



# Test and Evaluation Trends and Costs for Aircraft and Guided Weapons

Bernard Fox, Michael Boito, John C. Graser, Obaid Younossi



PROJECT AIR FORCE

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**SA Dillow**



## **Test And Evaluation Trends And Costs For Aircraft And Guided Weapons:**

**Test and Evaluation Trends and Costs for Aircraft and Guided Weapons**, 2004 As military systems have become more complex testing has become more time consuming and costly A number of efficiencies have been proposed and implemented such as increasing use of modeling and simulation and combining developmental and operational testing How have these approaches worked in practice And do traditional metrics for estimating the cost of testing still apply This study addressed these issues by examining system level testing for selected fixed wing aircraft missiles and guided munitions programs The actual times and costs appear to be largely in step with the increasing complexity of the systems and test programs so the proportion of development costs that the testing represents has not changed markedly Although the available data are not sufficient to isolate the effects of discrete initiatives some such as modeling and simulation and combined testing have empirically demonstrated their value on a variety of programs The authors provide cost estimating methodologies and reference information on the programs they studied

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Sources of Weapon System Cost Growth Joseph George Bolten, 2008 Previous studies have shown that the Department of Defense DoD and the military departments have historically underestimated the cost of new weapon systems Quantifying cost growth is important but the larger issue is why cost growth occurs To address that issue this analysis uses data from Selected Acquisition Reports to examine 35 mature but not necessarily complete major defense acquisition programs similar to the type and complexity of those typically managed by the Air Force The programs are first examined as a complete set then Air Force and non Air Force programs are analyzed separately to determine whether the causes of cost growth in the two groups differ Four major sources of cost growth were identified 1 errors in estimation and scheduling 2 decisions made by the government 3 financial matters and 4 miscellaneous sources Total development plus procurement cost growth when measured as simple averages among the program set is dominated by decisions which account for more than two thirds of the growth Most decisions related cost growth involves quantity changes 22 percent requirements growth 13

percent and schedule changes 9 percent Cost estimation 10 percent is the only large contributor in the errors category Less than 4 percent of the overall cost growth is due to financial and miscellaneous causes Because decisions involving changes in requirements quantities and production schedules dominate cost growth program managers service leadership and Congress should look for ways to reduce changes in these areas

### **Historical Cost Growth of Completed Weapon System**

**Programs** Mark V. Arena, 2006 This report is one of a series from a RAND Project AIR FORCE project The Cost of Future Military Aircraft Historical Cost Estimating Relationships and Cost Reduction Initiatives The purpose of the project is to improve the tools used to estimate the costs of future weapon systems It focuses on how recent technical management and government policy changes affect cost This report focuses on the accuracy of cost estimates For our analysis we used a very specific sample of Selected Acquisition Report SAR data namely only programs that are complete or are nearly so The analysis indicates a systematic bias toward underestimating the costs and substantial uncertainty in estimating the final cost of a weapon system In contrast to the previous literature the cost growth was higher than previously observed We also found few correlations with cost growth but observed that programs with longer duration had greater cost growth and electronics programs tended to have lower cost growth Although there were some differences in the mean cost growth factors among the military departments the differences were not statistically significant While newer programs appear to have lower cost growth this trend appears to be due to factors other than acquisition policies

### *Software Cost Estimation and Sizing*

**Methods** Shari Lawrence Pfleeger, Felicia Wu, Rosalind Lewis, 2005 Recommends an approach to improving the utility and accuracy of software cost estimates by exposing uncertainty in understanding the project and reducing the risks associated with developing the estimates The approach focuses on characteristics of the estimation process such as which methods and models are most appropriate for a given situation and the nature of the data used such as software size describing symptoms and warning signs of risk in each factor and risk mitigation strategies

*Is Weapon System Cost Growth Increasing?* Obaid Younossi, 2007 In recent decades there have been numerous attempts to rein in the cost growth of U S Department of Defense DoD acquisition programs Cost growth is the ratio of the cost estimate reported in a program's final Selected Acquisition Report SAR and the cost estimate baseline reported in a prior SAR issued at a particular milestone Drawing on prior RAND research new analyses of completed and ongoing weapon system programs and data drawn from SARs this study addresses the following questions What is the cost growth of DoD weapon systems What has been the trend of cost growth over the past three decades To address the magnitude of cost growth it examines cost growth in completed programs to evaluate the cost growth trend over time it provides additional analysis of a selection of ongoing programs This sample of ongoing programs permits a look at growth trends in the more recent past Changes in the mix of system types over time and dollar weighted analysis were also considered because earlier studies have suggested that cost growth varies by program type and the cost of the program The findings suggest that development cost growth over the past three decades has

remained high and without any significant improvement

**Verification, Validation, and Testing of Engineered Systems** Avner Engel, 2010-11-19 Systems Verification Validation and Testing VVT are carried out throughout systems lifetimes Notably quality cost expended on performing VVT activities and correcting system defects consumes about half of the overall engineering cost Verification Validation and Testing of Engineered Systems provides a comprehensive compendium of VVT activities and corresponding VVT methods for implementation throughout the entire lifecycle of an engineered system In addition the book strives to alleviate the fundamental testing conundrum namely What should be tested How should one test When should one test And when should one stop testing In other words how should one select a VVT strategy and how it be optimized The book is organized in three parts The first part provides introductory material about systems and VVT concepts This part presents a comprehensive explanation of the role of VVT in the process of engineered systems Chapter 1 The second part describes 40 systems development VVT activities Chapter 2 and 27 systems post development activities Chapter 3 Corresponding to these activities this part also describes 17 non testing systems VVT methods Chapter 4 and 33 testing systems methods Chapter 5 The third part of the book describes ways to model systems quality cost time and risk Chapter 6 as well as ways to acquire quality data and optimize the VVT strategy in the face of funding time and other resource limitations as well as different business objectives Chapter 7 Finally this part describes the methodology used to validate the quality model along with a case study describing a system s quality improvements Chapter 8 Fundamentally this book is written with two categories of audience in mind The first category is composed of VVT practitioners including Systems Test Production and Maintenance engineers as well as first and second line managers The second category is composed of students and faculties of Systems Electrical Aerospace Mechanical and Industrial Engineering schools This book may be fully covered in two to three graduate level semesters although parts of the book may be covered in one semester University instructors will most likely use the book to provide engineering students with knowledge about VVT as well as to give students an introduction to formal modeling and optimization of VVT strategy

**Mathematical Modeling and Simulation of Systems** Serhiy Shkarlet, Anatoliy Morozov, Alexander Palagin, Dmitri Vinnikov, Nikolai Stoianov, Mark Zhelezniak, Volodymyr Kazymyr, 2023-07-04 Modern complex multi domain systems require increased efficiency reliability and availability combined with reduced cost This book contains papers on mathematical modeling and simulation of processes in various areas ecology and the environment production and energy information technology samples of special purpose equipment and cyber physical systems The outcomes presented in the book are useful to specialists involved in the modeling and simulation of real world system management and decision making models production models and software products Scientists have the opportunity to familiarize themselves with the latest research in a variety of solutions proposed by leading scientists and to determine promising directions for solving complex scientific and practical tasks Chapters of this book contain papers presented at the 17th MODS International Conference November 14 16

2022 Chernihiv Ukraine      **Research Anthology on Military and Defense Applications, Utilization, Education, and Ethics** Management Association, Information Resources, 2021-05-28 Military technology is highly advanced in terms of technology being used in the field computer applications artificial intelligence and software applications These high performance technologies range from weapons to communications technology to automation in vehicles and weaponry These technologies must be both secure and reliable in harsh environments Research is being focused specifically on that including how military and defense applications operate what modern technologies are being used and the ethics surrounding these applications A holistic view of these applications is necessary for both understanding current military tactics and tools along with the future applications The Research Anthology on Military and Defense Applications Utilization Education and Ethics focuses specifically on military and defense operations expenditure technologies and tools and the ethics surrounding technologies like weaponry and artificial intelligence in the military The chapters cover a wide and diverse range of military and defense applications while providing crucial information on the functions security and reliability of these technologies Beyond an understanding of the applications themselves this book also focuses on military education surrounding these technologies and the ethics of usage to provide a well rounded understanding of research in the field This book is ideal for military consultants military personnel defense agencies national security agencies government officials defense personnel policymakers military educators and trainers stakeholders practitioners researchers academicians and students interested in the latest research in military and defense applications      **Operations Research for Military Organizations** Tozan,

Hakan, Karatas, Mumtaz, 2018-07-27 The study of operations research arose during World War II to enhance the effectiveness of weapons and equipment used on the battlefield Since then operations research techniques have also been used to solve several sophisticated and complex defense related problems Operations Research for Military Organizations is a critical scholarly resource that examines the issues that have an impact on aspects of contemporary quantitative applications of operations research methods in the military It also addresses innovative applications techniques and methodologies to assist in solving defense and military related problems Featuring coverage on a broad range of topics such as combat planning tactical decision aids and weapon system simulations this book is geared towards defense contractors military consultants military personnel policy makers and government departments seeking current research on defense methodologies

**Budget Estimating Relationships for Depot-level Repairables in the Air Force Flying Hour Program** Gregory G. Hildebrandt, 2007 Budget estimating relationships BERs for flying depot level repairables DLRs explain the direct effect of specified variables on obligated funds associated with spare parts that directly support the U S Air Force USAF Flying Hour Program In FY02 net sales of DLRs to Air Force commands hit historic highs To provide the Air Force Cost Analysis Improvement Group with a tool to better understand the commands budgetary submissions we develop several explanatory BERs to understand why flying DLRs are at their particular levels Using longitudinal regression statistical methods we

explain the historical net sales of flying DLRs using estimating models that relate net sales to the contemporaneous values of aircraft characteristics operational tempo and time related variables This is but one part of a larger project to develop better estimating methods for use by the acquisition community and to examine the impact of Air Force and DoD policies on weapon system costs The findings will also be of interest to those in the national security community who are involved in analyzing alternative military postures and to members of the aircraft industry s analytical community *Department of the Navy and Air Force Combat Aviation Programs* United States. Congress. House. Committee on Armed Services. Subcommittee on Air and Land Forces,2010 **Joint strike fighter DOD plans to enter production before testing demonstrates acceptable performance : report to congressional committees.** United States. Government Accountability Office,2006

*Impossible Certainty* ,2006 This report is one of a series from a RAND Project AIR FORCE project The Cost of Future Military Aircraft Historical Cost Estimating Relationships and Cost Reduction Initiatives **Hearing on National Defense Authorization Act for Fiscal Year 2009 and Oversight of Previously Authorized Programs Before the Committee on Armed Services, House of Representatives, One Hundred Tenth Congress, Second Session** United States. Congress. House. Committee on Armed Services. Subcommittee on Air and Land Forces,2008 **Evolutionary Acquisition** Mark A. Lorell,Julia Lowell,Obaid Younossi,2006 So far EA implementation of military space programs has produced mixed results The capabilities and requirements definition and management processes are major challenges in all EA programs EA programs require an evolutionary costing approach most cost analysts interviewed expressed generally positive views about EA BOOK JACKET **Why Has the Cost of Fixed-wing Aircraft Risen?** Mark V. Arena,2008 This report explores why in recent decades military fixed wing aircraft costs have escalated beyond the rates of commonly used inflation indices examining both economy driven factors that the Services cannot control and customer driven ones that they can The authors found that this trend of cost increases is true for all types of aircraft patrol cargo trainer bomber attack fighter and electronic warfare **War as Business** Armin Krishnan,2016-03-03 The privatization of defence assets and the outsourcing of military services from the armed forces to the private sector is an increasing trend This book approaches the issue of military privatization by linking it to the transformation of the defence industries since the early 1990s and shows the extent to which many military functions and activities ranging from military research to military consulting training to operational support services have already been outsourced in the US and in Europe This detailed study provides new and updated information on the ongoing privatization of the defence sector and offers an original theoretical explanation as to why the most modern armed forces throughout the world have come increasingly to rely on private companies for nearly everything they do Contributing to a better understanding of military privatization and its close connection to technological change the book explains the complexity of the whole phenomenon and discusses its implications for national and international security

**Naval War College Review** ,2009 **Department of Defense Authorization for Appropriations for Fiscal Year**

**2006** United States. Congress. Senate. Committee on Armed Services,2006



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