

# RESEARCH NOTE

## Mathematical analysis of the MPS MX missile system

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A model for the cost-optimization analysis of the multiple protective shelter (MPS) MX missile system is developed. Because many of the components of the system have never been built before and an enemy's capabilities are hard to predict, parametric analysis has been carried out to understand more about the system design.

**Key words:** mathematical models, missile systems, cost optimization, parametric analysis.

Recently, the development of a new land-based intercontinental ballistic missile (ICBM) system that could survive nuclear attack has been investigated by the US.<sup>1-4</sup> This new missile system was to be called 'MX' for missile experimental. Since the MX system was proposed, several basing modes have been considered. Some of these systems include: deep underground basing, continuous airborne basing, mobile missile systems, launch and attack systems, small submarine basing, surface ship basing, closely spaced basing and multiple protective shelter (MPS) basing. Of these options the MPS basing system has been seriously considered for possible future development. This paper analyses this MPS MX missile system mathematically. A model is developed which determines the cost-optimal design of the system under varying conditions. In light of the fact that many components of this system have never been built before and the enemy's capabilities are hard to predict, parametric analysis is carried out to understand more about the system design.

### System description and problem definition

The MPS MX missile system has several major features: the missiles would be deployed in protective shelters, hard enough to protect them from attacks on adjacent shelters; the shelters would be spaced in a linear grid pattern and positioned to form the vertices of a hexagon (Figure 1). This hexagonal array is the pattern that would minimize land area, while maximizing the number of warheads that must be expended to destroy the shelters. The shelters would be constructed together in connected groups called 'clusters'. Figure 2 shows two such clusters arranged linearly and each containing 24 shelters. Only one shelter chosen randomly within a cluster would house the actual missile, while the remaining shelters would house decoys, engineered to be indistinguishable from the actual MX missile.

As a further precaution to ensure that the locations of the actual missiles remained undetected, a specially designed transporter would shuffle the missiles and decoys frequently about the shelters within a cluster. The missile transporter is an extremely large manned vehicle weighing approximately 20000 lb, and when fully loaded it would have weighed 1.5 million lb. The shelters within a cluster would be connected by heavy duty roads capable of supporting the weight of the transporter. Each cluster would have one missile transporter and one missile maintenance facility for the exclusive use of that cluster. Physical barriers would be constructed between clusters to ensure that additional missiles could not be brought into the cluster, primarily due to enemy considerations. Viewing posts would be installed on the shelters' radars for satellite observations. Hence, if the MX system were designed to be verifiable, it was thought that an opponent would be less likely to build an accurate missile system.

The MX missile designed for the MPS system is the most accurate and powerful missile that the United States has ever built. The MX is a MIRV (Multiple Independently Targeted Reentry Vehicle) missile with 10 separate 300 kton warheads with plans to increase the warhead yield to 4 megaton each. The unclassified NATO Treaty specifies that 10 warheads are the maximum number of MIRV warheads a missile can carry.

The objective of the system is for the equivalent of approximately 1000 nuclear warheads to survive a hypothetical nuclear attack; it is the US Government's estimate that about 100 missiles would be needed to destroy nuclear force capacity.<sup>5,6</sup> Also it is assumed that a warhead strength of 2500 warheads would be assigned at the MX system.

The proposed MPS MX missile system would have been an extremely big job. The entire system will conservatively projected to cost approximately \$40 billion (1980 dollars).

# Misguided Expenditures An Analysis Of The Proposed Mx Missile System

**N. Stephen Kane**



## **Misguided Expenditures An Analysis Of The Proposed Mx Missile System:**

*Misguided Expenditure* David Gold, Christopher Paine, Gail Shields, 1981      *Misguided Expenditure* Owen Dodson, 1986

Instruments of War Spencer C. Tucker, 2015-07-28 This highly detailed and well illustrated single volume work documents the evolution of warfare across history through weaponry and technological change In war the weapons and technologies employed have direct effects on how battles are waged When new weapons are introduced they can dramatically alter the outcomes of warfare and consequently change the course of history itself This reference work provides a fascinating overview of the major weapon systems and military technologies that have had a major impact on world history Addressing weapons as crude as the club used by primitive man to the high tech weapons of today such as unmanned drones Instruments of War Weapons and Technologies That Have Changed History offers nearly 270 profusely illustrated entries that examine the key roles played by specific weapons and identify their success and failures The book begins with an introductory essay that frames the subject matter of the work and discusses the history of weapons as a whole The text is concise and accessible to general readers without extensive backgrounds in military history yet provides the detailed information necessary to convey the complexity of the evolution of warfare through technological change      Bulletin of the Atomic Scientists ,1981-12 The Bulletin of the Atomic Scientists is the premier public resource on scientific and technological developments that impact global security Founded by Manhattan Project Scientists the Bulletin s iconic Doomsday Clock stimulates solutions for a safer world      *Guns Versus Butter* United States. Congress. House. Select Committee on Aging. Subcommittee on Retirement Income and Employment, 1981      **Defence Expenditure, Industrial Conversion, and Local Employment** Liba Paukert, Peter J. Richards, 1991      **The Budget and the Economy** United States. Congress. House. Committee on the Budget, 1990      *The Defense Economic Adjustment Act* United States. Congress. House. Committee on Education and Labor. Subcommittee on Employment Opportunities, 1983      **Weapons and Warfare** Spencer C. Tucker, 2020-03-26 This work covers major weapons throughout human history beginning with clubs and maces through crossbows swords and gunpowder up to the hypersonic railgun lasers and robotic weapons under development today Weapons and Warfare is designed to provide students with a comprehensive and highly informative overview of weapons and their impact on the course of human history In addition to providing basic factual information this encyclopedia will delve into the greater historical context and significance of each weapon The chronological organization by time period will enable readers to fully understand the evolution of weapons throughout history The work begins with a foreword by a top scholar and a detailed introductory essay by the editor that provides an illuminating historical overview of weapons It then offers entries on more than 650 individual weapons systems Each entry has sources for further reading The weapons are presented alphabetically within six time periods ranging from the prehistoric and ancient periods to the contemporary period Each period has its own introduction that treats the major trends occurring in that era In addition 50 sidebars offer fascinating

facts on various weapons Numerous illustrations throughout the text are also included [Department of Defense appropriations for 1983](#) United States. Congress. House. Committee on Appropriations. Subcommittee on Department of Defense,1982 **Department of Defense Appropriations for ...** United States. Congress. House. Committee on Appropriations,1982 *Debating Counterforce* Charles-Philippe David,2019-04-08 Since the U S presidential elections of 1980 debate has intensified between those who believe that nuclear weapons can only deter a war not intended to be fought and those who see nuclear weapons as an advancement in weaponry that allows for the waging and winning of a nuclear war At the focal point of this debate is the rise of the counterforce [Toward Nuclear Disarmament And Global Security](#) Burns H Weston,2019-06-04 This text is designed to provide students and others with a theoretical and factual base for understanding the complex questions posed by continued reliance on nuclear weapons to protect geopolitical interests In Part One the authors examine the destructiveness and cost of modern nuclear arsenals and offer both normative and systemic explanations *Bulletin of the Atomic Scientists* ,1982-02 The Bulletin of the Atomic Scientists is the premier public resource on scientific and technological developments that impact global security Founded by Manhattan Project Scientists the Bulletin s iconic Doomsday Clock stimulates solutions for a safer world [Impact of Administration's Social Security Proposals on the Elderly](#) United States. Congress. House. Select Committee on Aging,1981 **Bulletin of the Atomic Scientists** ,1982-01 The Bulletin of the Atomic Scientists is the premier public resource on scientific and technological developments that impact global security Founded by Manhattan Project Scientists the Bulletin s iconic Doomsday Clock stimulates solutions for a safer world [Energy Abstracts for Policy Analysis](#) ,1982 **Selling Reagan's Foreign Policy** N. Stephen Kane,2018-03-15 This book examines President Reagan s and his administration s efforts to mobilize public and congressional support for seven of the president s controversial foreign policy initiatives Each chapter deals with a distinct foreign policy issue but they each is related in one way or another to alleged threats to U S national security interests by the Soviet Union and its allies When taken together these case studies clearly illustrate the book s larger thrust a challenge to the conventional wisdom that Reagan was the indisputable Great Communicator This book contests the accepted wisdom that Reagan was an exemplary and highly effective practitioner of the going public model of presidential communication and leadership that the bargaining model was relatively unimportant during his administration and that the so called public diplomacy regime was a high value addition to the administration s public communication assets The author employs an analytical approach to the historical record draws on several academic disciplines and grounds his arguments in extensive archival and empirical research The book concludes that the public communication efforts of the Reagan administration in the field of foreign policy were neither exceptionally skillful nor notably successful that the public diplomacy regime had more negative than positive impact that the going public model had minimal utility in the president s efforts to sell his foreign policy initiatives and that the executive bargaining model played a central role in Reagan s governing strategy and

essentially defined his presidential leadership role in the area of foreign policy making This study vividly demonstrates the enormous gap between the real word Reagan and the one that often exists in public mythology

**Economics of Arms Reduction and the Peace Process** W. Isard,C.H. Anderton,2014-06-28 The subject of peace economics and its ramifications are comprehensively and deeply attacked in this book First of all the book presents a compact survey of significant contributions already made and then it provides a broad theoretical background for examining the subject by evaluating four different approaches those of 1 neoclassical welfare theory 2 Keynesian and modern versions of macroeconomics 3 modern growth theory and 4 political choice theory A number of contributions deal with major questions on issues such as the impact of military cutbacks in the Eastern European economies upon their growth trade between nations arms trade nuclear defense and the benefits and costs of war as highlighted by the recent Gulf War Issues of a more general nature but equally significant are also discussed including the age old negotiations problem of two mature political leaders of major powers in conflict the determinants of military expenditures and the problems of developing countries In the last chapter the findings of the studies reported in the book are summarized and key directions for further research are identified This book is indispensable for any economist or analyst conducting research on peace economics and the peace process or concerned with the impacts of recent arms reduction and conversion by the major powers and the escalation of military expenditures elsewhere

*Almanac of American Military History* Spencer C. Tucker,2012-11-21 This almanac provides a comprehensive chronological overview of all American military history serving as the standard reference work of its type *Almanac of American Military History* is yet another reference work from acclaimed historian Dr Spencer C Tucker and ABC CLIO offering an unprecedented resource for a wide range of students and researchers A comprehensive four volume title this almanac traces all of American military history from the European voyages of discovery through 2011 chronicling the pivotal moments that have shaped the United States into the country it is today In addition to documenting key events this title presents biographies of more than 250 key individuals and provides information on more than 250 historically significant technologies and weapons systems A detailed glossary is included as are discussions of ranks and military awards and decorations Divided into conflict periods each chapter includes a detailed chronology reference entry sidebars statistical information primary source documents and a bibliography

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web at his sister s wedding in just over a week so we really need it if i am mistaken about the vocal selections being a solo please let me know answer from michael cole email me office stephenschwartz com section 2 storytellers telling the story children of eden storytellers question

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