The tool used most often is REVIC, a public domain computer program that utilizes the well documented COCOMO cost/schedule estimation algorithms.

The most effective method of disseminating information about estimation tools has been the working group which in reality has evolved into a regularly scheduled workshop. At the workshops, project personnel give presentations describing their use of the estimation tools and discuss their level of confidence in the tool(s) that they used. Descriptions of how an estimate was developed for specific projects is presented by SEPO along with demos and discussions of how models may treat some aspect of the software development environment. Typical subjects to date have included: Uncompensated Overtime vs. Cost/Schedule; Cost of Documentation; Impact of Design for Reuse; and Cost of CASE (Computer Aided Software Engineering) Tools.

To date, SEPO has provided estimation assistance to o2ver 30 projects. This experience has helped to highlight key elements that must be included in a formal estimation process. Key elements of the process include establishment of a Software Estimation File (SEF), formal inspections of cost estimates, identification of cost related metrics and performance of cost risk analysis.

Progress to date has been substantial but there is still a long way to go in making formal estimation processes an automatic part of every project. The instantiation of the process described here will hopefully contribute to increasing the credibility of proposed project costs and schedules.

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Software Reuse Savings and Benefits

Software reuse is a basic tenet of software engineering. Both are evolving as statistical evidence is gathered to validate (or invalidate) paradigms to make software processes repeatable and predictable. This paper presents some of the statistical background impacting software reuse as a software development paradigm. Recent success with software reuse is presented, along with the Reusable Ada Products for Information Systems Development's (RAPID) direction to prove the software reuse paradigm as a software development model.

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Software

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Software Cost Estimating for Automated Information Systems: Comparing Actual to Estimated Effort

The need for better software cost estimating methodologies has increased with the soaring software development cost of most Automated Information Systems (AIS). Software development cost has routinely exceeded the estimated cost by a significant amount.

This paper will show the actual software development effort, measured in labor months, for several Army AISs and will then compare these actuals to the estimates obtained from four software cost models (System Estimation and Evaluation of Resources - Software Estimation Model (SEER-SEM), Software Architecture, Sizing, and Estimating Tool (SASET), Basic COnstructive COst MOdel (COCOMO) and Intermediate COCOMO.

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LCURVE

Abstract

LCURVE is a computer program for fitting learning curves to cost data and for cost estimation. It incorporates the most desirable capabilities of a myriad of previously-developed learning curve programs. Each of these previous programs offers different capabilities: some address unit theory only while others address cumulative average theory; some will fit learning curves while others will only generate learning curve estimates; etc.

LCURVE, which was developed by Tecolote Research for the U.S. Air Force, combines unit theory, cumulative average theory, unweighted/weighted options, curve fitting, and estimation into one easy-to-use package. In addition, LCURVE contains:

- An on-screen tutorial
- Context - sensitive help windows
- Flexible inputs:
  Lot total costs or lot average costs
  Lot quantity or cumulative quantity
- Built-in inflation capabilities
  Input in Constant Year or Then Year dollars with conversion to user desired Constant Year
  Output in Constant Year or Then Year dollars
- Graphic Display of data and results
- Easy data editing
- Extended statistical analyses of variance and confidence intervals
- File storage, update and retrieval
- QuiCalc solutions for any combination of two pieces of learning curve information
- Production rate variable
- Documentation
- Single or multiple graph capability

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A Modeling System for Estimating Software (MOSES)

Abstract

MOSES (Modeling System for Estimating Software) is a PC based, estimating tool which assists a user/analyst in producing software cost estimates. MOSES implements four state-of-the-art software cost models: COCOMO (developed by Dr. Barry Boehm), Jensen (Dr. Randall Jensen), Ada-COCOMO (by Dr. Boehm) and REVIC (by USAF Maj. Ray Kile). The system allows the user to produce estimates using all four models at once, run on a common input set. Each model contains Cost Estimating Relationships (CERs) which estimate software project development cost and schedule, broken out by development phase, and annual maintenance costs. MOSES supplements these results with estimated productivity factors such as cost per line of code, lines of code per person-month, average staffing, and lines of code maintained per maintenance programmer.

MOSES consists of three primary workscreens: one screen for estimating software development cost and schedule, one for displaying the estimates broken out into development phases and drawing comparisons between the estimates of the different models, and one screen for estimating software maintenance. Each workscreen accepts user input, displays output, and can be printed at any time. In addition, MOSES provides a calibration work screen for each model which 1) allows the user the calibrate any CER to in house data, and 2) Overrides system default estimation factors for requirements analysis, software to software integration and test, or software to hardware integration and test.

MOSES' interface is user friendly and provides five levels of help to the user: a function key menu for each screen, a field definition line which displays a bullet level description of the current input field, field help screens which provide detailed information on the current input field, field choice lists which enumerate the candidate inputs for given field, and a trace function which allows the user to display the mathematical build up of the MOSES generated estimates.

This paper describes the use of the MOSES system and the algorithms used in computing its cost estimates. Each of the four models is defined and compared to the others. Particular attention is paid to: (1) The MOSES innovation which allows the user to rate individual Effort Adjustment Factors (EAF) which can then produce different cost impacts in each of the four models; (2) A technique which allows model comparison in a manner that adjusts for the cost impact of non common EAFs; and, (3) The mechanisms for adjusting MOSES cost estimates to accommodate development schedule stretch-out and compression.

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A Practical Approach to Maintenance of Cost Estimating Software

Maintenance of cost estimating software is often either overlooked or under estimated. To get the proper return on the initial investment of human resources, used in the development of the software, the maintenance of that software must be addressed. This paper will take a practical approach, from the cost estimators point of view, to software maintenance based on the Multi-System Cost Model (MSCM).

The MSCM is a cost estimating tool that was developed in support of the Armored Systems Modernization program. The methodology used by the MSCM was presented at the 24th Annual DoD Cost Analysis Symposium (the presentation was titled "Development and Implementation of a Cost Methodology to Reflect System Commonality"). Modifications to the MSCM have been driven by four main factors :

- Parts of the program that did not fully meet requirements
- Changes in cost estimating guidance
- Changes in the available data
- New and improved methodology

The maintenance required to implement the above modifications into the MSCM provides practical information on meeting the cost analyst's requirements. This paper will explore the methods used in implementing these modifications and updates. Major topics to be covered will be the following:

- General software administration
- Interface between cost experts and computer programmers
- Initial programming structure which facilitates future modification and updates
- Structured methodology for efficient documentation and implementation of programming changes
- Parallel development of validation software to be used to streamline the validation process of programming changes

Historically, cost estimating software has been developed to serve as an efficient tool for cost analysts to use in quickly producing precise estimates using decreased human resources. Often this software does not meet the needs of the cost analyst as well as initially intended. This paper will offer methods to maximize the benefits of existing software through corrective maintenance of that software. Maintenance will be isolated and techniques will be offered to maximize software functionality while at the same time minimizing the labor required.

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Calibration of Software Cost Models for DOD Acquisitions

ABSTRACT

Over the past four years, the Cost Analysis Technical Center (CATC) at MITRE has been involved in the calibration of the Boehm [1] COCOMO model to Department of Defense projects and, in particular, projects sponsored by the Electronics Systems Division (ESD) of the Air Force. This paper discusses recent efforts to improve our software cost prediction capabilities through an extensive statistical analysis of the CATC software database, including the calibration of software cost and schedule models to a database containing information on approximately 34 independent software developments, primarily command, control and communications applications. We calibrated models that predict software development effort as a function of developed lines of code, and software development schedule as a function of development effort. The paper also discusses the problems that arise when evaluating models with a great deal of inherent variation. A number of methods were employed to reduce modeling error, each described briefly below.

The primary modeling methodology was nonlinear regression using the Levenberg-Marquardt procedure. However, linear and log linear regression techniques were also employed. These procedures were used to develop two and three-parameter effort and schedule prediction equations.

Our second methodology involved an attempt to recalibrate the development effort multipliers (DEMs) associated with our database. We employed a quadratic programming methodology for recalibrating DEMs suggested by professors Marwane and Mili of Tunisia in a paper given at the Fifth International COCOMO User's Group Meeting.

Lastly, we developed a heuristic uncertainty methodology for computing a confidence interval about an estimate that is based on our newly developed cost equations. It will allow the analyst to say that she is p% confident that the true estimate lies between - L % and + U % of the point estimate. We accomplish this by determining a cumulative distribution of the relative error with respect to the estimate.

Results of each of the statistical methodologies are given in the paper.

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A PROCESS VIEW OF SOFTWARE ESTIMATION

The DOD Software Engineering Institute's (SEI) Process Maturity Model has had great impact on the software development industry. It has focused our attention on the basic processes we use in everyday business activities and identified areas where significant improvements can be made. A disciplined, repeatable process for estimating the size, cost, and schedule of a new software product is a key characteristic required of organizations which strive to meet higher SEI maturity ratings. Procedures which meet these criteria also provide a higher degree of estimating accuracy and generate information which can help meet program management's objectives for risk identification and mitigation. An eight phase estimation process is proposed which recognizes the difference between 'an estimate' and 'the bid' and separates the activities leading to both in a manner that facilitates performing a risk assessment of the proposed cost and schedule. The first phase establishes the Design Baseline and sets the minimum requirements for the project. After the design is established the next phase defines the Size Baseline for the software components required to implement the design. After the sizes for each component are identified, the Environment Baseline phase determines the personnel, development environment, and project characteristics which are used by cost estimating models. The Software Baseline Estimate phase next uses the size and environment baselines to develop the initial estimates for effort and schedule required to implement the design baseline. Since software cost models do not include all of the contractor's effort required to manage the contract and implement the design, the Project Estimate phase modifies the estimate to account for the peculiar cost model used and any exceptional project requirements. The Project Bid phase recognizes management's consideration of all risk factors in determining a price to bid which allows a reasonable change of making a profit in a competitive environment. The Risk Analysis phase collects the risk information identified in each of the previous phases and supports assessment and mitigation planning during the estimation process. The last phase, Dynamic Cost Projection, occurs after a contract award and uses the configuration controlled baselines from the successful proposal's estimation process to track progress and provide estimates-to-complete. The eight phase estimation process provides for formal review/approval of all inputs to cost models and provides complete traceability for each step in the process. Key features of the process are the separation of estimating activities from bidding activities and the built-in risk identification/mitigation support.

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COST MODELING AIR FORCE SOFTWARE MANPOWER

This research effort is an attempt to develop a reliable manpower requirements validation methodology for software development and maintenance. Current Air Force practices to determine software manpower requirement estimations lack standardization, consistency, and some degree of confidence. This document describes our research methods, findings, and conclusions.

Research started with a feasibility study to determine if software development and maintenance is a function that is measurable and, if so, how to measure it. Visiting 13 Air Force software units, we determined software is measurable with two ways to approach the measurement. One approach would be to use traditional manpower standard development processes and the second would use existing software cost models. We determined traditional management engineering techniques would not adequately quantify manpower requirements in software programming functions. We then evaluated 14 different cost models for possible Air Force use. Using internally developed evaluation criteria, we selected the Revised Intermediate Constructive Cost Model, more commonly known as REVIC. To accentuate the REVIC model, we developed an automated questionnaire which screens data before input to the model. This reduces the amount of input subjectivity and increases output reliability. We also developed a terminology index with specific definitions and documented a detailed task list for each phase of the software life cycle development. Then we pplied REVIC to Air Force programming environments at 13 different software work centers. This broad environmental spectrum enabled us to see, first hand, the intricacies of over 1,300 software development and maintenance costing efforts and is giving us the vision to satisfy customer reqirements.

We gained considerable perspective on Air Force software work center organization structures and an approach needed to determine software manpower requirements. We also found a validation process that works for us. To ensure reliable model input and consistent output, we discovered the need to standardize terms and definitions. We also learned that software costing is a complex process, requiring experience in both the manpower & organization management and computer programming functional disciplines. As such, this requires training to become familiar with these disciplines.

Our conclusions indicate REVIC is the model with the versatility for both software project management and manpower requirements validation. We recommend its use as a tool for Air Force wide application. With additional research, we believe the REVIC model and our associated validation methodologies, may have application throughout the Department of Defense. We propose continued gathering of data from various Air Force software centers to further develop and refine the cost model, environmental factor weighting and default percentage ratios. Then we feel other services could use our methodology to determine their software manpower requirements.

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TITLE:

The Complete COCOMO Model

Basic, Intermediate, Detailed, and Incremental Versions
for the
Original, Enhanced, Ada, and Ada Process Models of COCOMO

Featuring COCOMOID, Version 3.2
A LOTUS™ 1-2-3 Worksheet Unlike Any Other

PURPOSE: This paper will help the reader discover the **complete** COCOMO model. It outlines changes to the model since its first publication in 1981 and discusses methods to use the new changes effectively.

METHODS: Three sections are used to: 1) outline the full extent of the COCOMO model including information on the three documented updates to the model, then 2) some ways to use the model will be briefly covered, and finally, 3) a discussion of a sample implementation - COCOMOID will be used. This will be a description and demonstration of the COCOMOID 1-2-3 implementation of all COCOMO models in one spreadsheet. It will also include information on new features enhancing user friendliness and speed of usage.

RESULTS: The reader will be aware of the expansion of the COCOMO model to cover a wider range of areas including Ada and the Ada process model as it is defined by Dr Barry Boehm. The sample implementation will show the plausibility of using all or any part of the total COCOMO model as needed.

CONCLUSIONS: COCOMO is a living and flexible model that is suited to a wide range of uses. Many releases of COCOMO implementations with varying limitations are available to DoD. COCOMOID is one version with few limitations. COCOMOID is a copyrighted product provided "free of license fee" by the author to interested parties that implements the entire set of COCOMO models in an 4th generation, integrated, menu driven 1-2-3 worksheet. COCOMOID.WK1 is the most complete spreadsheet version this author is familiar with. But, a multitude of people have used their own spreadsheets to create a quickly developed versions of COCOMO to check work or develop understanding. Other commercial or DoD versions exist, each with their own strengths and uses.

KEY WORDS: Construction Cost Model, COCOMO, Software Engineering, Cost Estimating

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Software Model Calibration
Or, Why did You Collect all that Data?

Realistic cost estimating based on parametric cost models can only be expected when those models are specially developed from real world data or when commercial models are calibrated to real world data. Such data must represent the product, the development or production process, and the characteristic operating environment.

MCR has been collecting such real world data on computer software products, developed by typical aerospace contractors, for a space environment for Air Force Space Systems Division (SSD) over the past three years. The most recent result has been the Space Systems Division Software Development Data Base (SSD SDDB) which was described at the 24th Annual DoDCAS (in 1990 by B. Donald (Air Force Cost Center) and H. Apgar (MCR)). Now, MCR is able to describe a representative application of the collected data as used to calibrate three (3) commercial software development estimating models.

In this paper, MCR will describe how the original data base collection effort was structured to capture the most useful data in a minimum effort. Effort and size data as well as corresponding technical and program descriptions were assembled from recent software programs comprising more than 22 million source lines of code. Data collection goals were established and formats were developed so the data base could support subsequent calibration. Model input parameter collection forms were examined from a representative sample of software models in use by SSD cost analysts. The proof of this concept is that the data base has been used to successfully calibrate three (3) software development cost estimating models, wherein one such model was not even considered at the time the data collection effort was planned.

This paper will summarize the calibration results for the following software models:

- PRICE S,
- SEER, and
- SASET.

This information will be helpful to users of these software models in estimating space-related computer software development.

The paper will conclude with valuable lessons learned and insightful recommendations for others who want to construct useful data bases for specified applications.

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SOFTWARE REUSE ECONOMICS MODEL
VERSION 1.0

This model is intended to support the RAPID Center, an Ada Library maintained by the Software Development Center - Washington (SDC-W) of ISSC. The model will analyze the utility of a library of Ada reusable software. It will appraise the total cost, unit cost, cost reduction, and return on investment of reusable software. It has applications beyond the original mission of supporting the RAPID Center, for use by system developers and software library administrators in almost any situation. In an environment becoming more global and competitive, the reuse of software will play an increasingly important role in attaining and maintaining competitiveness, and achieving efficiency as resources are constrained. Specifically, the Army faces the threat of shifting budgets, priorities and missions. Software represents a 'force multiplier' for the Total Army Concept that must be exploited to the fullest degree. This model will pursue that goal by facilitating coordination and communication between technical and management segments of the software development community.

The model allows a software development project manager (PM) to input basic parameters from a specific application development and compare the total and unit costs of newly, developed software to those utilizing a percentage of reused software. This percentage is derived from a PM review of reusable software available and their estimated value to the application development. The break-even point and return on investment can be developed by comparing new verses reuse statistics. The break-even point represents the number of lines of code at which the reused code becomes more economical than developing new code. Thus the PM can perform an up-front analysis of the potential savings realized through the employment of reused software. In an unconstrained environment, mathematical optimization of bottom line costs can greatly assist the PM with a baseline set of variables for planning and comparative purposes. The Ada software library administrators will be able to take advantage of the model's ability to provide return on investment, break-even usage point, and cost factors for the library. These functions will provide the library administration the tools to effectively manage and maintain the library.

Utilization of reusable software may indeed save money, and often more importantly, time. It may be possible to compress the project schedule using this option although it may also be smart to plan for slightly more test and integration time to ensure proper functioning of the parts comprising the whole. There is an advantage in that the specific modules will have been tested and quality control performed prior to incorporation in the applications system. Quality control will be very important to the reuse library administrator. A reputation for poor quality software in the reuse library will negate any advantage this option has to offer.

This paper authored by George E. Raymond and David M. Hollis of the U.S. Army Information System Software Center (ISSC) located at Building 1465, Room B313, mail stop C-7b; Ft. Belvoir, Virginia, 22060. The telephone number for their office is (703) 355-7301/7162. Both individuals work in the Economic Analysis Division of HQ ISSC, an organization composed primarily of operations research analysts who create or operate cost simulation models in support of Army software development and computer hardware procurement. Mr. Raymond is the EA Division Chief, and Mr. Hollis is the analyst assigned to this modeling effort.

25th DoD Cost Analysis Symposium

NOTES

25th Annual DoD Cost Analysis Symposium
Weapon System Costing

Cost Analysis:
A Quarter Century of Progress -
Challenges for the Future

Life Cycle Cost Estimating for Non-Developmental Items (LCCE-NDI)

This model represents an attempt to determine Life Cycle Cost Estimates (LCCE's) for inexpensive Non-developmental items (NDI's), given limited system information. It does this based on historical relationships from prior Test Measurement and Diagnostic Equipment (TMDE) NDI procurements. The model requires the analyst to input basic information about the NDI item, and on the basis of this information it generates the LCCE annex's A through D, and the DCP annex's B through E. The factors and program cost documentation were automated in a Lotus 1-2-3 format in 1990. The current cost factors in the model were reviewed and updated in February 1991. The model has been used by PM TMDE to perform LCCE's and Economic Analysis (EA's) and other cost benefit efforts on Army TMDE Modernization items.

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Guided Weapon Cost Estimating Problems: A Little Knowledge May be a Dangerous Thing

To celebrate the 25th Annual Symposium, this paper looks back at the limited number of small to medium sized weapon systems developed during that period and considers the impact of small data bases on the predictive capabilities of parametric cost estimates for future weapon systems.

The first section of the paper sets the problems into a historical perspective and shows how small the potential data base is.

The second section deals with current practices in the context of improving cost estimating accuracy. Specific reference is made to the statistical restrictions which govern the confidence limits placed on parametric cost estimates. The difficulties in establishing actual costs as well as achieved rather than specified technical/performance characteristics are examined and methods of dealing with such uncertainties are discussed. Consideration is also given to the selection of suitable regression analysis parameters and their potential to be surrogates for technological change.

The final section looks towards the future and considers the effects of changes in procurement strategy and the influence of value analysis driven strategies on the "gold plating" of requirement specifications. The potential cost of a future peace dividend, the effects of competition, collaboration and buying "off the shelf" and cash limited weapon system life cycles are discussed. The introduction of alternative cost estimating methodologies or greater awareness of value, rather than cost or price, are thought to be the way forward.

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Life Cycle Cost Model: TOP Level Cost Model (TOPCOM)

TOP Level Cost Model (TOPCOM) is a PC based cost model for the calculation and presentation of the life cycle cost (LCC) of military systems on high aggregated level (top level). Industrieanlagen-Betriebsgesellschaft (IABG) has developed it in accordance to the LCC concept of the German Ministry of Defense.

TOPCOM is a standardized cost model, applicable to all kinds of military systems without any modification. The cost breakdown structure, the equations and the output format are predefined and not changeable by the user. Because of these model characteristics and the high level of cost aggregation TOPCOM does substitute detailed and specialized models for estimating and optimizing of individual LCC items. The objective of TOPCOM is rather to provide the governmental system planning management with a transparent, aggregated and comparable presentation of the LCC of planning alternatives in standard formats, produced by governmental authorities and/or industry or consulting companies.

In this frame, TOPCOM can be used:

- to get an idea of the order of magnitude od the life cycle cost of a system during development, procurement and in service phases.
- to determine LCC data for comparison of system alternatives.
- to perform a rough trade-off analysis of cost driving input data.
- to show the budget effects and consequences.

TOPCOM is also an element of the agreement on the Data and Cost Reporting Procedure, concluded between the Federation of German Industries and the German Ministry of Defense.

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HELO-MIICOM: An Automated Model to Estimate Avionics-Related Modification Integration and Installation Costs for Helicopters

In times of decreasing budgets, it is especially important to maximize the efficiency of existing assets. One common technique is to modify the avionics suites of existing aircraft to either add new capabilities or to enhance existing capabilities. These modification programs incur several types of recurring and nonrecurring costs. MCR has collected actual cost, technical, and programmatic data on a wide range of avionics-related helicopter modifications and has developed a comprehensive cost estimating model for all major nonrecurring and recurring cost elements. The cost estimating relationships (CER's) only require that the analyst know basic technical and programmatic characteristics for the modification program to be estimated. MCR has developed an automated version of the model using a popular spreadsheet program that develops estimates in constant dollars as well as annual funding requirements by appropriation. This presentation will describe the modification process, the study Work Breakdown Structure, the data used to develop the CER's, and the CER's themselves. The structure of the automated model will also be described.

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USING RIDGE REGRESSION TO ANALYZE PRODUCTION LEARN/RATE COSTS

Learning curves have been used since 1936 for the prediction of the cost of future production. Graphical displays of production cost, usually plotted on loglog paper, show that the usual Unit Cost versus production quantity curve fit does not lie on a straight line.

Examination of the residuals from a learning curve fit indicates that the variability is not random. There are clearly other parameters in production that influence cost beside production rate. Costs that are affected by production rate are indirect or overhead costs and material costs.

Costs that are affected by production maturity (learning) are direct costs of fabrication, assembly, inspection and test. The equation most often used by cost analysts to study production learn and rate effects is:

$$\text{Cost} = T1 * \text{Mid } b * \text{Rate } c$$

This equation performs well under most circumstances. There are, however, times when colinearity between the variables, which is always present to a greater or lesser extent, can yield regression coefficients which ar unrealistic. Most notably, the learning curve will show a slope greater than 100% and the are slope will be steeper than 60% or vice versa.

Quite often the analyst can make use of nonlinear curve fitting programs that are less sensitive to data colinearity, however, these programs tend to introduce bias into the curve fit which increases the mean square error of the curve fit. It has been demonstrated that ridge regression (developed in 1970 by Hoerl and Kennard) can be used quite effectively to counter the effects of data colinearity and provide better curve fits than non linear least squares estimators.

In ridge regression a small amount of bias (.0003) is added to the diagonal of the sums-of-squares and crossproducts matrix. This bias has the effect of decreasing the variance of the curve fit. The root mean square (RMS) deviation of the residuals and the mean squared error (MSE) are usually slightly increased.

One of the problems with ridge regression is knowing how much bias to add to obtain an optimum balance between bias and variance. It was discovered that both negative bias and positive bias can be added on a trial basis until the rate slope approaches 93%. The 93% slope can be used as a stopping rule for cost analysis purposes. It will be found that curve fits obtained in this way are considerably more accurate, have better statistics and less bias then non linear curve fit estimators.

A ridge regression program has been developed, written in the C programming language, which is tailored for production learn/rate cost analysis. It provides a full set of statistics such as R 2, adjusted R 2, RMS, MSE, t statistics and F statistic. It has been compared with a number of commercial statistical programs and obtains similar statistical results.

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Non-Linear Optimization of a Cost Analysis Problem

A frequently occurring problem in cost analysis is: Given a series of time periods, say fiscal years, the quantities of end items procured in each year, and the cost of each annual batch, what first unit cost and learning rate will best account for the data?

The usual method involves passing to the logarithms of the variables, which linearizes the problem, then applying standard linear regression techniques. The linear regression optimizes by minimizing the sum of the squares of deviations, where each deviation is taken as the difference of logarithmic variables. This suggests the possibility of optimizing by defining deviations as differences between the variables themselves rather than logarithms of the variables. This paper makes a beginning in the exploration of the modified approach.

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Modeling Experience in the Flight Test Environment

This paper presents a discussion of recent developments in cost estimating methodologies in the aircraft flight test and evaluation (T&E) environment. The importance and visibility of the T&E phase of system acquisition have increased dramatically over the past ten years. Coupled with a corresponding increase in cost, this has elevated concerns over accurate and timely cost estimates. Past efforts to build parametric cost models for aircraft system test and evaluation have focused on contractor T&E and have bee largely unsuccessful.

The Air Force Test Center embarked on a research program to develop a resource and cost estimating methodology, having determined that the standard engineered estimate approach was too slow and laborious to meet the dynamic needs of the T&E environment. The resulting Resource Estimating Model (REM) was designed to meet two requirements: 1) to provide a summary level cost estimate for budgeting purposes; and 2) to provide a detailed level estimate of the products, services, and consequent resources necessary to perform the test and evaluation of the aircraft systems.

The PC-based model is based on the business concept of fixed and variable costs. The fixed costs are typically determined by the months of program support required. They include costs during build-up, operations, and phase-out portions of the program for planning, staffing, facility operations, and report writing . Variable cost reflect the test support resources tied to the actual flight test activity, usually on a test hour basis. These include costs such as support aircraft, range radars and antennas, mission control rooms, and data processing. The model consists of a menu of modules which categorize typical types of test or phases of program support and identify the required resources. The test program is defined through the selection from the menu of types of test to be performed and the test hours or months associated with each type. Start and stop dates for each module are identified which builds a program phasing schedule. Some of the modules allow for additional tailoring by selection of large or small test aircraft and low, medium, or high complexity test effort. Model output can be reviewed by appropriate test managers and modified for special circumstances. Contents of the model modules are determined and maintain by selected test experts.

Version 7.0 of the REM is scheduled for release in October 1991, and includes several enhancements. It adds additonal test types which recognize the growing importance of ground test facilities. An open test type if none of those available through the menu are sufficient. Finally, it includes a word processing capability to allow documentation-on-the-fly by the user.

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25th Annual DoD Cost Analysis Symposium
Operating and Support Cost Analysis

Cost Analysis:
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Challenges for the Future

The Naval Center for Cost Analysis' Naval Aircraft Operating and Support (O&S) Cost Estimating Models: Recent updates and applications

The paper describes the research and analysis undertaken by Delta Research Corporation to update the Naval Fixed Wing Aircraft Operating and Support Cost Estimating Model and the Naval Rotary Wing Aircraft Operating and Support Cost Estimating Model for the Naval Center for Cost Analysis (NCA). In particular there is discussion of the new Cost Estimating Relationships (CERs) developed to reflect changes in Navy policy and funding of several direct cost elements: Component Rework, Emergency Repair, Engineering Support, Replenishment Spares, and Modification Installation. The paper relates how the model has been used successfully in its past and present forms to generate independent cost estimates (ICEs) for the Office of the Secretary of Defense (OSD) Cost Analysis Improvement Group (CAIG) reviews, as well as to provide ad hoc support for quick-turnaround Chief of Naval Operations (CNO) what-if questions. The updated Fixed Wing O&S Cost Estimating Model is illustrated using F-14A inputs and results.

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A CER APPROACH TO ESTIMATING AIRCRAFT INTEGRATION COSTS

In the wake of the reduced threat in Europe, President Bush has promised significant reductions in the size of our armed forces (and DoD budgets) and to continue the development of high technology avionics subsystems. As they have in the past, future budget constraints will inevitably mean a further decrease in the number of new aircraft acquisition programs. Future challenges for the cost estimating community will shift from estimating the cost of developing and producing new aircraft to integrating new technology into existing aircraft. This paper presents the results of four CER studies which collectively constitute a complete model for estimating the cost of integrating new avionics subsytems into existing aircraft.

The first study developed CERs for the following three cost elements: (1) integration engineering; (2) Group A Kit recurring production; and (3) Group A Kit nonrecurring production. Each of these CERs is, in reality, a summation of eight different weight driven CERs. The study is documented in Section 1.

Installation costs were estimated as a function of modification complexity which was defined in terms of the eight cost driver categories used by the ELSIE (ELectronic Subsystem Integration Estimator) Model. The CER was the result of regression analysis on previous attack and fighter aircraft case histories.

Kitproof and Trial Installation labor (the third study) were estimated as a function of Installation labor costs.

The fourth and final study expressed all other integration cost elements as a percentage factor of the Group A and B kit costs. The factors were based on ten previous A-10 modification case histories.

The Material Science of Operating and Support Cost

PURPOSE: Operating and support cost data sources are documented and evaluated in this paper.

OVERVIEW: As the US Army tightens management of its Operating and Support (O&S) resources, better O&S costing will be required. In the past, many cost modeling efforts have emphasized the requirements (Customer Needs) and ignored data sources (Material Science) in designing cost estimating systems. Many of these systems are consequently gathering dust on bookshelves. This paper attempts to document all potential sources of Army O&S data. This should make it easier for cost estimators/modelers to make more optimal use of available data. If any data sources are unintentionally overlooked, it is hoped that the author will be notified so that the next update can also include those data sources.

CONTENT OF EXECUTIVE SUMMARY: This short paper provides an overview of operating and support cost demand data and related material science problems.

CONTENT OF REFERENCE PAPER: The content of this paper is highly structured to facilitate reference using the following outline structure:

I. Army Cost Data Element from the B matrix in P-92.

  A. Phase of the Life Cycle (when estimating)

    1. Generic Estimating Approach (Price X Quant)

      a. Data Type ie. quantity or price etc.

        (1) Data Source - A Generic Name

          (a) Original Data Source

          (b) Accessible Data Sources

          (c) Accessibility

          (d) Bias if known

        (2) etc.

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Operating and Support Cost Reduction (OSCR)

The world wide political changes at the turn of this decade combined with domestic economic crises have manifested themselves in a severely reduced Defense budget. Much of this reduction has been absorbed by the Army. Cutbacks in the Army's total budget can be expected in continue and may become larger.

Significant reductions in O&S cost will require action at all levels and across the entire life cycle. The proposed program involves broad participation throughout the Army and its supporting industrial base. To assure that both short and long term benefits are realized, six methodologies are proposed which cover the entire product life cycle. These methodologies are proposed which cover the entire product life cycle. These methodologies focus on reducing selected O&S costs through management action and through insertion of technology at relevant points in the system's life cycle.

These six processes provide a practical means of reducing O&S costs.

- Technology insertion for components/spares which uses a portion of the Army Stock Fund to re-engineer spares causing high O&S costs.

- O&S Value Engineering which uses a portion of the production funds to pay for redesigns, thus reducing O&S costs.

- A Major Modification/New Start process which will assure that the O&S implications of any new program are well understood and that tradeoff analyses are presented to decision makers at major program milestones.

- Materiel Change Management process which will assure that product improvements aimed at O&S cost reduction are second only to critical safety issues in funding priority.

- Establishing "exit criteria" for Advanced Technology Transitions Demonstrations which will assure that the O&S implications of the new technology are well understood and which will provide the basis for the required tradeoff analyses new start programs must be present at the program start decision milestone.

- Attacking the generic cost drivers by identifying the underlying causes of Army O&S costs and pursuing technology base projects aimed at those fundamental cost drivers.

Significant O&S cost reductions are achievable. Their attainment will require a concerted systemic application and institutionalization of the principles outlined in this paper. The Army owes it to the soldier and the American public to do so.

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Operating and Support Cost Reduction

Operating and Support (O&S) cost today is consuming about 60% of our budget dollars. The Army's goal for systems Operating and Support Cost Reduction (OSCR) moves toward new concepts with a bright future for success. Many systems perform extremely well but have very high O&S cost. This O&S cost reduces the funding for Research, Development, and Acquisition (RDA) to lower levels. OSCR also challenges the user and industry, who for years worked autonomously until a contract was awarded. Our concept to help these problems is the "Best-in-Class" (BIC) pamphlet.

Initially, our BIC pamphlet focuses on reducing both materiel systems and training O&S cost. This approach links both the user and industry with a BIC pamphlet for reference to systems or training savings. This concept is proven in athletic competition. For many years, the 4 minute mile was the record to break. Once Roger Banister broke the record in 1954, the record has continued to be broken. We will apply the same concept in OSCR that proves our best system can get better by reducing O&S cost. Also, our concept comes from a method used by Ford Motor Company.

The Ford Motor Company's Taurus model in the 70's and early 80's shows how this concept of BIC works. First, Ford identified the best parameters from the customer's viewpoint. Two examples include a long adjustable seat bar to allow quick adjusting and wide windshield wipers to better clean the window. Secondly, Ford through design changes achieved "Best-in-class" on 80% of the 206 parameters. Using the BIC pamphlet, we can develop a program to arrive at systems OSCR.

The BIC pamphlet will have data for identified parameters (high cost drivers) e.g., power packs, turret components, and main gun. It will identify the achievable and demonstrated hardware and support parameters for various types of systems. We will use technology to select the best methods for reducing O&S costs, considering composites, robotics, etc. By showing the best fielded parameters in the BIC pamphlet, our customers can identify needed, affordable, and realistic system requirements in documents. Our approach would lower O&S cost while increasing combat and sustainment capability. A strong benefit of this approach is the focus on "best value." This BIC concept for systems OSCR will free up dollars for continued RDA investments.

We believe that every dollar invested in O&S cost during research and development (R&D) can "leverage" greater savings later. This will reduce the budget burden on tomorrow's smaller but more responsible force. This concept works in other areas as well e.g., reducing training cost. With emerging technologies, we may establish tomorrow's best-in-class on "training and systems values." The BIC pamphlet will serve as a two fold goal.

In conclusion the BIC pamphlet's goal is to achieve OSCR by bridging the gap between user and industry. Next, it will save dollars for future investments in RDA. Our BIC pamphlet is in effect a "consumer report" for the Army systems and training OSCR. Finally, it will help the Army's goal in operating and support cost reduction.

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Technology Insertion O&S Cost Modeling

Technology Insertion (TI) is a U.S. Army Operating and Support Cost Reduction (OSCR) initiative. The goal of the program is to procure spare parts that, when compared with the spares presently in the system, provide an overall cost savings to the Army. This cost savings may result from a decrease in the unit cost of a component or from Reliability, Availability and Maintainability (RAM) considerations.

This paper provides a cursory overview of OSCR progams, and a comprehensive discussion of Technology Insertion and the cost estimates that are involved in analyzing a TI proposal. The concept of concentrating on technologies with the purpose of inserting them into weapon system spares will require large efforts from the engineering disciplines. This paper should provide personnel not formally trained as cost estimators with enough information to understand the analyses involved.

In addition, this paper will provide a trained cost analyst with the procedures to be used in developing TI estimates.

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Composite Wing Force Structure Considerations in Estimating the Costs

Along with force reductions, we are experiencing changes in the ways ours forces are organized. One of these changes is the composite wing concept. That is, the combination of dissimilar weapons systems, in one location, that together satisfy an overall mission requirement.

Estimating the costs associated with the composite wing concept presents some challenges. Some of the considerations are rather obvious and easy to estimate, e.g., moving the aircraft and people from their current location to the composite wing location. Others are more difficult to determine and may or may not be easy to estimate. Some examples are: MILCON requirements, duplication of manpower requirements, and impact on flying hour programs.

This paper examines what should be considered when developing an estimate on the composite wing concept. It discusses the obvious cost of transferring the weapon systems to the composite wing location, as well as, the costs of transferring the displaced weapon systems. It highlights the challenges of developing the cost estimate, specifically examining manpower, MILCON, and training requirements. It further suggests some models that are useful in doing these estimates. While this paper is written from an Air Force Perspective, the concepts are applicable to any situation where dissimilar weapon systems or units are combined.

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Estimating Cost Savings for Technology Insertion in Stock Funded Items

The AMC Technology Insertion (TI) effort was instituted to develop strategies which will induce industry to re-engineer older and less reliable components and sub-systems which are either in production or fielded. TI, in stock funded items, is an attempt to re-engineer a system by selectively replacing the original technologies with more modern versions in order to make the system more producible, supportable, maintainable or less costly to operate. TI may be targeted at different levels of a system, such as individual components, circuit card assemblies, modules and subassemblies, mechanical parts or the entire system itself. Suitability of a system for a TI undertaking takes into account factors such as the maintenance philosophy, remaining system life expectancy, field replacement rate, availability of current components and operational requirements.

During an AMC Technology Insertion Senior Panel Meeting on 17 Sep 90, LTG Thomas stated that there are three goals for TI: reduce O&S cost; ensure the availability of spares; and force the rapid maturation of Form, Fit and Function (F3) and Hardware Description Language (HDL) types of technical information.

This paper will focus on the effort to establish a methodology for estimating cost savings and calculating a return on investment in the operating and sustainment (O&S) areas when TI is applied.

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AIR RESERVE COST, ANALYSIS, AND PLANNING SYSTEM (ARCAPS)

1. The primary goal of ARCAPS is to provide standardized cost factors for Air Force Reserve military personnel. Those factors must be timely, accurate, and accessible to all authorized users. In this paper, we will discuss the Air Force program, especially differences between active duty military personnel and Reserve personnel, in terms of differences which impact formulation of Reserve personnel cost factors. We will also discuss the characteristics of ARCAPS, especially hardware and software, how the system operates, and what the system achieves.

2. Developing cost factors for Reserve personnel presents several problems which are not encountered by the active Air Force. Reservists are uniquely different from active duty military personnel in several distinct ways.

a. Active duty personnel are assumed to be available for duty 24 hours per day, 7 days per week, but reservists only perform duty on an intermittent basis. They are essentially part-timers and are only paid for the training periods they actually perform.

b. The pay entitlements for Reserve personnel change when their military status changes from active duty for training to inactive duty for training. When performing training under active duty status, reservists receive a full complement of pay and allowances on a day-for-day basis. When performing training under inactive duty status, reservists are paid only base pay but are entitled to a full day of base pay for each 4-hour training period.

c. Finally, reservists are authorized a minimum number of paid (active duty and inactive duty) training periods per year. They can, however, perform additional paid training periods, depending upon their unit training/mission requirements.

3. To develop Reserve cost factors, we used actual historical pay data from the Joint Uniform Military Pay System-Reserve Forces (JUMPS-RF), the Command On-line Accounting and Reporting System (COARS), and the Personnel Data System (PDS).

a. The backbone of ARCAPS is the JUMPS-RF, which maintains the actual payment data and training period information for all Reserve personnel. The interface provides the amount of actual payments of military pay and allowances made to Reserve personnel.

b. The Command On-line Accounting and Reporting System (COARS) interface provides the amount paid to Reserve personnel for support type costs, e.g., travel and per diem, billeting, subsistence, etc.

c. Finally, the USAF Personnel Data System interface provides the monthly assigned strength for each AFRES location. ARCAPS is therefore able to compute an average cost per reservist, per assigned unit.

4. ARCAPS is hosted on the Air Force Reserve command's UNISYS 2200/400 and uses MAPPER programming language.

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HAWK MISSILE SYSTEM OPERATING AND SUPPORT COST REDUCTION PROGRAM

PURPOSE

The purpose of the study was to analyze and summarize the HAWK System Operating and Support (O&S) Cost reduction results that had been achieved over the life cycle of the system. The HAWK system was fielded by the U.S Army in 1960 and is one of the earliest missile systems deployed that still remains in the active inventory. HAWK is expected to remain in the inventory into the 21st century.

SUMMARY

During the life cycle of HAWK, major efforts were expended in the design cycle to reduce the O&S costs of the system. A series of product improvement programs over the past twenty years has maintained the viability of the system to meet the threat. While major goals of the various product improvement programs instituted over the years included defeating advanced threats and improving performance of the system, equally important was the goal of reducing the cost of ownership. During this analysis, the various major improvement programs were reviewed and the impacts of these efforts on O&S costs were analyzed. The system which was first fielded in 1960 was Basic HAWK. The first product improvement program converted the system to Improved HAWK which began fielding in 1972. The Phase I product improvement program began fielding in 1979 while the Phase II product improvement program began fielding in 1983. The Phase III product improvements began fielding in 1989. Other improvements are planned for implementation later this decade. The analysis describes the O&S savings resulting from each of the improvements. The study was limited to major improvement programs and did not include design efforts on repair parts, value engineering efforts, and minor study efforts.

The results of the study revealed that over the life cycle of HAWK, these efforts will result in O&S savings of over $4.8 billion. While the study indicated that the efforts achieved the goals that were set forth as was expected, the magnitude of the savings was impressive. In addition, it pointed out a number of areas where HAWK has been a leader in technology that other missile systems were able to take advantage of in their designs.

The lessons learned in the analysis indicates that specific attention to cost reduction in the initial design as well as the product improvement programs can be very fruitful in reducing the cost of ownership of expensive, high technology systems.

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Defining the Force Structure Cost Problem

In the current environment of drawing down and reconstructing the structure of military forces, cost analysts involved in the PPBS process are often called upon to evaluate the cost consequences of proposed changes. However, proposals for force structure change in the programming and budgeting process are typically under-specified for purposes of calculating the associated cost, requiring the analyst to make or ask a series of questions or make a series of assumptions about how the change will be implemented. However, knowing the right questions to ask requires an expertise in force structure issues that one would not expect a large number of analysts to have.

The goal of this research was to establish a set of generic guidelines to assist the cost analyst in establishing a full problem scope before turning to the application of a cost methodology and other details of the cost analysis. The method used was case studies; the guidelines were derived from an examination of actual force structure change proposals that recently arose in the PPBS process.

The results of this effort is a generic question list, applicable to force structure proposals across services and components. The list of 15 questions (most accompanied by a series of second level questions) can be organized into three subject areas. The first section is designed to identify all parts of the force that are indirectly affected and the nature of the change they are expected to undergo. The second section addresses the transition tasks (and costs) associated with the implementation of a proposed change; while the third section focuses on changes in resource and activity levels that drive cost.

With even qualitative answers to the question list, the analyst is equipped to identify the full scope of a force structure change and the major cost-driving factors that are likely to influence the final results. With that information, the analyst can either plan the detailed work of a longer cost analysis, or properly qualify (by highlighting of critical assumptions) the results of an immediately required cost estimate.

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Force Costing

Force costing is both a process and a tool that identifies and estimates costs associated with a force unit. The costs included in force costing can be categorized as: direct or indirect, recurring or non-recurring, and fixed or variable. Depending on which costing option is being considered, various combinations of cost categories apply.

The mission of force costing in the Army is to provide accurate cost estimates on the creation, modification, operation, maintenance and inactivation of force units down to SRC level of detail and aggregated to any size of force structure. In other words, force costing can provide costs of a three division corps with a strength of about 150,000, down to a two member detachment.

The force structure system in the Army is being automated. Both a data base and model are available today with additional modules under development for delivery during FY91.

The different force structure options envisioned for force costing are:

- Activation/Acquisition - Available
- Operations - Available
- Reorganization/Modernization - FY91
- Relocation - Prototype Testing
- Inactivation - FY91
- Conversion - TBD

Each of the force structure options listed above require increasing amounts of information as you go down the list. Similarly, the complexity of the scenarios increase as you go down the list. The analyst must define what happens to the people, equipment and facilities in order to make accurate estimates of the force structure costs.

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Force Structure Costing for the 90's and Beyond

The 90's will bring rapid and drastic change to the force structure we know today. Type of units, Active Component (AC) or Reserve Component (RC) mix will be vastly different. The need to be postured to cost a variety a scenarios has driven the development of several models that facilitate force structure costing.

This document was prepared as a guide. It describes tools available for decision makers to evaluate future force structure. It is not intended to educate the decision maker on the complexities of the algorithms in each model or the variety of input (source data). It offers an overview of the output for use as a tool in decision making. Three criteria were applied in evaluating the available models. The model must provide the decision maker with the data to determine the size of an affordable force, the best mix of AC and RC, and a optimal stationing (basing) plan.

It is clear in evaluating a number of models that one premise was universal. Population and equipment density drives force structure cost. They are the key factors used in the models selected for this guide. These key factors are processed with a variety of other input to provide output on equipping, sustain and facilitating.

After applying the criteria there was not a singular model that provided the output for force structure size, component mix and basing. However, using output from multiple models that complement allows for more optimal decisions. The Army Force Cost Model (TAFCS) and Real Property Planning and Analysis System (RPLANS) were selected for this guide as the best tools for the decision maker. Together they meet the criteria to determine size, composition and basing of the future force.

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Determining P-2 Mission Cost Factors in a Period of Instability

This paper illustrates how changes in supply and maintenance systems effect the capacity of the three year moving average to accurately forecast requirements. The purpose is not to provide a complete solution but instead identify the source of distortion that requires remedies. The cost factor for repair parts (CL IX) and Spares (PA2) has two objectives. First to provide a budget tool for funding CL IX and PA2 requirements. Second, to provide a cost estimate of the actual CL IX and PA2 requirements associated with operating a material system. In a period of stability, the current methodology of using a three year moving average has provided the Army an accurate estimate of the requirements to meet both objectives. The Army is no longer in a steady state. The advent of Defense Management Review Decisions (DRMD) 901 and 904 are nothing short of a complete renovation of the way CL IX and PA2 are managed throughout the Army. Motivated by self preservation, USAREUR's game plan for implementing DMRD 901 and 904 has caused major changes to the supply and maintenance operations. The net effect of the changes is to sizably reduce demands at the wholesale level. The existing cost factor methodology cannot discriminate from the wholesale data base, permanent and impermanent demand reductions. The decrease in demand related to greater maintenance activity is a permanent efficiency that should correctly lower the cost factor to reflect reduced requirements. The decrease in demand related to asset redistribution efforts is an impermanent reduction. As long as the impermanent condition suppresses requirements but understates operating requirements. In the year the impermanent condition expires, the historic based cost factor understates both funding and operating requirements. The problem is complicated by the fact that demands recorded at the wholesale level are also distorted by the pipeline changes of a multi-tiers supply system.

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Development of Spares and Repair Parts Cost Factors in Support of the P2 Training Resource Models

Purpose: As the U.S. Army moves into a more austere resource position with the advent of the DMRD initiative, it becomes increasingly important to be able to resource the units at the right level so that the training objective can be met. This paper addresses the methodology that was used to generate the P2 OPTEMPO cost factors used in the HQDA training resource models.

Methods: The Army's Operating and Support Management Information System (OSMIS) is a repository of actual historical O&S costs for fielded major materiel systems. Contained there-in are MACOM level costs associated with spares and repair parts, depot maintenance costs of end and secondary items, ammunition expenditures and costs, fuel consumption, number of fielded systems, and total miles or hours of operation. Historical demand data, and corresponding activity data (miles or hours) for FY87 through 2d QTR FY90 were extracted from the Army's Operating and Support Management System (OSMIS). This data was massaged to incorporate the impact of DMRD 901 (Reducing Supply System Costs), DMRD 904 (Stock Funding of Reparables), Army Materiel Command's (AMC) Major Subordinate Command (MSC) commodity specific surcharges and return credits, HQDA unserviceable return rate goal, reduction for excess, and inflation. For those materiel systems where no historical data were available, engineering estimates based upon the Provisioning Master Record (PMR) from each of the MSCs were used to develop the parts cost factors. Parts costs were calculated at the NSN level with appropriate MSC adjustments. The costs were then rolled to provide MACOM level total costs for each weapon system. The spares and repair parts costs were then divided by the MACOM activity (miles or hours) to calculate the cost factor. Fuel consumption and fuel costs were also calculated for the systems. MACOM level cost factors were generated for over 243 systems to support FY 92/93 Budget and Future Years Defense Plan (FYDP).

Conclusion: Cost factors are an integral part of the OPTEMPO based resourcing process. They reflect the manner in which the units train and maintain their equipment. A tremendous amount of effort is put forth to validate the input data, process, and outputs. Several on-site validation trips have been made and will continue to be made to ensure the information reflects what is being experienced in the field.

Recommendation: OSMIS continues to expand materiel systems and MACOM coverage. Refinements need to be made to reflect the current DMRD initiatives and HQDA guidance. Improved coordination must occur between the various players involved in the factor development process and PPBES.

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Development of Division Level Cost Factors for United States Army, Europe

HQ USAREUR DCSOPS and DCSRM conducted a joint review of non-OPTEMPO support costs. The goals of this review were to: define cost drivers; develop the methodology for collecting data; establish a cost element structure, develop cost factors; and integrate the standard methodology into various models for programming, budgeting and execution of P2 mission funds.

The current non-OPTEMPO cost categories have proven to be inadequate to USAREUR for the following reasons: non-OPTEMPO dollars are poorly defined and not objectively substantiated, OPTEMPO/non-OPTEMPO budget is not in balance with requirements, and the impact cannot be articulated when non-OPTEMPO dollars are cut.

With the above goals and current inadequacies in focus, DCSOPS and DCSRM jointly undertook this study to improve their management of non-OPTEMPO costs. This study involved the participation of the 1st and 3rd Armored Divisions and the 3rd and 8th Infantry Divisions. The FY 90 execution data for these four divisions were obtained in an Accounting Processing Code (APC) and Element of Resource (EOR) level of detail. An analysis of this data led to the development of a division level cost structure and rules for mapping the APC/EOR data to the cost structure. Cost factors were developed for the various cost elements which were categorized as Direct OPTEMPO, Indirect OPTEMPO, Other Training Support, and Civilian Personnel.

The cost factors developed from the divisions' execution data (i.e., obligation data) are a function of multiple variables. These variables include OPTEMPO, battalion rotations to the major training areas, and division personnel strength. Although the emphasis of this study was on the Indirect OPTEMPO and Other Training Support cost categories, macro cost factors were developed for the Direct OPTEMPO cost elements to enable a division or corps resource management office to quickly estimate a total division or corps P2 mission budget and to rapidly run excursions on the baseline budget.

This study has produced a standard methodology for collecting non-OPTEMPO costs using USAREUR's Standard Resource Budgetary and Control System (STARBUCS), developing cost factors, analyzing execution, and observing trends over previous fiscal years. The cost factors will directly feed the existing suite of training resource models and the force planning/costing models used at HQDA.

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ARMY WEAPON SYSTEMS MANPOWER COSTING

This paper describes the Army Manpower Cost System (AMCOS) procedures for manpower costing associated with weapon systems, as required in the "Instructions for Reformatting the Baseline Cost Estimate(BCE)/ Independent Cost Estimate(ICE), DCA-P-92.

AMCOS is a tool designed, for the Army, to analyze manpower costs. It was developed to improve the accuracy and flexibility of manpower cost estimates and to provide a uniform methodology for estimating manpower costs.

There will be a brief overview of the historical background, methodology, and data sources for AMCOS, followed by an instructional block on manpower costing for the sustainment of an aviation system. The approach used for manpower cost estimating of an aviation system follows the Army policy required to operate, maintain, support, and train for a Major Defense Weapon System.

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The Effects of Desert Shield and Desert Storm on Class IX Operating and Support Costs

Purpose: As the U.S. Army began preparation for Operation Desert Shield and follow-on Operation Desert Storm, tremendous costs were anticipated in Class IX Spares and Repair Parts because of environmental and OPTEMPO considerations. This paper depicts the costs associated with Class IX parts for the U.S. Army units deployed during these operations.

Methods: Divisional level logistics data were extracted from the Army's Operating and Support Management Information System (OSMIS). Operations Desert Shield/Storm costs were displayed on a fiscal quarter basis (4 QTR FY90, 1st QTR FY91, and 2d QTR FY91) for the deployed divisions, separate brigades, and armored cavalry regiments. The units included in this analysis are:

24th Infantry Division (MECH)
101st Airborne (AIR ASSAULT) Div.
82d Airborne Division
2d Armored Division
2d Armored Division (FORWARD)
1st Cavalry Division
3d Armored Division
1st Infantry Division (MECH)
1st Armored Division
197th Infantry Brigade (MECH)
2d Armored Cavalry Regiment

A comparison was made to the previous average quarterly costs (peacetime environment) to determine the increased costs for the operation. The costs were further identified to specific weapon systems (e.g., M1 ABRAMS TANK, AH-64A, APACHE, etc.) and top cost driver parts (e.g., M1 engine, AH-64A Rotor Blades, etc.).

Results: The build-up is clearly identified for each of the FORSCOM deployed organizations. Although the USAREUR units show an increase in Class IX costs after notification of deployment, the increase is not as pronounced as for the FORSCOM units. This was caused by USAREUR units withdrawing theater stocks to support the operation in lieu of requisitioning the parts. Replenishment of theater stocks may be observed in more recent data and will be incorporated into the analysis. Current information shows an average quarterly cost increase of $124M over normal training cost. Costs associated with the environment (sand) and threat (chemical) are also obvious with a large increase in costs for Nuclear, Biological, and Chemical equipment, water purification apparatus, aircraft components, filters, and tires/tubes.

Conclusion: Historical data can be used to evaluate logistical requirements for future plans. Further analysis is needed to address the issues of back orders, war reserve stockpiles and excess. An effort is underway to develop Cost Estimating Relationships (CERs) for the Spares and Repair Parts.

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Cost Reductions for the Joint Computer Based Instructional System (JCBIS)

The purpose of the study is to show the cost reductions which can be realized for JCBIS. JCBIS is a networked set of Control Data Corporation Cyber computer systems that are used to distribute and administer computer based instruction throughout the government, using the Programmed Logic for Automated Teaching Operations (PLATO). At the time for the study, computers were located at Fort Belvoir, Virginia; Redstone Arsenal, Alabama; Fort Leavenworth, Kansas; Fort Huachuca, Arizona; and the Federal Aviation Administration, Oklahoma. These computers are linked with a packet switching network. Cost reduction for the users is desired. I will show how reductions can be realized in the areas of contract consolidation, replacement of outdated communication equipment, network consolidation, and upgrade of computer equipment.

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