Providing the Means of War

Perspectives on Defense Acquisition 1945–2000

Edited by
Shannon A. Brown

Providing the Means of War
Historical Perspectives on Defense Acquisition, 1945–2000

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General Editor

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Foreword

Acquisition as defined by the Department of Defense denotes our national security establishment harnessing the scientific and engineering knowledge of military and civilian professionals to create the tools of modern war. It encompasses research and development, engineering, contracting, test and evaluation, fielding, and disposal of weapon systems and other forms of technology that are vital to the nation. The acquisition process includes resource-management and strategic decisions that determine the new forms of technology that are developed.

The Industrial College of the Armed Forces (ICAF)—which is celebrating its eightieth anniversary in 2004—is dedicated to supporting the study of national security decision-making and understanding the vital defense acquisition process that supports it. The U.S. Army Center of Military History (CMH) is committed to having the study of the past inform the decisions of the future. This book, a product of both institutions, is an important contribution to understanding the complex relationships that characterize the defense acquisition process central to our shared missions and goals.

These pages highlight the papers and presentations from the defense acquisition symposium, Providing the Means of War. Held on 10–12 September 2001, the symposium was organized by CMH historians with the assistance of the ICAF faculty. During the second day of the conference, the connections between national security strategy and resource management became the subject of even more reflective discussion as the tragedies of 11 September unfolded. Since the watershed events of that day, the U.S. armed forces have been battling terrorism around the globe and are in the throes of an institutional transformation to meet twenty-first century challenges. The history of acquisition—and the acquisition community—can teach us much about institutional changes, the American response to global threats, and how resources can be best applied to address them.

The motto of the Industrial College of the Armed Forces is *Industria et Defensio Inseparabiles* ("Industry and Defense Are Inseparable"). True to this spirit, the contributions in this volume show that the acquisition process is a shared burden, with both private industry and the American government having important roles to play. We trust that these papers will

enhance our awareness of this process and of the inseparable partnerships that continue to provide our men and women in uniform with the most modern and capable means of war.

Washington, D.C.
15 March 2005

FRANCES C. WILSON
Major General, USMC
Commandant
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JOHN S. BROWN
Brigadier General, USA (Ret.)
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Preface

This book, *Providing the Means of War: Historical Perspectives on Defense Acquisition, 1945–2000*, is based on the papers presented at an Acquisition History Symposium that took place on 10–12 September 2001. While acquisition is always a critical and timely subject, this conference gained special meaning because of the dates on which it was held. On the second day of the conference, two planes slammed into the World Trade Center in New York, a third smashed into the Pentagon in Washington, and a fourth crashed into a field in Pennsylvania. For those who might be tempted to think of the symposium as an academic exercise, the events that took place on 11 September serve as a reminder that the outcomes of the defense acquisition process have sweeping strategic consequences. For good or ill, our country and the men and women in the armed forces depend on the products and services obtained through this process for the defense of the nation. While acquisition is frequently a contentious process, at once political, technical, and managerial, the chapters presented here illustrate both the remarkable achievements of the system and the ongoing struggle to transform to support the changing needs of the military. As a nation, we have experienced remarkable changes in technology, doctrine, and capabilities during the fifty-five years following World War II. The security environment of the first years of the twenty-first century calls for continuing, indeed, increased flexibility, speed, and the capacity to change.

The Department of Defense (DoD) is facilitating an understanding of the past through the Acquisition History Project. This symposium represented the first major product of that ongoing project. The defense community, we hope, will build on the experiences of others, for the benefit of those who depend on the capabilities developed by the DoD and its industrial partners. The Defense Acquisition History Project is one way for the acquisition community to learn about the past and illuminate our understanding of contemporary and future issues. The project is truly a joint effort, looking back at case histories from the Army, Navy, and Air Force, as well as from the Office of the Secretary of Defense (OSD).

Creating and nurturing joint endeavors often takes vision and persistence. This Acquisition History Project owes its existence to the late Dr. James H. Edgar. It was his vision, creativity, and persistence that pulled the services and OSD together to sponsor this important effort. The acquisition community lost a valued member and a dear friend with Jim's untimely passing not long after this symposium. A long-time acquisition professional and a Senior Executive in the Department of the Army, Dr. Edgar is represented in this volume by his article, "The Origins and Impact of the Defense Acquisition Workforce Improvement Act." It is fitting that Dr. Edgar's chapter deals with the acquisition workforce. Not only was he instrumental in the crafting of this legislation during his time on Capitol Hill, but he also cared deeply for the acquisition workforce and always strove to advance the capabilities of that workforce so that it might better serve the nation's needs. He was always interested in education and training for the workforce, and he personally loved learning. It was in the convergence of his love of learning and the needs of the workforce that this project began, and it is only fitting that this first volume be dedicated to Dr. Edgar. He touched many lives in many ways, and this project is only one of his many concrete works by which he will be remembered.

Shortly after 11 September, our nation engaged in military action in Afghanistan. Our men and women brought with them their skill and determination, plus the strategies and the military capabilities developed by the Department of Defense and the industrial base that supports it. The national security community demonstrated remarkable flexibility and ability. History teaches us that we have many names for our continuous efforts to maximize and make effective our DoD processes. Whether called revolution, reform, transformation, or any other name, what we do to maximize the effectiveness of defense acquisition really matters. In the memory of visionaries like Dr. Jim Edgar, and to those who depend on the fruits of our work, we look back at history, to learn better how to approach the future.

September 2003

LINDA S. BRANDT
Industrial College
of the Armed Forces

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Dr. Jeffrey Clarke of the U.S. Army Center of Military History (CMH) at Ft. Lesley J. McNair, Washington, D.C., gave me the opportunity to edit this volume and provided outstanding oversight and "top cover" during the *Providing the Means of War* symposium held from 10–12 September 2001. The papers included here were originally presented at that symposium, which served as a capstone event for the first year of the multiyear Defense Acquisition History Project. As the Chief Historian of the Army and the government official supervising the ongoing project, Dr. Clarke continues to support my work and the work of the other team members.

I owe special thanks to the authors who contributed to this collection. After being asked to participate in the 2001 symposium, many of them prepared their papers on very short notice. All were a pleasure to work with, and I hope they are satisfied with the final result of our collective labors. For their participation in the symposium and willingness to contribute to this book, I am especially indebted to Professor J. Ronald Fox of the Harvard Business School, Dr. Jacques Gansler of the University of Maryland (former Under Secretary of Defense, Acquisition, Technology, and Logistics), Paul Ignatius (former Secretary of the Navy), and Dr. Paul Kaminski (former Under Secretary of Defense, Acquisition and Technology).

The members of the Defense Acquisition History Project oversight board played an important role in supporting the symposium and securing the participation of certain key Department of Defense acquisition professionals who made the symposium a success. My thanks go to Brig. Gen. (ret.) David Armstrong, Chief Historian of the Joint History Office; Blaise Durante, Deputy Assistant Secretary for Acquisition Integration (Office of the Assistant Secretary of the Air Force for Acquisition); Dr. Alfred Goldberg and Dr. Stuart Rochester of the Office of the Secretary of Defense Historical Office; Janet Hassan of the Office of the Assistant Secretary of the Air Force for Acquisition; Capt. (ret.) Michael Jaggard, former Executive Director,

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To Dr. Elliott Converse, I express my gratitude for kind assistance and editorial support provided throughout the preparation of this book. He, and the other members of the Defense Acquisition History Project—Dr. Walton Moody, Dr. Walter Poole, Dr. Andrew Butrica, and Dr. Philip Shiman—are the best a scholar could hope for in friends and colleagues. An outstanding editor, Dr. Carolyn Höfig, assisted with the final preparation of this volume, and I owe her a great debt of gratitude for her efforts.

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Clark, and many other SAIC employees were instrumental in making the symposium a success in the face of unexpected tragedy—the events of 11 September 2001.

March 2005 SHANNON A. BROWN

Introduction

Shannon A. Brown

In 1948, the Research Institute of America issued a publication entitled *How Rearmament Affects Your Business*.[1] Referring to the dramatic role science and technology assumed in the recently terminated world war, the report noted that "the day of a Buck Rogers type of war hasn't arrived yet, but there has been a revolution in military science which will snowball the problems of industry."[2] This "revolution," heralded by such tools of warfare as the atomic bomb, long-range bombers, guided missiles, high-speed (jet) aircraft, and radar, had shaped the outcome of World War II, and in the years to come, it promised to change the nature of political relations between the United States and Soviet Union. The Research Institute publication pointed out that American industry would, as it had during World War II, bear much of the responsibility for ensuring that the military forces of the United States retained their technological edge over international competitors. Nonetheless, the postwar "problems of industry" were considerable; complicated federal contracting rules and restrictions, obstructionist policies governing the transfer of public money for basic scientific research, and confusing intellectual property laws, among other matters, combined to hamper the logical relationships that industry hoped to forge with the government in the years immediately following the Research Institute report.

As the Cold War grew more intense and the United States rearmed to meet the global threat of communism, these problems of industry were quietly addressed in what could be called a parallel revolution. In addition to the revolution in military science and technology that observers of the rearmament industry proclaimed in 1948, this parallel revolution changed the way that U.S. defense institutions did business. It linked contracting with national resource management in order to harness the scientific, technical, and industrial strength of the country. Through statutes and executive orders that facilitated this process, the government slowly

reshaped the methods traditionally used to build and buy weapons and other supplies for the armed services. These same laws encouraged and promoted new relationships between government, military, industry, and academic institutions, which, in turn, developed management techniques to facilitate the creation of technological wonders that had been mere fantasy only a generation earlier. With the direct support of the country's civilian leadership (expressed in legislative resolutions and acts), *acquiring* the best, fastest, and most efficient forms of technology became an explicit goal of the military. By the early 1960s, the word *acquisition* came to describe the complicated processes associated with conceptualizing, developing, manufacturing, and deploying ever more sophisticated weapons. The purpose of this volume is to explore aspects of this parallel revolution, a revolution that, over time, yielded the mature acquisition processes that we know today and fostered the civil-military partnerships that provide the means of modern war.

Prelude to Acquisition

Acquisition, as it is defined in the twenty-first century, comprises "the conceptualization, initiation, design, development, test, contracting, production, deployment, logistic support, modification, and disposal of weapons and other systems, supplies, or services (including construction) to satisfy Department of Defense (DoD) needs, intended for use in or in support of military missions."[3] This definition has evolved over time, along with the laws and procedures that guide acquisition activities. Since the early 1960s, the word has meant many things to different people; some have used the term without understanding the scope of its meaning, while others have employed it as a kind of catchall to describe complicated contracting and management. Acquisition—both the term and the practice it denotes—has also evolved as our understanding of technological innovation has changed and the processes of invention and improvement have become institutionalized.

The seeds of modern-day acquisition were sown in the 1920s, with the passage of the Air Corps Act of 1926. In addition to establishing formally the air arm of the U.S. Army as a separate corps (thereby giving it permanence within the institution), this law institutionalized one of the hallmarks of modern acquisition: negotiated contracting. There were limits to this power; under the law, the War and Navy secretaries were permitted to engage in price negotiations with parts suppliers and airframe manufacturers, although the language of the act favored the use of traditional sealed-bid proposals for this kind of procurement. For the

purchase of experimental aircraft, however, either service secretary could purchase "at his discretion . . . with or without competition, by contract, or otherwise, such designs, aircraft parts, or aeronautical accessories as may be necessary in his judgment for experimental purposes." The law continued that these purchases, once evaluated, could be procured in quantity after negotiation with the manufacturer.[4] Thus the act gave the new Air Corps a measure of autonomy within the Army to perform research and development work (another important aspect of contemporary acquisition) and to make arrangements to purchase equipment that was favorably evaluated.

The right of the military to engage in negotiated contracting was strengthened shortly after President Franklin D. Roosevelt declared a national emergency on 8 September 1939.[5] Congress responded in June 1940 by passing a national defense measure that broadened the procurement powers of the secretary of the Navy. Interestingly, this act also used the word "acquisition" in connection with procurement, perhaps for the first time in the official record of the subject. Under the terms of the Navy Reorganization Act, Congress authorized the secretary of the Navy to "negotiate contracts for the acquisition, construction, repair, or alteration of complete naval vessels of aircraft, or any portion thereof . . . with or without competitive bidding." Although, in this context, the word acquisition did not carry the meaning ascribed to it two decades later (no connection to research and development was made, nor were there any allusions to management relationships between the Navy and industry), the appearance here of the term is significant because it implied the use of negotiation to obtain materiel or "plans, spare parts, and equipment," rather than its traditional legal usage, namely the appropriation of private resources for government use.[6] Another congressional measure, the Army Appropriation Act of 1941, granted the secretary of War the authority to obligate certain funds without advertising. Although not as sweeping as the Navy's contract negotiation powers, this prewar enactment set a precedent for the military to make expedited procurement decisions.[7]

After the Japanese attacked Pearl Harbor, Congress and the president took additional steps to enhance the procurement abilities of the armed forces. The First War Powers Act of 1941, signed into law on 18 December, authorized the president to empower federal agencies to "enter into contracts without regard to existing provisions of law, wherever such action was deemed to facilitate the prosecution of the war."[8] This act was supplemented by Executive Order 9001, which implemented the act and authorized the service secretaries to begin immediately signing negotiated war-prosecution contracts. Another landmark contracting decision was made in early March

1942, when the War Production Board prohibited *all* contracting by formal advertising (except in rare cases).[9] For most of the war, military procurement was negotiated according to the terms of Title II of the War Powers Act, which was subsequently amended and expanded by the Second War Powers Act, signed into law in 1942.[10]

Because of these and other measures, military research, development, and procurement activities authorized by Congress and the president during World War II departed significantly from established practice and created important new legal precedents. The War Powers Acts empowered the Army and Navy to expedite source-selection decisions by disregarding cumbersome contracting laws, many of which had been in place for over a century. Another important feature of wartime legislation was the power given to the services to alter the terms of contracts already in place, ostensibly to reduce the excessive profits of contractors, but also to allow the service to redefine commercial arrangements without financial or legal penalties.[11] The armed forces also obtained the power to hold design competitions for aircraft, and, if "unable, through voluntary negotiation to contract with or purchase from the winner of the competition," the Army or Navy could "retain the designs in question."[12] These designs could then be put into full-scale development and production; according to the statute, the designer was entitled to seek financial redress from the government four years after production of the aircraft in question had begun.

Taken together, these wartime expedients provided the armed forces with a set of powerful tools that could be used to create new weapons by harnessing American industry. When the war ended and the War Powers Acts expired, representatives of the government and civilian industry lobbied for a continuation of the special relationships that had been forged during the conflict; these relationships had, after all, produced some of the most important weapons of the war. The defense establishment did not forget the resource management lessons it learned during the war, nor did it disregard the problems faced by a rapidly mobilizing American economy in the opening days of the conflict. In the years that followed the Japanese surrender, Congress and the president, at the behest of the armed forces and representatives of industry, drafted new laws to improve military procurement and encourage further cooperation between private industry and the government, with the understanding that such collaboration would strengthen the armed forces and yield even more impressive and powerful weapons.

Between 1947 and 1950, four new laws were passed to sustain collaboration between the military and industry, and many of the practices that evolved from these laws became the foundation of contemporary

defense acquisition. The first and most significant of these, the Armed Services Procurement Act (ASPA) of 1947, was a consolidation of the diverse service-specific rules and regulations that had governed military procurement since the Civil War. The ASPA also established the legal groundwork for postwar research and development contracting (a kind of purchase that existed in a gray area, from a legal point of view, because research activities did not always yield a "product"). Drafted with the assistance of the armed forces and input from civilian industry, the ASPA became the basic law for *all* military contracting until 1956, when the act was codified as Chapter 137 of Title X. The ASPA was implemented through the Armed Services Procurement Regulation (ASPR), first issued in May 1948. The ASPR encouraged standardized purchasing and the use of common items and supplies across the military services. In theory, most government contracting under the ASPR was to be of the advertised sealed-bid variety; however, the ASPR included seventeen exceptions to the sealed-bid rule. Thus, under specific circumstances, for example, when the president declared a national emergency, the armed forces could engage in negotiated contracting.[13] These exceptions became the subject of much congressional debate in the years to come, as it became clear that the services were favoring negotiated contracting over traditional source selection, in spite of the intent of the ASPA and ASPR.[14]

Three additional statutes augmented the powers of the military in military industrial relations. The Selective Service Act of 1948 authorized the president—or any agency head acting on his behalf—to issue mandatory production orders to American factories.[15] This act, as well as the recently issued ASPR, led the Research Institute to publish analyses and guidance on postwar industrial economics. (The Research Institute saw the codification of the ASPA/ASPR as a potential boon to industry, especially given the services' "wider latitude in making deals through negotiation," while the Selective Service Act seemed more like an ever-present thumb, poised to leverage the scales of U.S. manufacturing.[16]) Two other acts were written to strengthen the hand of the government in planning for "M–Day," the emergency mobilization of the country. The first, the Renegotiation Act of 1948, extended the wartime power of the military in redefining the terms of contracts. The other, the Defense Production Act of 1950, gave new resource allocation and factory oversight powers to the government.[17]

Although M–Day never arrived, these laws facilitated linkages between civilian industry, the country's academic research institutions, and the armed forces. Sustained by perceived Cold War threats, and encouraged by burgeoning defense spending, these linkages, in turn, formed the basis of modern defense acquisition—the management of industrial capabilities,

human capital, financial resources, and science and technology to provide the means of modern war.

Providing the Means of War

The term acquisition began to come into more common usage in the early 1960s, when the Office of the Secretary of Defense (OSD) and the military services began applying new management and analysis techniques to create the *weapon systems* of the future. This emphasis on *systems*—rather than hardware or technology—bespeaks the significance and innovative nature of the new approaches that were being used to design military equipment. No longer were aircraft designed around an airframe, an engine, or a handful of operating parameters, for example, service ceiling, range, or payload. Instead, engineers and designers were making an effort to address mission requirements and performance expectations (applications) by matching the airframe, engines, weapons, and avionics to produce a true "system." This design approach—first implemented in a complete weapon system by the Air Force and the aircraft manufacturer Convair in the early 1950s—focused on the seamless and efficient integration of both new and existing technologies so that the finished product was greater than the sum of its component parts. This kind of technology development was accomplished through the use of systems engineering, systems analysis, and system dynamics, three manifestations of the "systems approach."[18]

The systems approach began to mature during the years that followed World War II, a period that saw two monumental military engineering successes: the Atlas Intercontinental Ballistic Missile (ICBM) and the Fleet Ballistic Missile Submarine (Polaris). Headed by General Bernard A. Schriever and Admiral William F. Raborn, who supervised legions of military engineers and civilian consultants, these programs broke new ground for the defense establishment, providing vivid examples of the usefulness of compartmentalized management and structured program planning that emphasized the quick deployment of new hardware. The urgency of the early Cold War drove many of these programs, and the process of developing components for these military systems often required OSD and the services to depart from established procurement and contracting practices. New laws and regulations were written to support these deviations and facilitate defense-related scientific and technological innovations.

Historian Thomas Parke Hughes, a leading authority on the history of large technical systems and networks, has made several observations about the systems approach that explain how acquisition became part of the

DoD vocabulary and why acquisition differs from earlier procurement and contracting practices. Hughes notes that the improved analytical capabilities that were offered by computers did much to promote the use of the systems approach. Moreover, computerization lent a "mystique" to those planners and officials who applied the systems approach to problem solving. The systems approach was propagated by experts who claimed to have special knowledge and authority derived from their abilities to combine high technology with analytical methods that could be employed to manage large projects. Hughes (among others) writes that the technological, social, and cultural implications of the systems approach make it as important an influence on human activities in the twentieth century as the industrial labor management regime associated with Frederick W. Taylor.[19]

For our purposes, all of these points relate directly to the nascence of acquisition. Like the systems approach, defense acquisition evolved from traditional military procurement as experts, wielding an authority derived from new management techniques, worked to shape the military technologies of the future. The power of these experts was augmented by new laws and regulations designed to support and promote scientific and technical advances in the name of postwar national defense. *Acquisition*—rather than procurement—was the term that an emerging generation of defense professionals gradually adopted to refer to the process of building and buying weapons with the aid of management and analysis techniques in the evolving legal and regulatory framework that permitted close relationships between the military and private industry. This framework was part of the ongoing contracting revolution that underpinned the larger "revolution in military science" hailed by the Research Institute in 1948.

From the beginning, Congress, the services, and the secretary of Defense all claimed a role in these dual revolutions. Who should decide which weapons to develop? Weapons development programs such as Polaris could grow enormous in scope, so how could the myriad activities that would lead to the development, production, and fielding of a new weapon best be integrated? What laws and executive orders would facilitate the best use of the technical and industrial power of the United States? Who should make the resource-allocation decisions necessary to support the creation of technologically advanced weapons? These questions have shaped the evolution of defense acquisition, and variations of the same questions are being asked today.

Defense acquisition exerts an influence on the lives of hundreds of thousands of Americans, from the defense plant employee to the foreign policy analyst to the soldier deployed to Southwest Asia. The pages that follow examine the history of this multifaceted enterprise. Only if we first

apprehend its past can we hope to understand the present and future of defense acquisition.

Organization of This Volume

Providing the Means of War is an anthology of essays on the history of defense acquisition. Very little formal scholarship has addressed defense acquisition history, even though acquisition has been subjected to some of the most intense scrutiny of any government function. Existing historical works that address defense economics or the so-called military industrial complex largely acknowledge the importance of acquisition activities (such as contracting), and often attend to aspects of the evolving acquisition process. Still, there is a dearth of detailed work on the capabilities and tasks of personnel responsible for conducting and overseeing the defense acquisition process, including government institutions, commercial entities, and the laws and conventions that govern their relationships. As the first "product" of the Defense Acquisition History Project, this volume is intended to increase the existing base of historical knowledge about defense acquisition matters and stimulate interest in this rich history by providing readers with a selection of historical interpretations of how our government has built and bought weapons since the middle of the twentieth century. Like the symposium that preceded it, this volume takes a very wide view of the subject and includes works that address a range of acquisition-related issues.

This collection of articles is organized chronologically. The five periods identified in the Table of Contents correspond to the five volumes that eventually will comprise the Defense Acquisition History series, which will be published by the U.S. Army Center of Military History. The first spans the waning years of World War II through 1958, a year marked by the passage of the Defense Reorganization Act. The second period covers 1959–1968. The third begins with the inauguration of Richard M. Nixon in January 1969 and ends with the election of Ronald Reagan in November 1980. The fourth looks at defense acquisition from 1980 through the end of the Cold War in 1989–1990, and the fifth period, the post-Cold War years, includes acquisition to the present day. Each of the chronological sections in this anthology begins with a survey article that identifies important events, trends, and personalities in defense acquisition at the time.

The more topical contributions that follow look at such matters as the interaction between professional military and civilian scientific communities, as in Gary Weir's article, "SOSUS, the Navy, and Bell Labs," while others explore the interplay of technical problems and antagonistic

service cultures that led to the eventual failure of some of the earliest unmanned aerial vehicle systems, as Tom Ehrhard writes in "Seeds of a Revolution: Maritime UAVs in the 1960s." Cultural influences are also the focus of W. Blair Haworth's "Moving Target: The U.S. Army Infantry Fighting Vehicle Program in the 1970s," while Timothy L. Francis discusses the political and economic influences on the FFG–7 *Oliver Hazard Perry*-class frigate program. Other essays featured in this volume address matters of acquisition reform, including Donald Baucom's "The Strategic Defense Initiative and Acquisition Reform: The Case of Brilliant Pebbles," and James H. Edgar's discussion of the Defense Acquisition Workforce Improvement Act. More recent management issues, such as research and development difficulties and program cycle-time reduction efforts, are discussed in articles by Mark Montroll and Ross McNutt, both of whom write about the challenges of post-Cold War acquisition.

This anthology collects conference proceedings, and, to provide the reader with a relatively complete picture of the *Providing the Means of War* symposium, also includes contributions by key participants who did not present formal papers during the three-day event. The insightful opening remarks of Professor J. Ronald Fox of the Harvard Business School set the tone for the conference; as such, his comments appear here in order to frame the history papers that follow. Professor Fox is a recognized authority on defense acquisition issues, versed in the complex history of acquisition and sensitive to the need for a detailed institutional history of the subject. Indeed, he opens by noting that many of the "painful periods" faced by the acquisition community "have occurred . . . because of the absence of a comprehensive history of defense acquisition, or even a record of lessons learned."[20] Similarly, Professor B. F. Cooling of the Industrial College of the Armed Forces, the author of the closing remarks, draws on his own experiences as a professional government historian to evaluate the importance of acquisition history for the current generation of defense professionals.

A highlight of the *Providing the Means of War* symposium was the acquisition round table discussion. An edited transcript of that session follows the five chronological sections, and it stands out for two reasons. First of all, the transcript captures the perspectives of three key defense executives who served in diverse positions during different presidential administrations; as such, each faced different problems, and they drew different lessons from their experiences. Additionally, the round table transcript is a historical document that captures reactions to a watershed event in American history, namely the terror attack of 11 September 2001, which happened to be the second day of the symposium.

As Professor Cooling notes in his closing remarks, there is a great deal more to the story of how we build and buy weapons than budgets, memos, and regulations. There are human dramas to be found in every acquisition program; the familiar literary conventions of failure, comedy, tragedy, and triumph are certainly applicable to the acquisition endeavor. It is the hope of the Defense Acquisition History Project staff that this volume will inspire additional research on both the weapons acquisition process and the people who conduct and oversee it.

NOTES

[1] The Research Institute of America (RIA) was founded in 1936 by Carl Hovgard and Leo Cherne. The company, originally established to provide advice to businessmen on compliance with Social Security policy, was one of the first firms in the United States to sell economic and tax analysis reports to private industry. Over time, the scope of RIA's body of publications expanded to include legal and industrial affairs advisories and political analyses, including discussions of the defense industry and reports on the spreading influence of communism.

[2] Research Institute of America, Inc., *How Rearmament Affects Your Business*, Analysis 60a (New York: Research Institute of America, Inc., 1948), 1.

[3] Defense Acquisition University, *DAU Glossary: Defense Acquisition Acronyms and Terms, 11th Edition* (Fort Belvoir, Va.: DAU Press, 2003), B–1; http://www.dau.mil/pubs/glossary/11thglossary2003.pdf.

[4] *Air Corps Act of 1926*, PL 69–446, *U.S. Statutes at Large* 44 (1927): 784, §10 (1c); also refer to Edwin P. Bledsoe and Harry I. Ravitz, "The Evolution of Research and Development as a Procurement Function of the Federal Government," in Albert C. Lazure and Andew P. Murphy, eds., *Research and Development Procurement Law* (Washington, D.C.: The Federal Bar Association, 1957), 204.

[5] President Franklin D. Roosevelt, "Proclaiming a National Emergency in Connection with the Observance, Safeguarding, and Enforcement of Neutrality and the Strengthening of the National Defense Within the Limits of Peacetime Authorizations, Proclamation 2352," *Federal Register* (September 1939).

[6] *Navy Reorganization Act of 1940*, PL 76–671, *U.S. Statutes at Large* 54 (1941): 440, §2.

[7] See *Army Appropriation Act of 1941*, PL 77–139, *U.S. Statutes at Large* 55 (1942): 366.

[8] *First War Powers Act of 1941*, PL 77–354, *U.S. Statutes at Large* 55 (1942): 838, §201; also refer to U.S. Department of Justice, *The Acquisition of Property for War Purposes* (Washington, D.C.: GPO, 1943), 39.

[9] U.S. Senate, *Hearings Before the Procurement Subcommittee of the Committee on Armed Services*, 86th Cong., 2d sess., 8–9 February 1960, 52.

[10] *Second War Powers Act*, PL 77-507, *U.S. Statutes at Large* 56 (1943): 176; *see also* U.S. Department of Justice, *The Acquisition of Property for War Purposes* (Washington, D.C.: GPO, 1943), 39.

[11] U.S. Department of Justice, *The Acquisition of Property for War Purposes* (Washington, D.C.: GPO, 1943), 39.

[12] U.S. Department of Justice, *The Acquisition of Property for War Purposes* (Washington, D.C.: GPO, 1943), 57.

[13] Military agencies were authorized to use negotiated contracting "1) where it's decided that the step is necessary in the public interest during a national emergency declared by the president or Congress; 2) when, in an emergency, there's no time for advertising; 3) where the total amount involved isn't more than $1,000; 4) where the goods and services are to be produced and used outside the limits of the U.S. and its possessions; 5) where medicine and medical supplies are involved; 6) where the materials are purchased for authorized resale; 7) where the goods are perishable subsistence items; 8) where the nature of the goods makes competition impractical; 9) where the purchase is for experimental, developmental or research work; 10) where the nature of the goods must remain secret for security reasons; 11) where considerations of standardization or interchangeability of parts of technical equipment make competitive bidding impossible; 12) where the goods are of a special or technical type requiring a big initial investment or a long period of manufacture, and competitive bidding would only result in duplication or undue delay; 13) where the agency heads decide that the prices offered in competitive bidding are unreasonable because they weren't independently arrived at in open competition; and 14) where it's necessary in the interest of national defense to keep a plant, mine or facility running, and the only way to do it is through a negotiated contract." These broad exceptions were exercised regularly by all of the armed services. See Research Institute of America, Inc., *How Rearmament Affects Your Business*, 11.

[14] See U.S. House of Representatives, *Report to Honorable Carl Vinson, Chairman, House Committee on Armed Services from Chairman, Subcommittee for Special Investigations on Use of Section 2(c) (1) Through (17), Armed Services Procurement Act, 1947*, 84th Cong., 1st sess., 14 December 1955. This report notes that, between 30 January 1953 and 30 June 1955, 94.19 percent of all reported military contracts were negotiated; only 5.81 percent were the result of sealed bidding.

[15] James F. Nagle, *A History of Government Contracting* (Washington, D.C.: The George Washington University, 1992), 467.

[16] Research Institute of America, Inc., *How Rearmament Affects Your Business*, 2–9, 11.

[17] Nagle, *A History of Government Contracting*, 467.

[18] Thomas Parke Hughes defines systems engineering as the "management of the design and development of technological systems;" systems analysis is described as "the comparison of systems" to evaluate "alternative solutions to problems, such as the use of long-range bombers

versus intercontinental ballistic missiles;" and system dynamics is the use of modeling for use in policy making, used for "predicting and comparing the downstream consequences of outcomes of alternative policies." See Agatha C. Hughes and Thomas P. Hughes, eds., *Systems, Experts, and Computers: The Systems Approach in Management and Engineering, World War II and After* (Cambridge, Mass.: MIT Press, 2000), 1.

[19] Ibid., 6–11, 24.

[20] Some of these "painful periods" are addressed in J. Ronald Fox with James L. Field, *The Defense Management Challenge: Weapons Acquisitio*n (Boston: Harvard Business School Press, 1988).

Defense Acquisition History Symposium Keynote Address 10 September 2001

J. Ronald Fox

Good morning. I am pleased to be with you at the beginning of this symposium. When Dr. Elliott Converse invited me to speak at this session, I asked him what he would like me to cover. He suggested that I share with you some of my experiences and thoughts on acquisition lessons learned.

It's clear to me that this history project fills a long-standing need. Defense acquisition has evolved over several decades, slowly improving, but not without moving through painful periods of re-creating and re-experiencing acquisition management problems of the past. I believe that the painful periods have occurred to a significant degree because of the absence of a comprehensive history of defense acquisition or even a record of lessons learned.

I want first to acknowledge that there is much that is right with defense acquisition. As most of you know, the Defense Department develops and produces the most sought-after weapons and equipment in the world. These products are often designed to achieve performance levels never before realized, with many components and some materials never before used in military or commercial applications.

Beyond those significant acquisition accomplishments, the Defense Department has also had notable successes in systems engineering, logistics, contracting, and many other areas. But the complexity and first-of-a-kind nature of major acquisition programs places them among the most difficult industrial management jobs in the world. Problems are inherent in the nature of this work.

Everyone who has worked in defense acquisition knows that managers do not spend a lot of time congratulating themselves on their successes. That is not their job. They spend their time identifying problems, trying to

solve problems, and searching for ways to prevent problems from occurring in the future.

Every secretary of Defense during the past fifty years has made a commitment to improve the management of defense acquisition. Indeed, each secretary has taken specific steps to identify problems and to initiate improvements.

These management improvements have been undertaken by a number of very capable people in OSD (the Office of the Secretary of Defense) and in the military services. But all too often, their efforts have experienced serious shortfalls in implementation. By creating a shared understanding of these experiences, the Defense Acquisition History Project can enable the future efforts of others to benefit from the strengths and weaknesses of the past. The rich history of defense acquisition must be captured so that it can be put to constructive use.

In explaining the reasons for the shortfalls that occur in implementation and why the Defense Department has had to re-experience problems of the past, I would like to review with you this morning four enduring but often counterproductive practices that I have observed during the past several decades—practices that have played important roles in shaping the course of defense acquisition but that need not play the same roles in the future.

Authority and Responsibilities of Government Program Managers

The first practice pertains to the mismatch between government program management responsibilities and authority. As most of you know, the program manager is the key person responsible for an acquisition program. But the limited authority given to program managers usually falls far short of their responsibilities.

You will often hear that a government program manager is responsible for the schedule, cost, and technical performance of an acquisition program. As you know, however, the vast majority of the work required to develop and produce acquisition programs is actually performed in contractor plants. But it is the *government contracting officer*, not the program manager, who has the authority and the responsibility to provide directions to contractors. And the contracting officer does not normally report to the program manager or even to the program manager's immediate boss. In a number of programs that has *not* been a problem. But in other programs where contractors have had difficulties meeting contract requirements, for example, the Navy A–12 aircraft program, it can be a serious problem.

There are many government personnel who at times provide advice, suggestions and even direction to contractors, whether they are authorized to do so or not. They can be from the requirements office, or from any of several functional support organizations in the Army, Navy, or Air Force systems commands, for example, engineering or test personnel. Or they can be from the military service headquarters or from OSD.

None of these personnel are authorized to change the scope of a contractor's work, but they may consciously or unconsciously provide direction to the contractor through their frequent discussions with contractor personnel. Unfortunately, this advice, suggestions and direction from other than the program manager and the contracting officer has often been unplanned and contrary to what the program manager really wants the contractor to do. And it has caused unanticipated increases in the work to be performed, producing delays in schedules, and increases in costs.

Further confusing a program manager's authority is the fact that the government plant representative, who resides in the contractor's plant, approves or disapproves a contractor's progress payments and determines the allowability of contractor costs. But the government plant representative and the government auditor do not report to the program manager or to the program manager's immediate boss. Indeed, they report through entirely different chains of command than does the program manager.

Yet another constraint on a program manager's authority comes from the Congress, the DoD comptroller, and the military service comptroller who authorize and limit the funds to be spent on a program in at least three separate categories: research and development, procurement, and operations and maintenance. Throughout the life of an acquisition program, organizations above the level of the program manager often reduce the funds allowed to be spent in one or more of these three categories, resulting in changes in schedules and quantities, and increasing unit costs. The funding process should not be, as it is today, one that encourages program managers to hide contingency funds as a means of coping with that turbulence.

In sum, the authority given to program managers needs to be more consistent with the challenges, problems, and responsibilities that program managers are expected to handle effectively.

Training the Defense Acquisition Workforce

The second practice that has shaped acquisition pertains to the training of the acquisition workforce—a key part of defense acquisition history. During the thirty-year period from 1970 through 2000, major increases have occurred in the complexity of defense acquisition programs, including a

massive growth in the use of software. Nonetheless, throughout this period it has been difficult to convince senior military and civilian officials in the Army, Navy, Air Force, and OSD that the skills needed to manage large, first-of-a-kind acquisition programs are as difficult or more difficult to acquire and implement as learning how to fly fighter aircraft or operate surface ships, submarines, or tanks.

To reach high levels of proficiency in complex military operations requires many months, often years, of formal training along with years of back-to-back dedicated assignments in positions of increasing responsibility. The same is true in the field of acquisition. Acquiring the knowledge and skills needed to manage complex development and production programs requires an in-depth training program comparable to that currently employed in developing skills to perform complex military operations.

Yet for more than thirty years, a myth has persisted in the Defense Department that government managers of large acquisition programs can acquire the needed knowledge and skills to perform effectively as program managers with no more than fourteen to twenty weeks of in-residence training. That assumption seriously underestimates the complexity of the technical and financial analyses required, and the importance of the frequent informal negotiations that are conducted every week within government and between government and industry. These analyses and negotiations are an important part of the job performed by program managers and deputy program managers.

Thirty years ago, in 1970, the original Department of Defense course to train government program managers was proposed by the Army to be one year in duration, somewhat shorter than the time required for initial flight training or legal training. But a training program of that duration was rejected by OSD as too long because it exceeded the TDY limits and would require a permanent change of station, as is the case with flight training. So, the first DoD program management course was limited to twenty weeks, the maximum period allowed for TDY.

In 1995, during a period of DoD reductions-in-force, the twenty-week course was reduced to fourteen weeks in-residence in order to further limit the time required for students to be away from their jobs. The course was never returned to the former twenty-week duration. Indeed, as I speak, there is further pressure from advocates of distance learning to reduce the time for in-residence training to possibly eight weeks. In my view, distance learning is unquestionably a reasonable and effective method of transferring information to students. But it is no substitute for the face-to-face interactions involved in developing and practicing the difficult analyses and decision-making skills required in day-to-day program management.

I am pleased to report that as of this year, a small group of outstanding faculty headed by Steve Israel, John Horn, and Ed Hirsch at the Defense Systems Management College (DSMC), under the capable leadership of Defense Acquisition University and DSMC, is currently developing a case-based program manager's course, albeit no longer than ten weeks. The course deals explicitly with the commonplace challenges and problems that occur in major acquisition programs. If this effort is successful, it could begin to fill a long-standing need in DoD acquisition training.

Introduction of New Acquisition Management Techniques

The third persistent practice that has shaped the course of defense acquisition pertains to the ways in which new management techniques are usually introduced. Periodically, new techniques are adopted by OSD or by the military services to improve acquisition management. Despite the competent and dedicated work of those who introduce these new techniques, the intended results often turn out to be far more difficult to achieve than originally anticipated. This is because the incentives that support the status quo must be changed or removed in order to successfully implement these new techniques, and institutional inertia is difficult to overcome. This problem has occurred, for example, with the initiatives called "Cost as an Independent Variable," "Best Value Contracting," and "Reducing Government Oversight."

A review of past practices will show that when new management techniques are introduced, it is important to ensure that individuals are rewarded for implementing and using the desired management techniques. And the incentives should resolve the long-standing conflicting roles of manager and marketer, counteracting incentives to underestimate and oversell.

Acquisition Lessons Learned

The fourth and last practice I will describe pertains to the absence of an inventory of lessons learned in acquisition management gathered from the past four decades. By contrast, most successful defense contractors have long followed the practice of collecting, retaining, and reviewing their lessons learned in the management of acquisition programs. When companies fail to do so, they soon encounter major financial and marketing problems.

A good example of the Defense Department's short memory for lessons learned can be seen in the massive cost growth and technical performance

shortfalls on large acquisition programs in the 1960s and early 1970s that employed fixed-price-type contracts for development with production options. They were called Total Package Procurements. When costly problems emerged from these programs in all military services, Deputy Secretary of Defense David Packard issued a directive prohibiting the use of fixed-price-type contracts on large engineering development programs.

About twelve years later, however, in the early 1980s, Packard's directive was superceded when the secretary of the Navy once again adopted fixed-price-type development contracts as the standard method of contracting for large engineering development programs for aircraft, missiles, and equipment.

The employment of this practice in the 1980s again resulted in large financial losses for the Defense Department and for its contractors. More significantly, the use of fixed-price contracting resulted in serious delays in obtaining weapons and equipment that the military services needed. After the problems associated with fixed-price contracts were rediscovered, the use of the concept in contracting for large engineering development programs again fell out of favor.

As I conclude my remarks, I want to return for a moment to the Defense Acquisition History Project. The history of defense acquisition is an important and interesting story, and it contains valuable lessons that need to be identified and recorded. The story pertains to the development and production of truly outstanding products, but many of these products have cost far more than was anticipated and have taken significantly longer to acquire than planned. In the process, we have placed some excellent military and civilian people in unnecessarily difficult positions.

It is to the great credit of the Defense Department that it has the wisdom to assemble an impressive group of historians to record its acquisition history and, hopefully, its lessons learned as well. Acquisition managers, warfighters, taxpayers, and the nation will stand to benefit.

I wish you great success.

PART I

Into the Cold War

Into the Cold War: An Overview of Acquisition in the Department of Defense, 1945–1958

Elliott V. Converse III

For those who take note of such things, the content of presidential inaugural and state of the union addresses in the twentieth century's last decade is revealing. For the most part, they have had little to do with foreign or defense policies—for example, one page of eleven in Bill Clinton's 1996 State of the Union; a few lines in George W. Bush's 2001 Inaugural.[1] Dwight Eisenhower's 1958 State of the Union address stands in sharp contrast. Almost all of its fourteen pages covered the Cold War struggle with the Soviet Union. In his remarks the president, who that spring would ask Congress for authority to reorganize the Department of Defense (DoD), paid special attention to the process for acquiring advanced weapons. The Defense Department, said the president, must "plan for a better integration of its defensive resources, particularly with respect to the newer weapons now building and under development. These obviously require full coordination in their development, production and use."[2]

By 1958, following the shock of the Soviet Sputniks the preceding fall and the well-publicized and long-running rivalry between the services over guided missiles, the United States' methods of developing and producing new weapons appeared to be seriously deficient. Until this time, most critics of the Defense Department's materiel activities concentrated on eliminating wasteful duplication and integrating the services' separate supply systems. Neither of the two Hoover commissions (1949 and 1955), for instance, had much to say about the acquisition of major weapon systems.[3] The purpose of this paper is to describe the principal features of defense acquisition from the end of World War II to the Defense Reorganization Act of 1958. The emphasis will be on the acquisition of the major weapon systems that accounted for most defense research and development (R&D) and procurement dollars in those years. An understanding of the essential

characteristics of acquisition in DoD as it had evolved by the end of the 1950s should throw light on subsequent efforts to better control and guide that process.

But before beginning, I should say a little about the words that have been used over the years to describe the activities involved in providing the U.S. armed forces with the means of war. Since the 1980s, those activities have been referred to as "acquisition." The word, as defined in the Defense Acquisition University's *Glossary of Defense Acquisition Acronyms and Terms*, means "The conceptualization, initiation, design, development, test, contracting, production, deployment, logistic support, modification, and disposal of weapons and other systems, supplies, or services to satisfy DoD needs, intended for use in or in support of military missions."[4] This is a very broad definition and purposefully so. It recognizes acquisition as a process, essentially corresponding to a system's life cycle, with logistic support as an integral part of that process—indeed over a system's entire life, the most expensive part. In the 1950s, however, no one used the word "acquisition" to describe any, let alone all, of these activities. In the context of materiel support, the word began to appear only in the 1960s, perhaps first but certainly most prominently in Harvard's Weapons Acquisition Project which began in 1960 and resulted in several studies, including Merton Peck and Frederic Scherer's 1962 classic, *The Weapons Acquisition Process: An Economic Analysis*.[5] In 1969, "acquisition" achieved institutional legitimacy as part of the title of the Defense Department's DSARC—Defense Systems Acquisition Review Council.[6] Even so, quite a few more years passed before its use became universal. Prior to the 1960s, the umbrella term that sometimes denoted the totality of materiel support activities was "logistics."[7] But that word, even in its broadest sense, lacked the idea of integrated process normally associated with the word "acquisition" as it is used today. Indeed, the concept of a weapon as a "system" to be managed from beginning to end had only just emerged and was beginning to evolve in the 1950s. Most often during these early years, two terms embraced the sequence by which new weapons were added to the inventory: "research and development" and "procurement" (meaning purchase and production).

From 1945 to 1958 (and arguably to the present), nothing influenced acquisition policy, organization, or process more than the pursuit of advanced technology. World War II had produced remarkable weapons—radar, proximity fuses, very long-range and jet aircraft, guided missiles, and the atomic bomb. American civilian and military leaders believed that the next war would begin with a sudden attack carried out with the most advanced and destructive of weapons of this kind. There would be little time to prepare and the oceans would no longer be effective barriers. The nation

would have to fight with the weapons it had on hand. Advanced technology, it appeared, would be the arbiter of future warfare, and maintaining superiority in this area would be essential to assure national security.[8]

By the 1950s, the quest for superior technology was central to an American security strategy grounded in nuclear weapons. Early in 1955, President Eisenhower told Charles E. Wilson, his first defense secretary, that "we should base our security upon military formations which make maximum use of science and technology in order to minimize numbers of men."[9] In this respect, all of the services were on board. Even the Army, less technologically oriented than the Air Force or the Navy, sought sophisticated new weapons, particularly guided missiles.[10] Maj. Gen. John P. Medaris, who headed the Army's missile program in the 1950s, told officers from the Ordnance Corps: "If you put all your energy and effort into justifying . . . conventional weapons and ammunition . . . I think you are going to get very little money of any kind. It is far easier to justify a budget with the items that are popular."[11]

Achieving and maintaining technological superiority required substantial increases in money for research and development. Following World War II, government spending on defense-related R&D greatly exceeded prewar amounts—in Fiscal Year (FY) 1947 thirty-eight times as much as in 1937; in FY 1948, twenty times what it had been in FY 1940.[12] And funds for this purpose continued to rise in the postwar period—from nearly $750 million in FY 1949 to more than $5 billion in FY 1959. Moreover, R&D's share of the defense budget climbed from about 2 percent in FY 1949 to about 6 percent in FY 1959.[13] These aggregate figures, however, mask some important points. Although spending on R&D was much greater between World War II and the Korean War than it had been before 1940, overall defense spending declined steeply between 1945 and 1950, and many R&D projects had to be cut. For example, a reduction in such funding for FY 1947 caused the Air Force to reduce its guided missile development budget from $29 million to $13 million dollars, terminating ten of its twenty-eight missile projects.[14] In the Army between World War II and Korea, new weapons, except for missiles, were "out of the question."[15] R&D spending, as a percentage of total defense outlays, generally leveled off between 2 percent and 3 percent in the 1950s, doubling to almost 6 percent only after Sputnik.[16] Nonetheless, such qualifications notwithstanding, research and development had assumed a measurably enhanced status in the American defense effort.

Increased spending was but one of countless impacts the drive for technological superiority had upon the nature of acquisition in DoD. The characteristics of the weapons themselves also had major effects. Guided

missiles, for example, were neither clearly airplanes nor artillery; they transcended the traditional land, sea, and air boundaries of the services and intensified the rivalry among them. Each service could find application for missiles in missions it had been assigned by previous agreements or in missions that it coveted. The development of an intermediate range ballistic missile (IRBM), notably the Thor-Jupiter contest between the Air Force and the Army in the 1950s, is perhaps the best illustration.[17]

The blurring of responsibilities resulting from the inherent technological characteristics of a weapon was not only an interservice but also an intraservice phenomenon. In the Navy, competition between the Bureau of Ordnance and the Bureau of Aeronautics in missile development programs had begun in World War II. In 1947, Rear Adm. Daniel V. Gallery, head of the division on the staff of the chief of naval operations (CNO) charged with coordinating the Navy's missile effort, put it bluntly: "BuOrd and BuAer are very jealous of each other's efforts. BuAer feels that BuOrd is muscling in on their field. . . ."[18] Similarly, in the Army in 1950, the Ordnance Corps and the Transportation Corps each had a program to develop a replacement for the service's World War II amphibious vehicle, the DUKW. Although producing the successor only involved development engineering and not new research, disputes between the two technical services caused the effort to drag out over a decade. Finally in 1960, the Army accepted the LARC, a smaller amphibian that had been developed under contract to the Transportation Corps.[19]

Another characteristic of post-World War II weapons dramatically affecting acquisition was their enormous complexity. The Air Force's B–29 and B–50 bombers each had about 10,000 electronic components; the B–47, about 20,000; the B–52, approximately 50,000; and the B–58, nearly 100,000. As James Nagle, author of a history of government contracting, has noted, no one firm could produce this many components and they were forced to subcontract, previously a practice resorted to only reluctantly. Lockheed, for instance, subcontracted 18 percent of its business during World War II and 40 percent in 1951. One consequence of extensive subcontracting was to spread business around geographically to a large number of companies, thus increasing the overall political power of the defense industry.[20]

Weapon acquisition was also shaped by the belief that the United States was in a race for national survival. The Soviet explosion of an atomic bomb in 1949 and a hydrogen weapon in 1953, its development of long-range bombers and ICBMs, and, finally, the spectacular launch of the first Sputnik in October 1957 gave acquisition a sense of urgency not unlike that prevailing in World War II. Thus, the perceived need to stay ahead of

the Soviets caused Air Force planners routinely to project technologically ambitious performance requirements for bombers. These requirements were sometimes "far beyond the state of the art" and depended on as yet unforeseen technological advances. Until those advances were achieved, sometimes by accident, programs were delayed.[21] To speed up system development by stimulating competition between contractors and to hedge against failure, some systems were developed in parallel. The similar Atlas and Titan ICBM systems followed this path. Convair won the contract to design, develop, and test the Atlas, and the Martin Company got the contract for the Titan.[22] Another method adopted to develop, produce, and deploy a system as rapidly as possible came to be called "concurrency." In this acquisition strategy, aspects of production and support overlapped phases of research and development, such as testing.

For President Eisenhower, the solution to the difficulties of integrating advanced weapons into the nation's defense was straightforward. "Good organization," he said in his 1958 State of the Union Address, "can help assure this coordination."[23] Following World War II, the services and, after 1947, the secretary of Defense sought both to adapt old and to fashion new organizational structures to the process of acquiring major weapon systems. But as Eisenhower also knew, coming up with efficient organization was a "never-ending problem."[24] In the first Cold War decade, it proved to be especially stressful.

Soon after the national military establishment was created in 1947, it became apparent that if there were to be anything more than technical unification in the nation's defense structure, the power and authority of the secretary of Defense in relation to the individual services would have to be strengthened. Many of the reforms initiated in 1949, 1953, and 1958 were directed toward this end. Overall there was a gradual trend toward centralization and more control vested in the Office of the Secretary Defense (OSD), including greater authority over weapon acquisition. In this area, the changes meant more power for OSD to decide what weapons to acquire; to determine what resources to apply against weapon programs; to coordinate research, development, and production; and to set procurement policies in the Armed Services Procurement Regulation. Still, centralization proceeded slowly and the enhanced authority provided by the Defense Reorganization of Act of 1958 was not tapped until the early 1960s by Secretary of Defense Robert S. McNamara, leaving the services (sometimes abetted by the Congress) with considerable autonomy in acquisition at the end of this period.[25]

A short review of organizational changes affecting acquisition that occurred between 1947 and 1958 will show nevertheless that OSD's

authority in this area grew steadily if slowly. The National Security Act of 1947 charged the secretary of defense to "(t)ake appropriate steps to eliminate unnecessary duplication or overlapping in the fields of procurement, supply, transportation, storage, health, and research."[26] The act also created a joint-service Research and Development Board and a joint-service Munitions Board, under the secretary's direction, to coordinate acquisition in the national military establishment. The Research and Development Board, for example, was to "prepare a complete and integrated program of research and development. . . ."[27] Despite some strengthening of the powers of their chairmen in 1949 and 1952 (and some accomplishments), the two boards proved largely ineffective for numerous reasons, including the failings inherent in a committee structure.[28] Their principal weakness, however, was the inability of the service representatives on each board, whether military or civilian, to take a DoD-wide perspective when an issue conflicted with the interests of their particular service. They were, as the historian Doris Condit has described the members of the Munitions Board, "both claimants and judges for their own service requests. . . ."[29]

In 1953 President Eisenhower carried out a reorganization of the Defense Department that abolished the Research and Development Board and the Munitions Board and assigned their functions to four assistant secretaries reporting directly to the secretary. The responsibilities of the Research and Development Board were divided between an assistant secretary for research and development and one for applications engineering (in 1957 the two positions were merged into a single post—an assistant secretary for research and engineering).[30] Although a further step toward centralization, one scholar has pointed out that these organizational changes "did little to enhance effective control of military research. . . ."[31] The assistant secretary could advise the secretary and try to coordinate service programs but he could not alter or veto them.

In 1958, responding to the Sputniks and what those feats demonstrated about Soviet missile capabilities and seemed to imply about U.S. missile programs, then still embroiled in bitter interservice rivalry over intermediate range missiles, the Eisenhower administration sought changes in the Department of Defense's organization for acquisition. The results significantly increased the secretary of Defense's control over acquisition and further centralized its management in OSD.[32] The Advanced Research Projects Agency (ARPA), established in February 1958, sponsored early research and development of systems, such as satellites and antimissiles, not yet assigned to a particular service. ARPA was the first time OSD became involved directly in implementing acquisition programs. Creation

of the agency was also a way, wrote Herbert York, its first chief scientist and within a year DoD's first director of defense research and engineering, to accomplish research and development projects "without having to cope with service red tape."[33] When the office of the director of defense research and engineering, authorized by the Defense Reorganization Act of 1958, was established in February 1959, the secretary of defense's authority over acquisition appeared clear cut. The director of defense research and engineering (DDR&E) had the power "to direct and control . . . research and engineering activities that the secretary of Defense deems to require centralized management."[34] In short, OSD could now approve, disapprove, or modify service acquisition programs. But neither Secretary of Defense Neil H. McElroy, nor his successor Thomas S. Gates, Jr., chose to exploit the powers made available by the 1958 changes; the services thus maintained most of their traditional autonomy. Some scholars have suggested that their reluctance stemmed not so much from absence of will but rather from lack of the right tools to wield the new authority. Only in 1961, under a much more aggressive leader, armed with the techniques of systems analysis, would it become evident how extensive the secretary of Defense's power in the acquisition arena could be.[35]

Since the end of World War II, the services had sought to adapt their traditional organizations or to create new structures to meet the challenges presented by increasingly sophisticated and rapidly changing technologies. One lesson of the war seemed to be that research and development came off second best in organizations oriented toward production and procurement.[36] Vannevar Bush, who headed the wartime Office of Scientific Research and Development, testified to the House Military Affairs Committee soon after the war:

> New developments are upsetting to procurement standards and procurement schedules. A procurement group is under the constant urge to regularize and standardize, particularly when funds are limited. Its primary function is to produce a sufficient supply of standard weapons for field use. Procurement units are judged, therefore, by production standards.
>
> Research, however, is the exploration of the unknown. It is speculative. It cannot be standardized. It succeeds, moreover, in virtually direct proportion to its freedom from performance controls, production pressures, and traditional approaches.[37]

General Eisenhower believed the two functions should be organizationally separate and, while Army chief of staff in 1946, established a research and development directorate on the General Staff on the same level as the service, supply and procurement directorate. But "in-house" research and development in the Army actually took place in the arsenals and laboratories of the technical services—primarily the Ordnance Corps,

Signal Corps, and Chemical Corps. In these organizations production usually dominated and emphasis tended to be on making incremental improvements to existing weapons rather than on developing entirely new systems. This orientation was a key reason (although not the only reason) it took the Army a dozen years following World War II to come up with a replacement for the M–1 rifle. By the end of the 1950s, the Army, in spite of the urging of some of its top officers and its scientific advisors, had still not achieved much independence for R&D or moved very far in the direction of centralized R&D management. On the Army staff, the technical services reported to the production-oriented deputy chief of staff for logistics, not to the deputy chief of staff for research and development.[38]

The Office of Naval Research (established in 1946) and its laboratories gave the Navy an independent research organization. On the other hand, most research and development in the Navy was under the control of the materiel bureaus, principally Aeronautics, Ordnance, and Ships. The Navy's peculiar bilinear structure gave the bureaus—each with its own budget and responsible to the secretary of the Navy up through the civilian-dominated business chain rather than through the military-controlled operational chain that went through the CNO—extraordinary independence (and not only from the CNO but also from each other). Moreover, within the materiel bureaus and in its laboratories and shipyards, R&D supported procurement. "The old-fashioned bureau system," writes the historian Rodney Carlisle, "made R&D a part of the Navy's procurement activity, an approach quite out of touch with the Big Science expectations of the postwar period. . . . [It] preserved the prewar view of science and engineering as an auxiliary to private sector purchasing, not as a modern integral system, the view which had begun to emerge as a consequence to World War II efforts."[39]

In 1946, in the soon-to-be-independent Army Air Forces, one organization—the Air Materiel Command—had responsibility for R&D, procurement, and logistics. Here as in the other services new weapons development was secondary to the other materiel functions; most attention went to improving existing systems. But the Air Force, the most scientifically and technically inclined of the services and lacking long-lived acquisition structures as well as much of an in-house R&D capability, moved fairly quickly after the war to separate R&D from procurement. In 1950, it established the Air Research and Development Command, leaving other acquisition and logistics functions to the Air Materiel Command. The separation created friction between the two commands at the sometimes indistinct juncture between development and production. Ironically, after breaking apart its organizationally unified materiel support, the Air Force began a four-decade-long process of putting it all back together again in

keeping with the larger trend of viewing acquisition as an integral process that ranged over a system's entire life cycle.[40]

Such a perspective, however, was just beginning to emerge in the 1950s. Its roots lay in the concept of a weapon as a system and the recognition that developing the complex weapons of the time would require new organizational structures and doctrine. A weapon system comprised all that was required for a weapon to perform its task: the weapon itself, the delivery vehicle, its operators (including their training), and all associated support facilities and services. Developing it meant cutting across established organizational boundaries. To achieve the necessary coordination and to manage system development, the services established entirely new organizational structures (initially called weapon system project offices in the Air Force and special project offices in the Navy). The project offices brought together, under a single program manager, representatives from all the service's components involved in developing, producing, and deploying the weapon system including their contractors.[41] Jack Neufeld, of the Air Force historian's office, has well and thoroughly described how the weapon system management concept and project office structure that had been evolving in the Air Force for several years were put into practice in the mid–1950s to produce the Air Force's Atlas and Titan ICBMs and Thor IRBM.[42] The management methods and structure employed in those programs were copied throughout the Air Research and Development Command, starting with the B–52 in 1956. By the end of the decade, they had been institutionalized in the Air Force's 375–series regulations.[43]

In his path-breaking study, *Polaris System Development*, Harvey Sapolsky has analyzed the weapon system management concept in the context of the Navy's Fleet Ballistic Missile program; the secretary of the Navy authorized its Special Projects Office in November 1955.[44] Although neither recognized nor intended at the time, the Special Projects Office marked the beginning of the end of the traditional bureau structure. It had been set up to resolve the dispute between BuOrd and BuAer over control of the fleet ballistic missile program and was supposed to be temporary. In 1956, the Libby Board, chartered by the chief of naval operations, examined the bureau structure as it related to weapon system development and concluded that the materiel process in the Navy did not require reorganization. Special projects offices should be used only in exceptional circumstances. Instead the board recommended that a "lead bureau" be designated to direct and to coordinate development of new weapon systems when more than one bureau was involved. This became Navy policy in 1957. Additionally, the merger of BuOrd and BuAer into the Bureau of Naval Weapons in 1959 was intended to eliminate jurisdictional

disputes. Thus despite the success of the Special Projects Office, the Navy sought for some years longer to adapt its traditional acquisition structure to the demands of new weapon development and the bureaus "retained a substantial degree of independence in program execution through the 1950s. . . ."[45]

Weapon system management methods and structures were especially well suited to concurrency. That acquisition strategy came to dominate the acquisition process by the end of the 1950s, especially (although not exclusively) in the Air Force and particularly in aircraft and missile programs (although again not only in those—the Army employed concurrency in developing the M551 tank beginning in 1958).[46] Traditional development methods were sequential. That is, research, design, engineering development, production, and deployment proceeded in an orderly way, one following the other. Stages were not compressed nor did they overlap. Testing was extensive. The underlying assumption was that technological uncertainties were best dealt with in this deliberate manner. Under concurrency elements of the acquisition process occurred simultaneously. Production and deployment activities took place even while research and development were underway. Thus in the Air Force's ICBM program, launch sites were constructed, support equipment was developed, and crews began training, even while the missile and its subsystems were being developed and tested, and before final configurations had been set.[47]

Concurrency was not new to the post-World War II period. It had been employed during the war, in fact, even before the United States entered the conflict. The B–29 is most often cited as an example of concurrent development. Its factories were under construction and its machine tools were being designed well before the aircraft's first flight in September 1942.[48] But production contracts had also been signed for the B–24 and the B–26 in 1939 before either of those aircraft flew.[49] Similarly, in 1940, Chrysler began building a plant near Detroit and installing production machinery before the design for the Army's M3 tank had been completed.[50]

In both World War II and the 1950s, the urgency of the strategic situation caused weapon development to be accelerated. What largely distinguished concurrency in World War II from the postwar era was the increasingly sophisticated and complex nature of the systems being developed in the latter period.[51] Achieving the required technological advances and effecting the essential planning and coordination demanded by concurrency became more problematic. Programs frequently failed to fulfill desired performance characteristics, fell behind schedule, and incurred dramatically higher costs. Even in some programs that produced the needed capability quickly, concurrency took its toll. In the Air Force's

successful ICBM development effort, writes Neufeld, concurrency "saved much valuable time but also increased costs considerably, often resulted in unrealistic training, and turned out systems that required extensive modification and refinement."[52] Costly modifications were especially numerous in Atlas and Titan I site construction.[53]

In the 1950s, the high cost and other drawbacks of concurrent development were accepted as necessary, even inevitable. General Bernard A. Schriever, who directed the ICBM program, told an interviewer years later: "You don't wait till you fly a missile downstream . . . to make a decision beforehand for production. You have to get long-lead-time items, do your production planning, get your training started, your logistics set up, all established. I don't know how the hell you could have done the ICBM program other than the way we did it, because we were plowing new ground."[54] By the end of the 1960s, concurrency came to be viewed in a much different light. In 1970, Deputy Secretary of Defense David Packard directed that all systems be developed sequentially (i.e., "fly before buy"). "As I reviewed program after program beginning in the spring of 1969," he wrote, "almost all were in trouble from a common fault—production. They had been started before engineering development was finished. . . ."[55] Concurrency, along with cost overruns, schedule delays, and performance shortfalls reemerged in the 1980s as the United States sought a rapid buildup in its military capabilities. In 1987, Les Aspin, then chairman of the House Armed Services Committee, referring to concurrency, proclaimed that it was "always a mistake."[56]

Michael Brown, author of an outstanding analysis of Air Force bomber programs in the post-World War II decades, argues that the problem is not the acquisition strategy per se, but rather the relationship between a program's development objectives and the strategy selected to achieve them. The more ambitious the objectives—the greater the technological advances required—the more likely it is that sequential development will succeed. Conversely, if it is not necessary to push the state of the art, then the probability that concurrency will fulfill program cost, schedule, and performance goals increases. "For programs with modest objectives," Brown says, "concurrent strategies may deliver operational systems quickly and inexpensively."[57]

Nearly every Air Force postwar bomber program was technologically ambitious. For example, the B–47 and B–52, both initiated in the 1940s, pushed the state of the art (although the B–47 to a greater extent than the B–52), initially employed sequential strategies, and met development targets. Problems occurred when the Air Force accelerated the programs in the early 1950s and interjected concurrency. The supersonic B–58, which

began development in 1951 and was comparable to the B–47 in terms of the technological advances demanded, employed a high degree of concurrency from the start. It experienced cost, schedule, and performance difficulties throughout its nearly decade-long acquisition history—in fact, the first B–58 wing was not operational until 1961, four years later than originally scheduled.[58]

The national emergency of World War II that had prompted concurrency to be applied to weapon development also caused radical changes in the nation's contracting procedures, dramatically altering the relationship between the government and private contractors. Those changes, unlike after previous wars, were not revoked and continued into the postwar period, profoundly affecting weapons acquisition.

Before World War II, the government used a system of advertising and sealed, competitive bids to award contracts. Except during wartime, that system, believed to be democratic and to foster competition, had been in place for much of the nation's history. During World War II (actually even before America's entry), the government authorized negotiated contracts to be substituted for advertising and competitive bidding and cost-plus-fixed-fee contracts to be used rather than fixed price contracts. Additionally, the government disbursed advance, progress, and partial payments to contractors and assumed much of the cost of new plants and equipment. These measures stimulated production but also shifted much of the risk traditionally borne by the contractor to the nation and its taxpayers.[59]

After the war, the government continued the wartime practices. The Armed Services Procurement Act of 1947, while specifying that advertising and competitive bidding were to be the standard contracting procedure, also provided liberal exceptions that opened the door to widespread use of negotiated contracts.[60] In FY 1950, negotiated contracts accounted for more than 72 percent of the total *value* of contracts awarded; in FY 1951 (the first year of the Korean War), nearly 88 percent; and by the late 1950s, still more than 80 percent.[61] Similarly, although the act required use of fixed-price contracts, it also permitted other contract instruments if justification were provided. By 1960, more than 40 percent of the contracts awarded by the Air Force were cost-plus-fixed-fee.[62] Under these arrangements, if a system required modification after production began, the government paid for it. In the 1950s, one study concludes, "[t]echnical competition was generally considered more important than price competition."[63]

The role of contractors in the acquisition process also changed, expanding far beyond what it had been before World War II when, with some exceptions (notably aircraft), the services performed most weapon R&D and considerable production in their own laboratories, shipyards, and

arsenals. "Increasingly," writes Harvey Sapolsky, "the military came to rely on contractors for the development of its weapons."[64] Under the weapon system concept, the services often employed a "prime contractor" to manage, under overall military supervision, a system's entire development and production. The prime contractor subcontracted with others to develop subsystems or specific components.[65]

With the government's assumption of more of the financial risk of weapon development and use of negotiated contracts as well as greater contractor involvement in the overall process came more extensive government supervision of and control over contractor activities.[66] This overall trend produced a need for a skilled and knowledgeable acquisition workforce. In 1958, one estimate is that about 11,000 officers, 43,000 civilian scientists and engineers, and 10,000 civilian price analysts, contract negotiators, administrators, auditors and attorneys were involved in weapon acquisition.[67] A 1952 DoD directive had required each service to establish a program to recruit and train competent personnel for acquisition, and in 1955 the Hoover Commission had called for career development of acquisition management and technical personnel.[68] In 1962, however, Peck and Scherer concluded that "the average level of capability available for U.S. weapons programs has been far from sufficient to meet the tremendous need for high competence in administering rapid technological advances."[69]

The revolution in contracting arrangements initiated in World War II and the greater role contractors began to play after the war in weapon design and development reflected a growing characteristic of postwar acquisition: it was shifting from the public to the private sector. The services (the Army and Navy more than the Air Force) continued to maintain substantial in-house R&D and production capabilities from 1945 to1958. The trend, however, was away from their use toward more reliance on private industry, the universities, and entirely new kinds of institutions like the non-profit RAND Corporation (1948), Institute for Defense Analyses (1956), or MITRE Corporation (1958) to design, develop, and produce weapon systems.[70]

Some specific examples illustrate the point. After World War II, the percentage of DoD's private-sector research and development was substantial in absolute terms—of more than $500 million for R&D in FY 1950, about 54 percent went to industry and 9 percent to industries and other non-profit research institutions.[71] In FY 1958, the Army spent 53 percent of its R&D funds in its own facilities; the Navy, 40 percent; and the Air Force, 27 percent. The rest went to the private sector.[72] Over the course of the 1950s, the government (in tune with the ideological bent of the

Eisenhower administration and reinforced in 1955 by the recommendations of the Hoover Commission), steadily reduced the large number (288 in 1954) of weapon-related industrial plants that it owned and increased federal support for the expansion of private facilities.[73] Finally, the Navy came under especially intensive pressure to "privatize." From 1953 to 1960, private shipyards gained a steadily increasing share (from about 55 percent to more than 85 percent) of new naval ship construction contracts and of ship repair and conversion work that normally had been done almost entirely in Navy-owned yards.[74]

World War II was a watershed in the system for providing materiel for the U.S. armed forces. Although there were elements of continuity, what came after differed markedly from had existed before. The never-ending and urgent pursuit of the most advanced weapons was the key change agent—significantly expanding the place of research and development in acquisition, intensifying interservice rivalry, challenging the adequacy of traditional organizational acquisition structures, and fundamentally altering the role private contractors played in the process. The services resisted OSD's effort to gain greater control over acquisition and centralize its management. At the same time, the services found their own acquisition structures wanting and developed new organizations, management methods, and acquisition strategies. By 1958, the acquisition landscape looked much different than it had in 1945. What had been mostly the province of the individual services had become more fragmented and diverse, including greatly expanded roles for private industry and the universities; the insertion of an overarching authority, OSD; and the creation of entirely new entities to perform research and development, closely tied to but still outside of government. Indeed, as acquisition moved more toward the private sector, it became much more visible and open to scrutiny.

NOTES

[1] William J. Clinton, "Address Before a Joint Session of the Congress on the State of the Union," 24 January 1995, *Public Papers of the Presidents of the United States: William J. Clinton, 1995*, 2 vols. (Washington, D.C.: GPO, 1996), I: 75–86; George W. Bush Inaugural Address, 20 January 2001, *Vital Speeches of the Day*, LXVII, no. 8 (1 February 2001): 226–28.

[2] Dwight D. Eisenhower, "Annual Message to the Congress on the State of the Union," 9 January 1958, *Public Papers of the Presidents of the United States: Dwight D. Eisenhower, 1958* (Washington, D.C.: GPO, 1959), 8.

[3] David E. Lockwood, Andrew C. Mayer, and Cheryl A. Crow, "Summary of Principal Reports," *Defense Acquisition: Major U.S. Commission Reports (1949–1988)*, Vol. 1, report prepared for the Defense Policy Panel and the Acquisition Policy Panel of the House Committee on Armed Services, 100th Cong., 2d sess., 1988, Committee Print 26, 3.

[4] Defense Department, Defense Systems Management College, Acquisition Policy Department, *Glossary: Defense Acquisition Acronyms and Terms*, 10th ed. (Washington, D.C.: GPO, 2001), B–1.

[5] Merton J. Peck and Frederic M. Scherer, *The Weapons Acquisition Process: An Economic Analysis* (Boston: Harvard University, 1962).

[6] C. W. Borklund, *U.S. Defense and Military Factbook* (Santa Barbara, Calif.: ABC-CLIO, 1991), 34.

[7] Richard M. Leighton and Robert W. Coakley, "Logistics—The Word and the Thing," in *Global Logistics and Strategy, 1940–1943*, U.S. Army in World War II (Washington, D.C.: Center of Military History, Department of the Army, 1955), 11–13; Steven L. Rearden, *The Formative Years, 1947–1950*, Vol. I, *History of the Office of the Secretary of Defense*, ed. Alfred Goldberg (Washington, D.C.: Historical Office, Office of the Secretary of Defense, 1984), 90.

[8] Michael S. Sherry, *Preparing for the Next War: American Plans for Postwar Defense* (New Haven, Conn.: Yale University Press, 1977), 52–57, 127–34.

[9] Dwight D. Eisenhower, "Letter to the Secretary of Defense on National Security Requirements," January 5, 1955, *Public Papers of the Presidents of the United States: Dwight D. Eisenhower, 1955* (Washington, D.C.: GPO, 1955), 3.

[10] A. J. Bacevich, *The Pentomic Era: The U.S. Army Between Korea and Vietnam* (Washington, D.C.: National Defense University Press, 1986), 71–101.

[11] Quoted in Michael H. Armacost, *The Politics of Weapons Innovation: The Thor-Jupiter Controversy* (New York: Columbia University Press, 1969), 44.

[12] Kenneth M. Jones, "The Government Science Complex," in *Reshaping American Society and Institutions, 1945–1960*, ed. Robert A. Brenner and Gary N. Reichard (Columbus: Ohio State University Press, 1982), 319, 327.

[13] Executive Office of the President, Office of Management and Budget, *Historical Tables, Budget of the United States Government, Fiscal Year 2002*, Table 9.7, "Summary of Outlays for the Conduct of Research and Development: 1949–2002" (Washington, D.C.: GPO, 2001), 170.

[14] Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945–1960* (Washington, D.C.: United States Air Force, Office of Air Force History, 1990), 28.

[15] James E. Hewes, Jr., *From Root to McNamara: Army Organization and Administration, 1900–1963* (Washington, D.C.: Center of Military History, United States Army, 1975), 244.

[16] *Historical Tables*, 170.

[17] Armacost, *Politics of Weapons Innovation*, 9.

[18] Quoted in Malcolm Muir, Jr., *Black Shoes and Blue Water: Surface Warfare in the United States Navy, 1945–1975* (Washington, D.C.: Department of the Navy, Naval Historical Center, 1996), 29.

[19] Hewes, *Root to McNamara*, 254–55.

[20] James F. Nagle, *A History of Government Contracting* (Washington, D.C.: The George Washington University, 1992), 476.

[21] Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program* (Ithaca, N.Y.: Cornell University Press, 1992), 25–26, 320–23.

[22] Neufeld, *Ballistic Missiles*, 122–31.

[23] Eisenhower, "Annual Message to the Congress," *Public Papers of the Presidents . . . 1958*, 8.

[24] Ibid.

[25] Roger R. Trask and Alfred Goldberg, *The Department of Defense, 1947–1997: Organization and Leaders* (Washington, D.C.: Office of the Secretary of Defense, Historical Office, 1997), 3–34; Peck and Scherer, *Weapons Acquisition Process*, 72–74; Hewes, *Root to McNamara*, 296–98; Booz, Allen & Hamilton, Inc., *Review of Navy R&D Management, 1946–1943* (1 June 1976), 19–33, 53–56, and *Summary*, 4, 7.

[26] "National Security Act of 1947," *The Department of Defense: Documents on Establishment and Organization, 1944–1978*, ed. Alice C. Cole, Alfred Goldberg, Samuel A. Tucker, and Rudolph A. Winnacker

(Washington, D.C.: Office of the Secretary of Defense, Historical Office, 1978), 40.

[27] Ibid., 47.

[28] Rearden, *Formative Years*, 90–103; Doris M. Condit, *The Test of War, 1950–1953*, Vol. II, *History of the Office of the Secretary of Defense*, ed. Alfred Goldberg (Washington, D.C.: Office of the Secretary of Defense, Historical Office, 1988), 501–09; John Perry Miller, "Military Procurement Policies: World War II and Today," *The American Economic Review* 42, no. 2 (May 1952): 460; Herbert F. York and G. Allen Greb, "Military Research and Development: A Postwar History," *Bulletin of the Atomic Scientists* 33, no. 1 (January 1977): 15–16, 18–19; Aaron L. Friedberg, *In the Shadow of the Garrison State: America's Anti-Statism and Its Cold War Grand Strategy* (Princeton, N.J.: Princeton University Press, 2000), 316–17.

[29] Condit, *Test of War*, 502.

[30] Trask and Goldberg, *Department of Defense, 1947–1997*, 21–22.

[31] Friedberg, *Shadow*, 317.

[32] Robert J. Watson, *Into the Missile Age, 1956–1960*, Vol. IV, *History of the Office of the Secretary of Defense*, ed. Alfred Goldberg (Washington, D.C.: Office of the Secretary of Defense, Historical Office, 1997), 274–75, 286, 288, 361–63; Booz, Allen & Hamilton, *Navy R&D Management*, 32, 53–56.

[33] York and Greb, "Military Research and Development," 24.

[34] "Department of Defense Reorganization Act of 1958," *Documents on Establishment and Organization*, 204–05.

[35] Watson, *Missile Age*, 291; Charles J. Hitch, "Evolution of the Department of Defense, in *American Defense Policy*, 3d ed., ed. Richard G. Head and Ervin J. Rokke (Baltimore: The Johns Hopkins University Press, 1973), 348; Alain C. Enthoven and K. Wayne Smith, "New Concepts and Tools to Shape the Defense Program," in ibid., 349–58.

[36] Peck and Scherer, *Weapons Acquisition Process*, 75.

[37] Quoted in Hewes, *Root to McNamara*, 120–21.

[38] Ibid., 121–26, 157–61, 242–58; Edward C. Ezell, "Patterns in Small Arms Procurement Since 1945," in *War, Business, and American Society: Historical Perspectives on the Military-Industrial Complex*, ed. Benjamin Franklin Cooling (Port Washington, N.Y.: National University Publications, Kennikat Press, 1977), 146–51.

[39] Rodney P. Carlisle, *Management of the U.S. Navy Research and Development Centers During the Cold War: A Survey Guide to Reports* (Washington, D.C.: Navy Laboratory/Center Coordinating Group and the Naval Historical Center, 1996), 5; Booz, Allen & Hamilton, *Navy R&D Management*, 3–17; David K. Allison, "U.S. Navy Research and

Development Since World War II," in *Military Enterprise and Technical Change: Perspectives on the American Experience*, ed. Merritt Roe Smith (Cambridge, Mass.: MIT Press, 1985), 292–99.

[40] Lawrence R. Benson, *Acquisition Management in the United States Air Force and Its Predecessors* (Air Force History and Museums Program, 1997), 2, 19–31; Michael H. Gorn, *Vulcan's Forge: The Making of an Air Force Command For Weapons Acquisition (1950–1985)*, Vol. I, *Narrative* (Andrews Air Force Base, Md.: Office of History, Headquarters Air Force Systems Command, 1989), 1–33, 51–72; *Reflections on Research and Development in the United States Air Force*, ed. Jacob Neufeld (Washington, D.C.: Center for Air Force History, 1993), 2–4.

[41] Benson, *Acquisition Management*, 24–31; Gorn, *Vulcan's Forge*, I: 28–33; Booz, Allen & Hamilton, *Navy R&D Management*, 347–48; Carlisle, *Management of the U.S. Navy Research and Development Centers*, 14; Thomas C. Hone, *Power and Change: The Administrative History of the Office of the Chief of Naval Operations, 1946–1986* (Washington, D.C.: Department of the Navy, Naval Historical Center, 1989), 36–39; Wilbur D. Jones, Jr., *Arming the Eagle: A History of U.S. Weapons Acquisition Since 1775* (Fort Belvoir, Va.: Defense Systems Management College Press, 1999), 358; David D. Acker, "The Maturing of the DoD Acquisition Process," *Defense Systems Management Review* 3, no. 3 (Summer 1980): 9–10; J. R. Nelson and Karen W. Tyson, *A Perspective on the Defense Weapons Acquisition Process*, IDA Paper P–2048 (Alexandria, Va.: Institute for Defense Analyses, September 1987), II–30.

[42] Neufeld, *Ballistic Missiles*.

[43] Neufeld, *Reflections on Research and Development in the United States Air Force*, 5.

[44] Harvey M. Sapolsky, *The Polaris System Development: Bureaucratic and Programmatic Success in Government* (Cambridge, Mass.: Harvard University Press, 1972).

[45] Ibid., 61–64; Booz, Allen & Hamilton, *Navy R&D Management*, 45–46, and *Summary*, 55.

[46] Brown, *Flying Blind*, 330–31; Nelson and Tyson, *Defense Weapons Acquisition Process*, II–33.

[47] Brown, *Flying Blind*, 17–18; Benson, *Acquisition Management*, 26–28; Neufeld, *Ballistic Missiles*, 201.

[48] Alfred Goldberg, "Equipment and Services," in *Men and Planes*, Vol. 6, *The Army Air Forces in World War II*, ed. Wesley Frank Craven and James Lea Cate (Chicago: University of Chicago Press, 1955; new imprint Washington, D.C.: Office of Air Force History, 1983), 201; Jacob Vander Meulen, *Building*

the B–29 (Washington, D.C.: Smithsonian Institution Press, 1995), 21, 86; Roger E. Bilstein, *The American Aerospace Industry: From Workshop to Global Enterprise* (New York: Twayne Publishers, 1996), 75–76.

[49] Brown, *Flying Blind*, 56–58.

[50] Philip Shiman, *Forging the Sword: Defense Production During the Cold War*, USACERL Special Report 97/77 (United States Air Force Air Combat Command and Department of Defense Legacy Program, Cold War Project, July 1997), 6.

[51] Benson, *Acquisition Management*, 26.

[52] Neufeld, *Ballistic Missiles*, 201.

[53] Ibid.; John C. Lonnquest and David F. Winkler, *To Defend and Deter: The Legacy of the United States Cold War Missile Program*, USACERL Special Report 97/01 (Department of Defense Legacy Resource Management Program, Cold War Project), 79.

[54] Quoted in Gorn, *Vulcan's Forge*, I: 48.

[55] Quoted in Robert G. Gibson, "Concurrency," *Defense Systems Management Review* 2, no. 4 (Autumn 1979): 68.

[56] Quoted in Brown, *Flying Blind*, 19.

[57] Ibid., 21 and 19–24 for the general argument.

[58] Ibid., 68–69, 105–06, 147–53, 157–62, 190–92, 338–39.

[59] Nagle, *History of Government Contracting*, 407–09, 415–23, 433–45; Robert Higgs, "Private Profit, Public Risk: Institutional Antecedents of the Modern Military Procurement System in the Rearmament Program of 1940–1941," in *The Sinews of War: Essays on the Economic History of World War II*, ed. Geoffrey T. Mills and Hugh Rockoff (Ames: Iowa State University Press, 1993), 174–77; Commission on Government Procurement, Appendix G, "Historical Development of the Procurement Process," *Report* (Washington, D.C.: GPO, 1972), 170–71; Miller, "Military Procurement Policies," 458–59.

[60] Nagle, *History of Government Contracting*, 467–70; Commission on Government Procurement, "Development of the Procurement Process," 171–72, 177–78.

[61] Miller, "Military Procurement Policies," 458; Jones, *Arming the Eagle*, 360.

[62] Nelson and Tyson, *Defense Weapons Acquisition Process*, II–30.

[63] Ibid.

[64] Sapolsky, *Polaris System Development*, 78.

[65] Ibid.; Benson, *Acquisition Management*, 27; Booz, Allen & Hamilton, *Navy R&D Management*, 347–51; and Nelson and Tyson, *Defense Weapons Acquisition Process*, II–30.

[66] Commission on Government Procurement, "Development of the Procurement Process," 180.

[67] Peck and Scherer, *Weapons Acquisition Process*, 85–86.

[68] Commission on the Organization of the Executive Branch of the Government, *Business Organization of the Department of Defense: A Report to the Congress* (Washington, D.C.: GPO, June 1955), 59–61.

[69] Peck and Scherer, *Weapons Acquisition Process*, 86.

[70] For an extended discussion, see Friedberg, *Shadow of the Garrison State*, chapters 7 and 8; Harvey M. Sapolsky, "Equipping the Armed Forces," *Armed Forces and Society* 14, no. 1 (Fall 1987): 117; U.S. Senate Committee on Government Operations, *Report to the President on Government Contracting for Research and Development* (Prepared by the Bureau of the Budget and Referred to the Committee on Government Operations), 87th Cong., 2d sess., 1962, S. Doc. 94, 1–3.

[71] Daniel J. Kevles, "K_1S_2: Korea, Science, and the State," in *Big Science: The Growth of Large-Scale Research*, ed. Peter Galison and Bruce Hevly (Stanford, Calif.: Stanford University Press, 1988), 314.

[72] Donald W. Mitchell, *Research and Development* (Washington, D.C.: Industrial College of the Armed Forces, 1960), 101–03.

[73] Shiman, *Forging the Sword*, 53–54, 69.

[74] Friedberg, *Shadow*, 257.

SOSUS, the Navy, and Bell Labs

Gary E. Weir

Since World War I, relationships among naval officers, the scientific community, and industry in the United States have demonstrated well the evolutionary trials facing productive professional dialogues. The customs and practices of industry or university ocean sciences laboratories contrast sharply with the traditions and conventions of midshipmen at the United States Naval Academy or officers deployed on warships.

Different professional groups exist in unique, culturally constructed worlds. During the course of the twentieth century, the understanding necessary for these distinct groups to work together toward a common goal has required social and political insight as well as careful cultural translation. Fruitful professional dialogues are products of conscious design and determination, not accidents or the natural course of events.

Beginning as individual cooperative efforts undertaken to compensate for the poverty of the interwar period, the initially ad hoc relationship between ocean science and the Navy in the United States developed an effective cross-cultural dialogue while responding to the considerable demands of World War II. This dialogue achieved maturity and maximum effect in the ocean sciences through a series of summer studies used by the armed forces in collaboration with science and industry early in the Cold War to clarify strategic, scientific, and technical priorities.

Copious oral history and textual primary sources from naval and private archives permit careful examination of the evolutionary steps in this process. Presently, I am going to trace the evolution of this critical dialogue from its wartime origins through the first of these enormously productive Cold War summer studies. In the process, I will briefly explore the genesis and early development of the deep ocean sound surveillance system, SOSUS. Through this system of fixed ocean-bottom hydrophones, the Navy detected, identified, and, for decades, monitored the movements of Soviet

submarines deemed as early as 1950 the most dangerous maritime threat to the security of the United States.

Before World War II, the Navy concentrated on preserving as many of its assets as possible in a time of budgetary constraints. The collection of ocean data fell to its poorly funded but imaginatively led hydrographic office, often referred to as Hydro. In the process of producing charts vital to safe navigation and performing hydrographic surveys in the Atlantic and Pacific Oceans, as well as in the Gulf of Mexico and Caribbean Sea, Hydro sought cooperative ventures of universities and research institutions to further its work.

In an atmosphere of mutual need, the Navy and civilian oceanography built a "common practice" on shared scientific ambitions driven by limited resources and institutional as well as personal agendas. After all, the Navy had the ocean-going ships and crews that were absolutely necessary for data collection at sea. In return for time at sea and logistical support, civilian scientists often provided special advice and the analytical skills necessary to digest more efficiently and swiftly the information collected by both Hydro surveys and naval vessels regularly plying the world ocean.

Few imagined that this relationship, wrought of poverty and necessity, could provide adequate resources in a time of national emergency; thus, upon the outbreak of the European war in 1939, responsible authorities quickly focused their attention on the need for closer cooperation between scientists and the Navy. The highest levels of American government acknowledged the importance of building relationships between the Navy and the civilian academy, and appropriate steps were taken to promote cooperation between these groups.

President Franklin Roosevelt established a National Defense Research Committee (NDRC) in June 1940. The NDRC came under the direction of Vannevar Bush of Washington's Carnegie Institution. Roosevelt sought to use the NDRC to mobilize scientific talent and resources for possible American involvement in World War II. Initially presented with a $4.8 million budget, Bush and his colleagues moved quickly to open communication and initiate dialogues with the armed forces.

Cultural and professional challenges posed the greatest potential obstacle to effective collaboration. Products of an educational process that imprinted individuals with a strong sense of naval culture, officers molded at the U.S. Naval Academy, with few exceptions, largely viewed themselves as engineers and seamen, applying modern technology to a style of warfare their community had virtually defined.

Many of them viewed with great skepticism the idea that science might play an effective role in naval combat. As the country's defense

mobilization began, the services of informal cultural translators emerged as one of the most effective ways to bridge the gap between combat officer and oceanographer, between engineer and scientist, indeed, between technology and science.

Neither scientists with a talent for engineering solutions nor engineers comfortable with scientific concepts and the extensive theoretical literature, "cultural translators" provided an opportunity for mutual understanding and bridge-building. The task took American scientists and some naval officials far beyond mere missionary work or linguistic translation. They neither desired to win over the professional souls of the individual naval officers nor felt that ocean science offered strategic salvation. Rather, if the Navy at large would employ oceanography or the ocean sciences as a significant and strategic tactical tool, the consequences would dramatically advance both science and the war effort. All of this had little to do with vocabulary. It had everything to do with opening professional borders and building a mutually profitable common experience. Unlike a simple common practice based upon mutual poverty, this kind of cultural translation brought together the people whose education, assumptions, habits, and interests stood in dramatic contrast.

This process had a twofold effect. The first represented an initial step toward a cross-cultural dialogue. In this sense, this cultural translation had nothing to do with rendering "navalese" intelligible to the scientific community. Anthropologist Clifford Geertz described this insightful activity as,

> not a simple recasting of others' ways of putting things in terms of our own ways of putting them (that is the kind in which things get lost), but displaying the logic of their ways of putting them in the locution of ours; a conception which again brings it rather closer to what a critic does to illumine a poem than what an astronomer does to account for a star.

Each community needed to learn about and appreciate an alternative view of the world. It fell to cultural translators to grasp the depth and scope of both communities' experiences and to use their potential and their common interests and ambitions as a wartime tool.[1]

The second effect proved inventive. The challenging bisociative context of the dialogue provided fertile ground for innovation. In a bisociative process, critical people interact outside their customary experience on multiple levels and along many intersecting intellectual paths, frequently producing significant scientific discoveries and technological innovations. In these circumstances, bisociation suggests that a type of benign shock occurred that permitted creative connections, intellectual leaps, and the kind

of curiosity that a professional can energetically indulge only when safely outside customary professional-cultural boundaries.[2]

The ocean sciences profited significantly from the effort of individuals offering new perspectives, challenging old habits, and building a dialogue with the Navy on the results. The war effort welcomed the beneficial application of ocean technology and environmental understanding to combat. In 1945, however, this productive process still rested on select individual initiatives.

Critical naval and scientific agencies created soon after the war helped the wartime working dialogue complete the transition to peacetime and to evolve further. From the rapidly demobilizing University of California Division of War Research, Director Gaylord Harnwell voiced his preference early after the war for continued ocean research in conjunction with the Navy. This initiative prompted the creation of the National Academy of Sciences Committee on Undersea Warfare, at the official request of the Navy's Office of Research and Invention. Populated almost entirely by wartime veteran scientists and experienced cultural translators, the National Academy of Sciences Committee assisted in planning programs to address what would soon become the Navy's principal strategic postwar priority: antisubmarine warfare. It also placed many experienced translators in the quasi-official position of advisor to the federal government on undersea warfare through the National Academy of Sciences. In a similar way, the creation of the Office of Naval Research and the Oceanography Division at Hydro in late 1946 placed within the federal service as naval officials select scientists with wartime experience and a talent for cultural translation.

These people knew the Navy, the needs of ocean science, and the importance of their post-war activities to an effective dialogue. Besides, scientists found it easier to communicate their needs to the federal patron if the person speaking for the government was a friend, a colleague, or a scientist or technician of stature. They used the same culturally constructed vocabulary, appreciated purely scientific needs and concerns, and addressed more effectively and immediately the incommensurability that often occurred between Academy-molded officers and industrial laboratory staff and university-shaped scientists. They truly had one foot in each camp and brought an understanding to the process of building mature post-war dialogues that no other individual or institution could match.[3]

It proved even more significant that these individuals, who could best understand this often difficult relationship, had in their control at the time the bulk of the Navy's money for sponsoring ocean science research. The rapid progress of the next decade was not simply good fortune but the result of this enhanced an effective dialogue empowered by individuals

who collectively possessed the cultural instincts of scientific insiders complemented by the administrative authority and the assets to act.

The first five postwar years seemed the perfect time to take the initiative. No sooner had the Cold War begun in earnest than the Navy defined Soviet exploitation of advanced submarine technology captured from the Germans as the most potent future maritime threat. The ability to detect that threat quickly became one of the Navy's most critical Cold War priorities. In 1949, the Navy accelerated its underwater sound effort by establishing Submarine Development Group 2, based in New London, Connecticut, to explore new discoveries in sound behavior below 300 hertz in conjunction with naval and civilian laboratories. Very low frequencies took center stage because a prewar discovery, ignored for some years now, took on a truly special significance.

In 1937, Maurice Ewing made a startling discovery while doing refraction experiments aboard *Atlantis*, the research vessel of the Woods Hole Oceanographic Institution. This scientist, a future founder of Columbia University's Lamont Geological Observatory, had no listening equipment onboard, just seismographs lying three miles down on the ocean bottom. Full of curiosity, Ewing put his ear to the ship's rail to listen for the rate of echo from the explosion of ten-pound blocks of TNT that provided a sound source for his experiments. In a period of roughly eighteen seconds, the explosion echo repeatedly transversed the distance between the ship and the bottom, making the round trip seven times by Ewing's calculation.

Allowing for surface and bottom reflections reduced the intensity of the signal each time it made the trip, the sound from the explosion traveled twenty-one miles before dying out. Ewing estimated that each reflection had reduced the intensity of the sound by roughly one-tenth. If his approximation came even close to the truth, a sound might retain its initial clarity and intensity in a horizontal ocean layer that would minimize reflection loss. Proper amplifiers and hydrophones could boost the signal a thousand times for the human ear. If research proved this hypothesis correct, the layer of the ocean that would permit minimal reflection could very well transmit sound over thousands of miles for the well-prepared listener.

Aboard *Atlantis* in that year, Ewing postulated the condition of this natural condition in the ocean and called it the "deep sound channel." Employing the Woods Hole Oceanographic Institution as his base of operations during the latter portion of World War II, Ewing combined his extensive experience at sea with new data arriving daily from Hydro to determine the nature and possible utility of the channel. In the process, he unwittingly set the Navy and the scientific community on the road to SOSUS.

Now, discovering strategically significant characteristics of the world's ocean at the time proved a lot easier than convincing the wartime Navy of its value. Ewing initially suggested that it would be a good way to triangulate on downed officers, flyers for example. He suggested that it was possible to put a grenade or some sort of detonation device in the water and it would sink, detonate, and receivers could triangulate the location of the pilot. Because the Navy was sufficiently comfortable with its existing rescue system, Ewing's proposal was never picked up. The Navy showed minimal interest in what Ewing called SOFAR (sound fixing and recording).[4]

Seven years later, however, in the postwar context and facing a potential Soviet submarine threat, the Navy's perspective changed considerably. Experimental detection results obtained over an early Pacific SOFAR based air/sea rescue system installed for the Coast Guard looked very practical and promising.

The data attracted the attention of both Rear Adm. Charles Momsen, as the Assistant Chief of Naval Operations for Undersea Warfare, and Bell Telephone Laboratories' Director of Research Mervin J. Kelly. Momsen and Rear Adm. Thorvald A. Solberg, Chief of Naval Research, discussed the matter in a meeting with Kelly in New York on 27 February 1950. Also in attendance at the meeting were J.B. Fiske, Kelly's assistants, and Julius Stratton, provost of MIT.

Given the Navy's view that Soviet submarines posed the most critical future naval threat, Stratton proposed to the Navy Department that Bell and MIT work jointly. He offered his institution as the best possible site for an intensive summer study of the problem, a course already suggested by the National Academy of Sciences' Committee on Undersea Warfare. Taking things one step further, Stratton nominated Jerrold R. Zacharias of MIT as the study director. At Munson's request, the committee formally recommended the project to the Chief of Naval Operations (CNO), Admiral Forrest Sherman, and Stratton went to MIT President James Killian for his blessing on the offer to host the project.

With community support for the study and Killian's endorsement, a 23 March letter from Admiral Momsen to the CNO won Sherman's approval. The effort was called Project Hartwell, after a popular watering hole not too far from the MIT campus. A preliminary gathering of participants took place on 27 April in the National Academy of Sciences building in Washington during the annual meeting of the American Physical Society. Before the planning session broke up, Admiral Solberg and Admiral Momsen encouraged the Hartwell recruits to remain in Washington to attend the Committee on Undersea Warfare's Fifth Undersea Symposium scheduled for 15 and 16 May.

A number of them did and, thus, were present for what many later came to call the "bombshell report" delivered by physicist Frederick V. "Ted" Hunt, wartime director of the Harvard Underwater Sound Laboratory. Hunt vividly demonstrated for his audience the combat potential locked up in Ewing's 1937 discovery of the deep sound channel.

Together with Norman Haskell of the Air Force Cambridge Laboratories, Hunt had looked to the general problem of sound transmission in the atmosphere for direction as he came to terms of the riddle of underwater acoustics. In concluding his comments, Hunt brought his audience and the Navy into modern Cold War ocean surveillance,

> All of this sounds queer, doesn't it? But not as queer as the fact that the time interval corresponding to echo reception from a range of 1500 miles is just 60 minutes. But for a small-interconnected network of fixed shore-based listening stations, the sweep rate would be an ocean per hour.[5]

What the Navy heard shortly afterward at the seminal Project Hartwell summer study proved equally exciting, and given the outbreak of the Korean War on 25 June 1950, very timely. The Hartwell group disclosed that low-frequency research suggested the feasibility of the shore detection ranges of at least 500 miles in the case of diesel-driven snorkeling submarines.

By all accounts, the Hartwell summer study marked the beginning of the SOSUS project. It also marked a new postwar phase in the evolution of the naval scientific dialogue. The Hartwell gathering at MIT demonstrated the potential of wartime cultural translation taken to the second power: the creation of an intellectual and creative critical mass.[6]

Along the way, cultural translators provided a very personal way of promoting interaction on ocean problems vital to the national defense. These translators, working in concert, facilitated the sharing of experiences and perspectives among scientists and naval personnel, no easy feat given the cultural and ideological distance that separated these professional groups. Translators made possible, in a fundamental way, that confluence of seemingly random personal, professional, and cultural experiences that broke down barriers and triggered both effective collaboration and amazing innovation. The war offered many examples, from the bathythermograph, to the proximity fuse, to the discovery of both acoustic shadow zones and the temperature microstructure of the ocean. For a time, Project Hartwell physically and intellectually took its participants out of their routines and away from the daily effort to validate their activity in ways professionally accepted.

Zacharias and the project leaders mixed and focused expectations, experience, talents, interests, hobbies, and ambitions in the name of the

national defense common denominator. In the process, they created for a brief time in the summer of 1950 a bisociative constellation of naval, industrial, and scientific talent, with potential well beyond the wartime experience. They permitted those involved to see the new for the first time and the old from very unfamiliar angles. Fueled by the Cold War and facilitated by the availability of extraordinary postwar resources, Hartwell created a prototypical innovative environment that could take advantage of numbers, talent, and diversity, with the throttle wide open. This collective effort clearly surpassed anything wartime translators might have accomplished in their related but discreet efforts before 1945.

In one of their most innovative moments, Hartwell participants made the leap from human voice transmission analysis (the telephone application) to ocean global surveillance. Shortly before the group met, Hartwell participant Ralph Potter, Director of Sound Transmission at Bell Telephone Laboratories, together with his colleague, David Winston, had developed a method of acoustically fingerprinting low-frequency sound signals as a by-product of the telephone company's analysis of human vocal patterns.

Thanks to Hartwell and in cooperation with the Navy's Submarine Development Group 2 in New London, the two scientists explored the unique acoustic regularities and rhythms of snorkeling submarines. Motor, engine, and propeller operation in these boats produced a natural cadence, manifesting itself as line components in the emitted signal. With their voice analysis technology, the Bell Lab scientists discovered that they could both detect submarines at a great distance and actually identify the target as a particular ship or class of vessel. Each submarine, it seemed, had its own distinctive acoustic signature.

These developments released the new and unexpected naval potential captive in Ewing's discovery of the deep sound channel so many years earlier. Thus, while MIT brought the Navy, industry, and science together under one roof, the Hartwell environment permitted scientists to find a point of intersection for three significant and simultaneous lines of inquiry: Ewing's sound channel, sound and voice analysis at Bell, and the need to address the Soviet submarine threat perceived by the Navy. This process clearly went far beyond the kind of cultural translation employed by scientists during the war. The Hartwell-enhanced dialogue on these issues quickly brought together critical talent, promoted interaction between diverging communities on multiple levels of ability and interest, and rapidly produced concrete results.

As Hartwell concluded, both the Chief of Naval Operations and the scientific community realized well the possibilities of low-frequency

underwater sound and the deep sound channel phenomenon. In the autumn of 1950, Mervin Kelly entered into discussions with Admiral Forrest Sherman, which resulted in Office of Naval Research Contract 210–00 of 12 December with the Western Electric arm of AT&T. This arrangement provided for a thorough research program in underwater sound with an emphasis on the detection and classification of low-frequency sound radiation from submarines. Bell Telephone immediately began a program very similar to that already undertaken by Maurice Ewing and Columbia University on Bermuda.

Bell's first SOSUS laboratory, complete with cable-borne and deep-ocean listening devices, opened in 1950 on Sandy Hook and monitored the New York City Harbor traffic with hydrophones installed three miles off shore and in only forty-two feet of water. The company planned to set up its first southern laboratory in Bermuda, but, in the summer of 1951, opted instead for Eleuthera, the site of Ewing's wartime operation, about 250 miles off Florida's Atlantic coast.

Shortly after the contract signing, Bell Telephone Laboratories submitted a report outlining the general details of their new low frequency analyzer, a production model that promised both submarine detection and classification. Called low frequency analysis and recording, or LOFAR, the new technique and its hardware emerged from research conducted by Potter and Winston. Bell Labs delivered this product of the Hartwell-enhanced dialogue to the Navy on 2 May 1951, less than ten months after the MIT meeting concluded.

As the significance of LOFAR emerged, a committee commissioned by the National Academy of Sciences and the original Hartwell group met at Columbia University. They lobbied for the creation of a single scientific entity to investigate the defense applications of underwater sound as discussed in their summer study report of the previous year. They wanted a central laboratory to reside at Columbia and asked the Navy for $10 million of seed money. While the envisioned central underwater sound laboratory never came about, the Chief of Naval Operations saw possibilities in the centralizing concept and provided a more modest amount to finance what became known as Columbia's Hudson Laboratory.

The revelation of Bell's low frequency analyzer inclined those in the Navy to live with two entities rather than one. They did not want to interfere with the remarkably quick and productive work at Bell Telephone nor retard the Hartwell momentum. Thus, next to Ewing's Bermuda operation, two official projects existed to explore deep ocean sound and surveillance. Navy contracts for Project Michael covered the Hudson Laboratory activity supporting ocean science and their efforts in low frequency sound, and the

code name, Product Jezebel, veiled the commercial effort at Bell that focused exclusively on developing an undersea surveillance system.

Both activities drew their funding from the Office of Naval Research and the Bureau of Ships. Within days of delivery, LOFAR went to sea onboard the submarine U.S.S. *Halfbeak*, the SS–522, in an area adjacent to Guantanamo Bay, Cuba.

The device recorded the signature of the SS–522, both onboard and at Bell's Sandy Hook facility, confirming the potential of the system and suggesting greater possibilities in deeper water. If the Sandy Hook station could manage a valuable analysis from data taken in forty-two feet of water, the sound channel depths off of Eleuthera and Bermuda held much greater promise.

It took Bell roughly one month to obtain British permission to extend the project to Bermuda. In July, three hydrophones went into the water at forty feet to compare with the installation at Sandy Hook. Two more went down to 960 feet, and the last penetrated to 4,000 feet, the axis of the Atlantic deep sound channel. By October, the data Bell had received and discussions with the Committee on Undersea Warfare brought a general vote of confidence in the National Academy of Sciences.

Deploying Michael and Jezebel products came under the code name Project Caesar. The Navy and Western Electric began the preparations for installing Caesar's first general listening devices and stations in 1952 under the phase code-named Caesar I. The first Caesar station or naval facility (NAVFAC), NAVFAC Charlie, was built in 1954 at Ramey Air Force Base, ninety miles west of San Juan, Puerto Rico. It began effective listening in February 1955, the beginning of SOSUS operation. As knowledge and experience increased, the initial requests from the CNO for six stations continued to grow in number over the next dozen years through Caesar phases 2–A, 2–B, 3, and 4. The Navy initiated the final first generation installation phase, Caesar IV, in 1961.[7]

Projects Jezebel and Caesar, both important Cold War priorities, provide a vivid illustration of the vitality and creativity that can drive a joint research and development effort. Crucial to this process is establishing a comfort level achieved by cultural translation enhanced through bisociation. Before the first postwar decade had concluded, the professional dialogue between the Navy and the ocean sciences seemed mature, completely natural, and richly productive, indeed, almost second nature to naval personnel and industrial scientists, as well as those trained in the academic ivory tower.

NOTES

[1] The thesis of this paper, the analytical framework presented, and the supporting factual material came from the author's book, *An Ocean in Common: American Naval Officers, Scientists, and the Ocean Environment* (College Station: Texas A&M University Press, 2001). See especially chapters 11–13 on World War II and the maturation of the "dialogue," as well as chapter 16 on SOSUS. Detailed sources are provided.

[2] The concept of bisociation was conceived and first used by Arthur Koestler in his work, *The Act of Creation* (New York: Arkana-Penguin Books, 1989). In that work, he pointed out that ". . . bisociative shock often has the effect of making . . . implicit rules explicit, of suddenly focusing awareness on aspects of experience which had been unverbalized, unconsciously implied, taken for granted; so that a familiar and unnoticed aspect of a phenomenon . . . is suddenly perceived at an unfamiliar and significant angle. Discovery often means simply the uncovering of something which has always been there but was hidden from the eye by the blinkers of habit."

[3] Gary E. Weir, *Forged in War: The Naval Industrial Complex and American Submarine Construction, 1940–1961* (Washington, D.C.: Brasseys, 1998), chapter 6; Weir, *An Ocean in Common*, chapters 14–18.

[4] RADM J. A. Furer, Memorandum for Files, 27 August 1943, box 4, Coordinator of Scientific Research and Development General Correspondence, RG298, National Archives; Ingram to VCNO Communications, 21 July 1943; Iselin to Ingram, 13 July 1943; Ingram to Iselin, 2 August 1943; Maurice Ewing, "Long Distance Transmission of Underwater Sound," 12 July 1943, File Cabinet 3, Drawer D, File: SOFAR Original Proposal, Office Papers of William Maurice Ewing, Creighton A. Burke, and J. Lamar Worzel, Institute for Geophysics, Pickle Research Campus Warehouse, University of Texas (UT) at Austin. When Worzel and Ewing first established the existence of the sound channel they did not call the concept SOFAR. Worzel preferred LORASTO for Long Range Sound Transmission in the Oceans. However, the Bureau of Ships had its own idea for a name. Thus the selection of SOFAR. Recollections of J. Lamar Worzel, [cover letter dated] 10 December 1980, "Sofar—Sonic Fixing and Ranging," 39–54, Oral History Collection of Marie Tharp, South Nyack, N.Y.

[5] Frederick V. Hunt, "New Concepts for Acoustic Detection at Very Long Ranges [Bombshell Report]," Fifth Undersea Symposium, 15–16 May 1950.

[6] "The Hartwell Project," by Dr. Jerrold R. Zacharias, MIT, 9–10 May 1951, Naval Studies Board Archive, National Academy of Sciences,

Washington, D.C. Project Hartwell, MIT: "A Report on Security of Overseas Transport," 21 Sep 1950, volumes 1 and 2, Post 1 Jan 46 Command File [general descriptive material including the quote on a summer study group as the essential approach; the balance of the report as of this writing is still classified Secret], Momsen to Distribution List with attachment, 26 January 1951, file 5, series 2, box 7, Submarines/Undersea Warfare Division, U.S. Navy Operational Archive; ASW Surveillance, Phase I, Volume II Appendix A—History of ASW Surveillance, 28 June 1968, Edward Dahlrymple File Cabinet 1, drawer 1, Bldg W–1/Rm 1667, TRW Corporation Underwater Surveillance Office Archive, McLean, Va.; Weir, *Forged in War*, 133–38.

[7] Memorandum from the Special Panel on Low Frequency Sonar to the Committee on Undersea Warfare, National Research Council, 20 October 1950, National Academy of Sciences Naval Studies Board Archive; Iselin to ONR, 10 June 1949; Iselin to A. A. Brown, Operations Evaluation Group, 29 July 1949; Brown to Iselin, 27 July 1949, box 11; Hart to Ryder, 19 May 1950; Ryder to Commanding Officer, Branch Office of Naval Research, 12 May 1950, box 12, Office of the Director; Sound Recordings of the U.S.S. *Amberjack*, 5 March 1949, WHOI Audograph Soundwriter Disk Collection 1949–1950. For some background on the WHOI technique for using explosives as sound sources, see John Brackett Hersey, Essays III [a handwritten text in a computation book], box 9 [unprocessed], John Brackett Hersey papers, Data Library/Archive, Woods Hole Oceanographic Institution; Gaylord P. Harnwell, "Underwater Detection," 25 April 1947; Report on Project Kayo Conference, New London Connecticut, 10–11 January 1950, Naval Studies Board Archive, National Academy of Sciences; Benson to ComSubLant, "SS vs SS Operations," 22 July 1949; Benson to ComSubLant, Kayo Report Number 3, 15 October 1949, series 5, file A 16–3 (3), box 20, Project Kayo Incoming Correspondence, Submarines/Undersea Warfare Division; Hamilton interview, 15 September 1993; Worzel interview, 22 August 1990, NHC Oral Histories, U.S. Navy Operational Archive; Interview with Captain Joseph Kelly by David K. Allison and John Pitts, 9 November 1984, Navy Laboratories Archive, David Taylor Research Center, Carderock, Md. (These records are now resident at the U.S. Navy Operational Archive); U.S.S. *San Pablo* File, 1949–1950, box 139, W. Maurice Ewing papers, Center for American History Archive, UT, Austin; Worzel to Hamilton, 24 January 1950; Ewing to Hamilton, 28 March 1950; Hamilton to Ewing, 12 April 1950, File: SOFAR Hamilton, File Cabinet 3, drawer D, Institute for Geophysics Archive, Pickle Research Facility, UT, Austin; Pegram to ONR, 29 May 1950 [with attached contract renewal application for N6 onr 27124 and NR 350 013]; Procurement Justification form for contract N6 onr 27124, 28 December 1950; Edward T.

Miller, *San Pablo* SOFAR Cruise—New London to Trinidad and Trinidad to Newfoundland Legs, 8 November 1950; Proposal for Contract Renewal: N6onr271, Task Order XIII, for the year May 1, 1951–April 30, 1952; Smith to Hamilton, 6 November 1950; Code 418 [Smith] to Code 100, 13 September 1950 [N6 onr 27124]; Hamilton to Smith, 12 September 1950; Contract Clearance Memorandum, between ONR and Columbia University, 8 June 1950; Procurement Justification form for contract N6 onr 27124, 5 May 1950, box 3 of 5, accession #62–A–3303, Office of Naval Research, RG298, Washington National Records Center, Suitland, Md. Project Jezebel: Final Project Jezebel: Final Report on Developmental Contract NObsr-57093, 1 January 1961 [covering the period 1 November 1951 to 1 January 1961]; ASW Surveillance, Phase 1, Volume II, Appendix A—History of ASW Surveillance, 28 June 1968, TRW Underwater Surveillance Office Archive, McLean, Va.; *Dictionary of American Naval Fighting Ships*, vol. 6 (Washington, D.C.: U.S. Naval Historical Center, 1976), 302–03.

Weapons, "Weak" States, and the Military Contract System: The Case of RAND and the Air Force, 1945–1950

Martin J. Collins

In November 1947, Project RAND, situated at the Douglas Aircraft Co. under a 1946 Army Air Forces contract, had been underway just over a year and a half. A draft progress report noted that it was impossible to convey "the intangible benefits of the project—the intensive thinking of more and more civilians on military problems, the spread of a feeling of personal responsibility for national security among industrialists as well as scientists and technologists. The test of these gains can come only in the future. Still, if modern weapons have wiped out the sharp distinction between the military and civilian in time of war, so in time of peace such a differentiation has become outdated. RAND is in line with this development and thus by its very existence aids the nation to face the dangers ahead." [1]

In its first years, RAND did not focus on the problem for which it would become well-known in the 1950s: nuclear weapons strategy. Rather the new project was created in response to a widely shared perception among military, scientific, and industrial leaders: that in the unsettled international landscape of the postwar period researching, developing, and procuring modern weapons required more active, intimate connections between military and civilian institutions. In this paper, I will examine two strategies used by RAND and the Air Force as they confronted the challenges of reworking the boundary between the military and the civilian in the period immediately after World War II. Each strategy had to contend with two firmly rooted characteristics of American political culture: the distinction between private markets and government and the decentralized and pluralistic character of decision making in the military and in national political forums. The production and use of modern weapons seemed to

call for integration and coordination among public and private institutions, yet political tradition provided relatively ineffective tools to achieve these ends. In the American system during and after World War II, research, development, and production of weapons were points of creative tension for defining the market-government divide, much as the large corporation and concentrated economic power had been in previous decades. The sources of science and technology—industry and academia—were part of the market, autonomous of the state, in theory. Linking these sources of research, development, and production to the aims of the Air Force required strategies for coordination and direction of the market, and equally important, a revamping of Air Force managerial culture to implement these strategies. In the several years after World War II, as the Cold War landscape took shape, leaders in and outside the military shared a sense that modern war might require specific but limited state interventions to coordinate the work of crucial sectors of American society. RAND symbolized a new and widely considered question of the postwar period: How could the institutional pluralism and antistatist strains of the American political landscape be reconciled with the military interest in new weapons? The former tended toward the distribution of power and resources; the latter, toward a strong concentration of power and resources in the military. Strategies of nationalization or rigid central control were not possible. Other approaches that balanced pluralism against statist control had to be crafted.

The status and possible uses of the military contract were central to this debate. The contract was the ideal instrument for the American system of politics and weapons procurement. It connected the public with the private, the military services with industry and academia to acquire a discrete service or device. Yet, in principle, the contract maintained and respected the historic distinction between separate military and civil spheres. The military contract, as exemplified by its use in World War II, was at once a technical, legal, and political tool, embedded in a system of congressional appropriations, military program offices, and private firms. In the postwar period, RAND, Air Force, and other leaders considered whether the contract system was suited to the new emphasis on preparedness and weapons innovation. Could the decentralized and sometimes ad hoc character of military contracting provide the strong managerial coordination of national resources to meet the challenges of a new world?

RAND's founding exemplified this debate. The Army Air Forces typically used contracts to acquire hardware with specific characteristics; in the case of RAND, the service expanded the function of the contract to create a new institution, with no specified end product, to assist service leadership in planning.

In the period 1945–1950, RAND was emblematic of the exploratory and contingent ways universities and industry might be joined to the state through the adaptation of the contract system and through the creation of new institutions. At different times, different aspects of the problem of managing the procurement of weapons across the public-private divide were regarded as more pressing, shaping RAND's institutional objectives and its relations with the Air Force. From 1945 to 1947, RAND represented a trade association strategy, linking the aircraft industry with the Air Force in ways reminiscent of the associational models of state-business relations developed by Herbert Hoover in 1920s when he was secretary of Commerce. From 1947 into the early 1950s, RAND embodied what I call a knowledge strategy for addressing the problem of state-market relations. RAND sought to make the Air Force (and the sets of technical and social relations associated with research, development, and weapons production) a domain of phenomena amenable to study. Knowledge concerning this domain, legitimated by such quasi-scientific practices as systems analysis (a RAND invention), could ameliorate and perhaps replace institutional politics within the Air Force and among the Air Force, industry, and academia by rationalizing choices or claims about military operations, practices, organization, or doctrine—any aspect of the military and its role in American life. Knowledge could thus be an indirect way of coordinating and directing Air Force relations with the market.

The timing and fate of these strategies were intertwined with the contentious discussions between President Harry S. Truman and Congress over postwar preparedness and defense appropriations. A leading issue was the reorganization of the military services into a new, unified structure. The tensions associated with the creation and early evolution of the National Military Establishment—the precursor to what would become the Department of Defense—highlighted the importance of defining the relationship between the military and the civilian. So did a crucial subplot of the preparedness tussles: the decades-long policy vacillations over government support for the aircraft and airline industries, the mainstays of military and civil aviation. The war had created broad public and political support for the air power—the shorthand term for maintaining a strong military and civilian capability in aviation. Air power advocates pushed for broad, governmental reviews of national air policy. President Truman responded by establishing in 1947 the Presidential Air Policy Commission, chaired by Thomas Finletter (who later became secretary of the Air Force); Congress followed suit by convening the Congressional Air Policy Board, chaired by Senator Owen Brewster. The service and industry leaders prominent in RAND, such as Commanding General Henry "Hap" Arnold

and Douglas Aircraft president Donald Douglas, served as members of or testified before these boards and enthusiastically supported preparedness through air power and increased budgets.

But the strategies articulated through RAND (and embodied in the RAND contract) highlighted a different thread of preparedness ideology. Appropriations and contracts, in this view, were perhaps a necessary but not sufficient prerequisite for crafting a working relationship between the service and industry. More cooperative managerial approaches, grounded in rational decision making, were required to stimulate, select, and develop the new technologies of war. The unruly process of interest group politics associated with military appropriations and procurement might subvert this need for deliberative decision making.

In the political science and sociological literature, this feature of American politics fits into a model of statebuilding called "weak" and "strong" states. Strong states are defined as those most capable of acting autonomously, formulating and pursuing goals independently of and, in some cases, in opposition to, the preferences of societal interest groups. Weak states, on the other hand, are permeated by pressure groups vying to influence and shape state decisions and policy. This latter model roughly describes the American political and bureaucratic system. The RAND strategies described above can be viewed as a means to temper and direct the many contesting interest groups associated with the politics of weapons procurement.[2]

In the period 1945–1947, the key actors were Commanding General of the Army Air Forces Hap Arnold and Edward L. Bowles, an MIT professor who served as a consultant to Secretary of War Henry Stimson and to Arnold during the war. Two factors shaped their conception of RAND. One, as described by Michael Sherry in his analysis of the Air Force at war's end, was an ideology of preparedness. Arnold was the principal Air Force official in articulating and promoting this ideology. To Arnold, a commitment to preparedness seemed like a natural extension of wartime experience, rapid technological obsolescence and innovation were the order of the day. The long-range bomber and the atomic bomb, exemplars of this technological process, augured an era of devastating, near-instantaneous modes of attack. National survival, Arnold concluded, required the assiduous cultivation of technology to stay at the winning end of this dynamic. Preparedness, to Arnold and to many military and political leaders, entailed a national commitment to a large air force capable of projecting power worldwide and a pattern of cooperation with industry and universities that ensured the timely, efficient development of new technologies.[3]

Arnold and Bowles also had more specific motivations in crafting a trade association strategy for RAND: competition with the other services

for securing postwar relations with industry and academia, but more especially a concern about Vannevar Bush and his advocacy of a role for elite science supportive of, yet autonomous from the military. Bush had been head of the wartime Office of Scientific Research and Development and, in the postwar years, was a preeminent voice for protecting the independence of academic science in its relations with the military. Bush's influential views ran both parallel and counter to those of Arnold and Bowles. All these postwar leaders believed in a managerial solution for balancing the public and private stakes that were thrown into relief by the politics of preparedness and weapons procurement. Bush pursued such a managerial tactic as he lobbied for one of his most important postwar achievements, the Research and Development Board (RDB). Created as a component of the National Military Establishment in 1947, it was designed to provide top-level, cross-service management of all weapons programs and research. Bush meant to use the RDB to protect university-based science from being overwhelmed by military money and interests.

Arnold and Bowles perceived the same need for grand managerial mechanisms but had a diametrically opposite objective. For Arnold, the wartime experience highlighted the Air Force's emergence as a more complex institution with a more ambitious mission. That experience also created a more complex external market with which the Air Force had to work, involving universities and industry. The solution to the problem of the marketplace was not to form a pact of equals, as suggested by Bush, but to craft relations in which the service had control over those external resources deemed critical to its work. To Arnold, this was part of the meaning of Air Force independence. Independence meant not just independent standing as a service but control over market resources. Each was essential if the Air Force was to have the authority to carry out its perceived mission. Critical to this mission was the production of technologies that supported strategic air power. Autonomy for the institutions of science as Bush defined it could possibly deny the Air Force the ability to procure and use resources it thought were essential for developing new weapons. The strategy of the trade association devised by Arnold and Bowles was practical; it was to ensure the procurement of new weapons.

Arnold was primarily responsible for defining this context of ideology and institutional interests; Bowles was responsible for crafting RAND to meet these ends. With Arnold retiring from the Army Air Forces in February 1946, a month before RAND was formally initiated by contract under Douglas Aircraft Co., Bowles's own distinctive views on the postwar organization of science and technology gave RAND its specific formulation. To begin, Bowles drew upon personal and institutional relationships forged

during the war. The core of RAND leadership was provided by Arthur Raymond, chief engineer at Douglas, and his assistant Frank Collbohm. Both were members of an extensive technical consultant corps that Bowles led during the war under the auspices of Stimson's and Arnold's offices.

Through special projects that the three worked on, such as the modification of B–29s for attack on Japan and a survey of guided missile activity in the Air Force, Bowles, Raymond, and Collbohm began to reconsider the relationship of the service to industry. During the war, the purchase of commodities through contract had been the backbone of the Air Force-industry relationship. The experience of the war, as Bowles interpreted it, demonstrated that industry and the military were joined in a common corporate enterprise, not just as supplier and purchaser of commodities. The shared corporate goal was preparing for and fighting a war. The military activities of strategy and operations and the industry activities of development and production were functions of an extended corporation with the military as top management. Planning also implied rigor in reaching managerial decisions and required, in Bowles's view, a new intellectual discipline whose subject was the study of the new warfare: society against society, in an indefinite struggle, each equipped with weapons capable of devastating destruction.

But to implement this vision, Bowles and Arnold believed the service would have to recast its own organization, moving decisions on research, development, and procurement from the Air Technical Services Command to the air staff. To this end, in late 1945, Bowles helped establish the position of deputy chief of staff for Research and Development, at the time the third-ranking position on the air staff. Curtis LeMay assumed the office, with the aim of rationalizing the service's internal handling of research, development, and procurement as well as relations with universities and industry, including RAND.

The notion that the military and industry comprised an extended corporation had a certain rhetorical elegance. But Bowles and LeMay confronted limits in translating this idea into a set of new institutional practices. Direct control of industry was neither feasible nor desired. American political culture suggested more indirect methods. The path through the problem was the concept of shared planning. To be partners in planning was to be partners in management.[4]

Arnold, Bowles, and the Douglas Co. moved quickly after the war to reconfigure the service-industry relationship. On 1 October 1945, at Hamilton Field near Los Angeles, Arnold, Bowles, Donald Douglas, Arthur Raymond (chief engineer at Douglas), and his assistant Frank Collbohm met to lay the groundwork for RAND. Bowles summarized the results

of the meeting a few days later in a memo to the new Secretary of War Robert Patterson. The focus of the meeting was a specific research project proposed by Raymond: an intercontinental ballistic missile. This project would eventuate in RAND's first published study, *Preliminary Design of a World Circling Spaceship*. The missile idea arose from several factors. These included Arnold's interest in guided missiles as critical to the future of the Air Force and the Douglas Co.'s interest in preparing for a new business opportunity. Equally important, though, was the fact that an undeveloped technology provided much more latitude for reconfiguring industry-military relations. The principle of joint planning and management could be implemented from the start.[5]

RAND's principal purposes were to enable the Army Air Force and the aerospace industry to plan jointly future weapons development and to construct a new social site in which professionals from industry and universities could dedicate themselves to service problems. The project's placement in industry was calculated. While Douglas possessed the contract, the intent was that RAND would serve as a means for joint planning between the service and a significant part of the industry.[6]

The problem that received the most initial attention was articulating a specific coordinating mechanism. The thought of Bowles, LeMay, Donald Douglas, and Arnold (who remained involved despite retirement) was that the Douglas Co., as a preeminent member of the industry, could provide coordination under its auspices. But Donald Douglas at first chose a conventional means by which to organize his industrial partners. RAND let subcontracts to Boeing, Northrop, and North American Aviation to study selected technical aspects of rockets, satellites, and long-distance bombers. Bowles recognized that this approach was inadequate to meet joint planning and coordination goals of RAND. In the summer and fall of 1946, with LeMay's and Arnold's backing, he pressed Douglas to establish a more adequate mechanism. The result was the RAND Advisory Council. The Council included J.H. Kindelberger, president of North American; J.K. Northrop, president of Northrop Aviation; C.L. Egtvedt, president of Boeing; and Douglas. The group met in November. The intention was for this body, with staffing from their respective companies, to provide for industry coordination. Such an arrangement was not unprecedented. During the war, the industry, under Douglas's leadership, organized itself into National Aircraft War Production Council. The RAND board summarized its mission in a report to Bowles:

> The more industry knows about military planning and the more military planners know about what is technically feasible, the greater will be the proportion of airplanes and missiles that turn out to meet squarely a military need and the smaller

will be the proportion of duds. It follows directly that the nation will get more protection per dollar spent. This is the essence of the thought back of RAND. . . .[i]t is expected that the collaboration of others in the scientific and industrial world will be fully marshaled, on a selective basis behind the project. The military felt that this joining of forces could best be worked out by the parties concerned. . . .[7]

The RAND Advisory Council sought to walk a fine line. The members recognized the benefits of integrated planning and cooperative management but they wished to retain their institutional autonomy. Regarding the industry gathering as a point of departure, Bowles arranged for the RAND Advisory Council to meet in late January 1947 the leading military brass and civilian leadership: Secretary of War Patterson, Secretary of Air Symington, Chief of Staff Eisenhower, and General Spaatz, Arnold's successor as Commanding General.

This January meeting, seemingly filled with promise, was the high point of the effort to merge industry and the military through an *ad hoc* administrative mechanism. The RAND Council met periodically into early 1948. But within months of the Jaunary 1947 meeting service encouragement for the effort diminished. The new secretary of War, Kenneth Royall, forced Bowles out of his special consultant role in August 1947. An Air Force reorganization in October 1947, in response to unification, abolished LeMay's post. But perhaps more important was that the need for a joint arrangement to plan research, development, and procurement was weak. No major new initiatives in guided missiles or strategic bombers were imminent under the restrained budgets of the period. In disbanding, members of the RAND council, it seems, decided that their interests were better served by the efforts of the Finletter Commission and Brewster committee. As with the associational experiments engineered by Herbert Hoover in the 1920s, the RAND Advisory Council was inadequate to the problems of both the service and the industry. The goal of RAND as an industry coordinating mechanism withered. By early 1948, RAND planned to depart Douglas and establish itself as a nonprofit corporation, a transformation that was accomplished in November 1948.

Despite the failure of the trade association strategy, the problem of structuring relations between the Air Force and science and technology remained. But the initiative for addressing this problem shifted from service advocates to RAND itself. Air Force leadership was too consumed with the challenges of unification to manage RAND actively. If RAND was to prosper, it would need to define a role for itself that the Air Force found worthwhile. RAND's greatest resource was its growing cadre of disciplinary specialists, numbering near two hundred in 1948, with mathematicians, physical scientists, and engineers dominating, but including a small number of

philosophers, social scientists, and economists. Frank Collbohm, RAND's director, John Williams and Edward Paxson, both mathematicians, were instrumental in directing this resource toward the goals Arnold and Bowles had earlier articulated, but in a way that drew upon RAND's strengths. A central component of Bowles's approach had been to assert the value of regarding the military, in all its functions, as a domain for scientific research. Bowles had no specific idea of how this might be accomplished; he fashioned this possibility by extrapolating from his familiarity with the limited application of operations research to military tactical problems during World War II. Bowles envisioned this research activity only in the context of the trade association model. Research would be translated through the collective of industrial and service leadership; they would weigh its value and make decisions. In this way, research could contribute to the goal of coordinating and directing the Air Force's relations with its external markets.

Collbohm, Williams, and Paxson sought to achieve this same end, but without the vehicle of an ad hoc trade association. They would have to define what constituted a military domain of research, what methods would be used for investigating and legitimating knowledge, and how to convey research findings to Air Force, other military, and political audiences. Knowledge itself and its presentation would be the vehicle for relating service leadership to its markets.

The transition from a trade association model to one in which the idea of the military as a domain of research and knowledge predominated is revealed in a 1949 discussion between Collbohm and H. Rowan Gaither, chair of RAND's Board of Trustees and a prominent San Francisco lawyer. "The military," Gaither ventured, "now is confronted with problems of the greatest complexity. They are no longer problems of simply hardware or training of personnel but they actually embrace all fields of knowledge, and the need to acquire this knowledge and assimilate it into the Military Establishment is greater in this period of our history than any other period. . . . Stating it in a functional way, the Military Establishment . . . must gear itself through some mechanism, some instrumentalities, for the rapid assimilation of knowledge which is available outside the Establishment."[8] RAND, in Gaither's eyes, was such an instrumentality, a professional site for defining the relationship among knowledge and service interests.

But Collbohm and his associates had to develop a well-defined set of practices for investigating this research domain and choose a research project that would serve as exemplar of their methods. By mid- to late 1947, Paxson and Williams began to formulate the notion of "systems analysis." Over the next couple of years, systems analysis was promoted to the Air

Force as RAND's defining corporate product. This product was part reality, part hope. It was grounded in an extension of the mathematical techniques of operations research developed during the war but sought also to embrace the possibility, conveyed by Gaither, that all knowledge could be correlated and applied to military problems, preferably through some mathematical calculus.

RAND chose a carefully delimited problem for its first study, one central to the deliberations of service leaders as they grappled with the question of how to conduct a nuclear attack on the Soviet Union. Choosing a strategic bomber for the postwar period had perplexed service leaders since the close of the war, with the B–52 emerging as the troubled but leading candidate. RAND's study, called the Strategic Bombing System Analysis and prepared by Paxson, investigated the question of what type of bomber could inflict the most damage on the Soviet Union, given a range of procurement budgets and of supplies of atomic bombs, in the period 1956–60.[9] The conclusion was that an airplane, slower and less technologically advanced than the B–52 might fulfill strategic objectives more quickly and cheaply. Started in 1947, the study was presented at various stages of completion through 1949 into early 1950.

The study came at a crucial time for service leadership. Boeing's problems with controlling the weight of the B–52 had brought the Air Force's Board of Senior Officers—a body headed by the vice chief of staff and responsible for making decisions on major procurements—to the verge of re-advertising the contract to industry in 1949 and the first months of 1950. In the same period, the Joint Chiefs of Staff asked the Weapons Systems Evaluation Group and a committee headed by Lt. Gen. Hubert R. Harmon to review the Strategic Air Command's plans for attacking the Soviet Union. For the Board of Senior Officers, these concurrent events raised the prospect of tumultuous contractor politics and emphasized the high stakes in selecting the right strategic bomber. The RAND study seemed to offer a means for sound decision-making and for negotiating a complex political situation.

Paxson and Collbohm had been briefing the study within the air staff beginning in late fall 1949 and to major industrial firms in the first months of 1950, provoking increasing interest and discussion. Collbohm in April 1950, after a series of meetings with the Senior Officers Board, set down his perceptions on how RAND's systems analysis was received. On one level the RAND report was a novel device for organizing discussion and defining issues. The Board of Senior Officers circulated the report throughout the service as well as to contractors as a means of organizing a consensus around the B–52 or the RAND airplane. On another level, the Senior

Officers Board shared, temporarily, RAND's own expansive sense of the possibilities of making the military and its activities a domain of research. The Board pressed RAND into examining, in Collbohm's words, "the whole problem of the Air Force, to take some time to do some analytical work, and come back with recommendations as to what the Air Force should do in major policy planning for the period 1950 to 1960." Some members of the board even wanted RAND to manage their numerous meetings with the service commands and contractors, to evaluate in their place the proposals put before them. In essence, the board accepted the premise of the RAND enterprise: the military had become a sufficiently complex domain that the application of scientific method was at a minimum an essential tool, if not something more, in making crucial decisions.

Air Force enthusiasm seemed to sober Collbohm. He recognized the limits of RAND's competency and of its institutional savvy to operate in the intimate confines of service politics. He resisted the board's offer. The urgency behind the board's appeals to RAND were motivated substantially by the confluence of the problems with the B–52, the JCS reviews of SAC, and the relatively austere Truman budgets of 1948 to mid–1950. Under these conditions, making the right procurement decisions seemed to have higher stakes. With the flow of money generated by the Korean War, the interest in actively integrating RAND's analytical tools into the work of the board diminished.

The preoccupations of elite planners in the period between the end of World War II and the start of the Korean War are now mostly forgotten. But the impassioned political debates over preparedness and organizing society for a generation-long effort to research, develop, and produce technologically advanced weapons gave rise to intense examination of the utility and value of traditional distinctions in American society—the state and the market, the public and the private. The contract, in important ways, stood at the center of this conversation. As argued here, the ideology and politics of preparedness made research, development, and production of weapons and state-market relations central problems in the period 1945–1950. One response to these issues, as exemplified by the Finletter Commission and the Brewster committee, focused on the appropriation and allocation of federal monies through contract to industry and universities. But another response, exemplified by the RAND-Air Force-industry case (and by Bush's short-lived RDB), was to experiment with specific mechanisms for jointly planning technological innovation and for cooperative decision making. The trade association and knowledge strategies suggest that the challenge of weapons production could not be resolved solely through appropriations, interest group politics, and contracts. In this

thinking, contracts and military program offices needed to be subsumed into a larger, pan-institutional managerial framework, informed by rational, scientific analysis and planning. Arnold, Bowles, and other leaders felt that new inventions were required, at least during the period of restrained budgets before the Korean War, to organize planning between the Air Force and industry and to smooth the rough edges of a pluralistic political system. The demise of this point of view, in favor of a looser system of appropriations, program offices, and contracts, fundamentally shaped the procurement landscape of today.

NOTES

[1] Draft in folder "War Effort—RAND Letters, 1944–03/48," box 1, Edward L. Bowles papers (hereafter cited as ELB), National Air and Space Museum (NASM). These materials are duplicates of selected parts of the Bowles papers deposited in the Library of Congress.

[2] On the relation of this literature to studies of the postwar national security establishment, see Aaron L. Friedberg, "Why Didn't the United States Become a Garrison State?" *International Security* 16 (1992): 109–42.

[3] The best treatment of Army Air Force postwar planning and ideology is Perry McCoy Smith, *The Air Force Plans for Peace, 1943–1945* (Baltimore: Johns Hopkins University Press, 1970). Also important are Michael S. Sherry, *Preparing for the Next War: American Plans for Postwar Defense, 1941–45* (New Haven: Yale University Press, 1977), and his *The Rise of American Airpower: The Creation of Armageddon* (New Haven: Yale University Press, 1987). On Arnold's views, see "The Past Predicts the Future," op. cit., n. 18. On Arnold and "air power," see, for example, his address on NBC's "The National Hour," 6 January 1946, folder "12107—PWP—Other Talks by H. H. Arnold . . . ," box 1, ELB, NASM. Also see H. H. Arnold, *Global Mission* (New York: Harper, 1949), 612–15. On the early history of the Scientific Advisory Group and von Karman, see Thomas A. Sturm, *The USAF Scientific Advisory Board: Its First Twenty Years, 1944–1964* (Washington, D.C.: OAFH, 1986).

[4] The fullest expression of Bowles's concept of planning and its relation to RAND is a memorandum to Secretary of Air Stuart Symington, 26 November 1946, folder "War Effort—RAND—Symington . . . ," box 1, ELB, NASM.

[5] The 1 October meeting is described in a Bowles letter to Patterson, 4 October 1945, folder "Background Data & Correpsondence on RAND . . . ," box 1, ELB, NASM.

[6] See, for example, the exchange of letters between Bowles and Arnold in the fall of 1946, folder "War Effort—RAND Letters, 1944–03/48," box 1, ELB, NASM. A comprehensive history of big business in World War II has yet to be written; no extended account for the aerospace industry is available either. For broad outlines, see G. B. Simonson, ed., *The History of the American Aircraft Industry* (Cambridge, Mass.: MIT Press, 1968); and John Bell Rae, *Climb to Greatness: The American Aircraft Industry, 1920–1960* (Cambridge: 1968). Arnold himself had looked to the business community as a managerial and productive resource for the Air Force during and after the war, including as a source of management models. For hints on Arnold's and the Air Force's contact with the business community

during the war, see Donald M. Nelson, *Arsenal of Democracy: The Story of American War Production* (New York: Harcourt, Brace and Company, 1946), 231–38. An interesting interpretive account of the role of the aircraft industry in the war is in R. J. Overy, *The Air War, 1939–1945* (New York: Stein and Day, 1981), 149–84; for example, Overy states: "The recruitment of administrators demonstrated a critical difference between Allied and Axis powers in the degree to which industry was co-opted into the work of organizing aircraft production. One obvious advantage in wedding industrial experience existed between the two situations. In the capitalist west this choice was an obvious one. A war in defense of an economic system represented by a political structure sympathetic to capitalism involved industrialists as closely as it did soldiers. Thus in America the senior administrators of the war economy were almost all drawn from large-scale industry; industry cooperated closely with the authorities and created its own administration in the National Aircraft War Production Council." (p. 160). After the war, the problem of the aircraft industry and the state continued as a key concern not only for the Army Air Forces but also for Congress and Truman. It was the subject of congressional studies as well as a presidential commission, "The U.S. President's Air Policy Commission." The commission was formed in mid–1947 and issued its report the following year, *Survival in the Air Age* (Washington, D.C.: GPO, 1948). As the title suggests, the question of air policy generally was subsumed under the concerns of national security. The assumptions upon which Project RAND was established also guided the deliberations of the commission: the aircraft industry was a vital national security resource that should be actively supported and managed by government. In the commission's work it is also evident that the problem of university research and the state was ancillary to the development and production needs of the industry and the military.

On the ideology of business and its attitudes toward state in this period, see also Barton Bernstein, "The Removal of War Production Board Controls on Business, 1944–1946," *Business History Review* 39 (1965): 243-260; and his "The Debate on Industrial Reconversion: The Protection of Oligopoly and Military Control of the Economy," *The American Journal of Economics and Sociology* (1966/67): 159–72; as well as Richard Polenberg, *War and Society: The United States, 1941–1945* (New York: 1972), 10–19.

[7] Letter from Donald Douglas to Bowles, 18 December 1946, with attached Report, folder "WE—RAND Dec. 1946," box 1, ELB, NASM.

[8] "Transcript of Conference—H. Rowan Gaither, F. R. Collbohm, J. R. Goldstein," 1 September 1949, pp. 1–2, "Dictaphone Transcriptions, 1949" folder, Collbohm papers, RAND.

[9] *Strategic Bombing Systems Analysis*, 1950, RAND Publication R-173. This report is still classified Secret-Restricted Data. The contents of the report, though, have been gleaned from RAND's periodic progress reports to the Air Staff, RAND's internal newsletter, Collbohm's dictaphone transcriptions of meetings, and Air Force records on evaluation of the study.

PART II

The McNamara Legacy

Acquisition in the Department of Defense, 1959–1968: The McNamara Legacy

Walter S. Poole

The Kennedy administration came to power convinced that national strategy had become outdated and the acquisition process functioned poorly. The proof seemed abundant: an alleged ”missile gap” that favored the Soviet Union; the irrelevance of placing “main but not sole reliance” on nuclear weapons when confronting wars of national liberation; the failure of the 1958 Department of Defense (DoD) Reorganization Act to end interservice bickering and duplication; and horror stories of cost overruns and mismanaged programs, coupled with growing congressional criticism of contract administration (especially the cost-plus-fixed-fee method).

Robert S. McNamara, who assumed the position of secretary of Defense on 21 January 1961, had a very specific understanding of his role as the department’s senior executive. First, he meant to help define the objectives of U.S. foreign policy and appraise established and emerging threats. Then, in what McNamara deemed his most important function, he sought to articulate a national strategy and translate that strategy into force level and weapon system requirements. Finally, he would oversee the drafting of specifications for those systems, which, for the most part, would be done several bureaucratic echelons down. During his first weeks in office, McNamara made major innovations. He added a programming function to bridge the gap between planning and budgeting, thereby creating a Planning Programming Budgeting System (PPBS) to integrate strategy, force levels, and budget requirements. McNamara also created a five-year defense plan, which projected force levels eight years and costs five years ahead while providing for annual program change proposals. He made extensive and increasing use of civilian analysts to apply cost-effectiveness calculations in making force-planning decisions. McNamara embraced systems analysis as the most rational, mathematically rigorous means of choosing among

plausible alternatives. He and his analysts adopted a two-part methodology for breaking down problems into what systems analysts judged to be their component parts. First, they developed alternative solutions to a problem. Then they carried out a systematic cost-benefit analysis of each alternative. As McNamara saw it, there had been very little analysis of how small shifts in specifications could affect the utility of weapon systems. There were many cases, he was convinced, where slight modifications at little cost could greatly improve performance.[1]

When considering McNamara's legacy, it is important to remember that the ready availability of funds during the early years of McNamara's tenure as secretary of Defense provided unique circumstances for the acquisition community and the Department of Defense as a whole. Shortly after taking office, President Kennedy lifted Eisenhower's fiscal ceiling on defense expenditures, hiking the defense budget from about $43 billion to $50 billion; Congress readily complied. As a result, there were none of the interruptions or stretch-outs in production that bedeviled subsequent administrations. In late 1965, as the Vietnam War escalated, President Johnson reimposed a budget ceiling. Congress clamped down further in 1968, canceling the fast deployment logistics ship and requiring (as part of the deal for a tax increase) a $3 billion cut in defense expenditures during FY 1969. It is in this context of large expenditures followed by belt-tightening that the effectiveness of McNamara's changes to the defense acquisition process must be considered.

McNamara had understandable reasons for presuming that the acquisition process was broken when he took office in 1961. The Eisenhower administration faced growing congressional criticisms of its procurement policies, which came to a head during 1960 hearings before the House Armed Services Committee. Assistant Secretary of Defense Perkins McGuire maintained that cost-plus-fixed-fee (CPFF) contracts had grown to cover 34 percent of procurement dollars because "development of new weapons predominates and buys of production quantities of weapons for inventory [had] become less common." Both firm-fixed-price and fixed-price incentives, he argued, were feasible only when past experience made possible a realistic base price, and the pace of change often precluded that. Unconvinced, Chairman Carl Vinson led the charge in calling cost-plus-fixed-fee overused and condemning incentives as giveaways to contractors. Why not, the committee concluded, employ more rigorous firm-fixed pricing? Increasing the risk to contractors presumably would force economy and efficiency on them.[2]

The McNamara team agreed with Vinson's criticism of cost-reimbursable contracts. To placate Congress and also pursue its own

inclinations, the team decided to emphasize fixed-price contracts with single or multiple incentives. Assistant Secretary of Defense Thomas Morris talked publicly of letting profits range up to 15 percent, compared to the current 4.5 percent to 9 percent. Indeed, during 1961–1962 the Office of the Secretary of Defense (OSD) and industry reached a consensus that incentivizing contracts was the right path to pursue. As an Air Force official argued, "The fatal flaw of the cost-plus-fixed-fee is that profit is a function of estimated cost, unaffected by how well or poorly the contractor performs. In a profit-oriented economy, this defect is basic."[3] McNamara wanted to recognize the central importance, as he saw it, of the cost-benefit ratio. Between 1961 and 1968, the percentage of CPFF contracts fell from 36 to 10, while fixed-price incentive contracts increased correspondingly. But this shift did not translate into higher profits—quite the contrary. Average defense business profit as a percentage of total capital investment actually declined during most of the 1960s. Paradoxically, greater use of competition seems to have been the chief cause. Most defense firms became heavily involved in the commercial market, creating more competition for resources and new capital within the defense industry. Booming orders for commercial jetliners provided the best example. Just at the time when research and development began accounting for an increasing proportion of the aircraft industry's total business, a broad decline in production runs, which traditionally had been the foundation of profits, undermined the stability of the industry. The combination of increased costs and a narrower production base meant that the production breakeven point rose steadily.[4] In this kind of financial environment, profits were determined by market forces and not by DoD's new weighted guidelines.[5] Revisions to the Armed Services Procurement Regulations and laws like the Truth in Negotiations Act (enacted 10 September 1962) seemed almost like flotsam carried along by the current of technology and market competition; RAND Corp. studies concluded that the switch to fixed-price incentives had almost no discernible effect on acquisition outcomes.[6]

A few examples of management reforms can illustrate both progress realized and problems faced by the acquisition community in the 1960s. First, consider the activities of James N. Davis, who served as deputy assistant secretary of Defense for Weapons Acquisition and Industrial Readiness from 1961 to 1964. As an early task, he set up a compartmentalized inventory of all machine tools owned by the Department of Defense. "Men accumulate machine tools," Davis later observed, "like money or women." Once the inventory lists were compiled and Davis's reform efforts were underway, the services had to contend with new procurement guidelines that governed the purchase and storage of machine

tools. If, for example, the Navy wanted to buy some milling machines and the Air Force wanted to sell some of its, the Navy was required to check and see what excess equipment was available before making purchases from the open market. The services, Davis recalled, "fought like steers" before accepting this reform, and there was concern within OSD that the services might try to undermine or circumvent this effort. The Air Force was building B–70 prototypes and had been allocated as much as $200 million for hard tooling. Worried that the Air Force still hoped for a full aircraft production run and would spend the full amount allocated for tooling, McNamara ordered Davis to inspect the facility at Palmdale, California, every three months and report what hard tooling was being stored there.[7] These reporting requirements and supervision of compliance with them were part of a growing movement within OSD to centralize elements of the acquisition process.

The Defense Supply Agency (DSA) serves as a useful second example to illustrate management reform and centralization under McNamara. DSA started functioning on 1 January 1962. Why was it needed? Single managers were operating under rules set by their parent services; customers had to use as many sets of procedures as there were commodity managers. The DSA began by functioning as a wholesale distributor between major depots. Although the services still set requirements and controlled retail distribution to users, economy was realized by reducing supply inventory levels. The agency also became responsible for administering most contracts. After a pilot test in the Philadelphia region, Defense Contract Administration Services took up the task, which mainly involved eliminating duplication and prescribing uniform procedures. The services, however, continued to administer the funding of state-of-the-art weapon system programs, that is, those contracts that mattered most in terms of visibility and dollar value.

The other great innovation of the 1960s—undertaken to control costs by fostering competition—was total package procurement (TPP). Developed in 1964, TPP was promptly applied to such major programs as the C–5A cargo plane, the amphibious assault ship (LHA), the short-range attack missile (SRAM), and the Maverick missile. Assistant Secretary of the Air Force Robert Charles, the creator of TPP, had been executive vice president of McDonnell Aircraft. Charles identified the cause of cost overruns as "iceberg procurement," which involved buy-in bidding at unrealistically low prices and then "getting well" through negotiation rather than performance. Contractors used low buy-in bids to get a foot in the door, so to speak, fully expecting to renegotiate the terms of the initial contract award. The services proved to be very tolerant of this practice in the 1950s, so McNamara welcomed any contracting arrangement that would restrict this questionable

business behavior. Hailed as a miracle of contracting, TPP would allow the government to establish, through competition, binding commitments about price and performance covering operating costs over a system's lifetime. The success of TPP, though, depended on the fulfillment of certain conditions. *If* the government and the contractor could determine with reasonable accuracy what the weapon system was supposed to do, and *if* the requisite technologies necessary to develop the system were sufficiently developed so that straightforward engineering practices could be applied to make the system work, then binding commitments could be obtained and enforced. The Defense Industry Advisory Council (DIAC), a body composed of senior business executives, studied TPP and, in mid–1966, the group gave its qualified blessing to the practice. Members were most concerned with whether TPP would stifle innovation and creative technology. As members of DIAC saw it, the history of aircraft and missile development was the history of constant improvement within a program (e.g., successive models of the B–52, C–130, F–4, and Sparrow air-to-air missile). What would happen, they worried, after a full life-cycle contractor was chosen and the spur of competition ceased?[8]

As it turned out, they were worrying about the wrong thing. A 1966 RAND study suggested that the switch to incentivizing had done almost nothing to spur contractor efficiency and control costs.[9] Total package procurement, nonetheless, drew favorable early reviews. A 1967 study by the Logistics Management Institute (LMI) concluded that TPP was proving effective for a particular category of acquisitions: those state-of-the-art programs where design, development, production, and logistic support could be defined and priced at a high degree of detail. Contractors, it appeared, were being pressed to innovate in order to meet their cost, schedule, and performance requirements. But the LMI report also cautioned that since TPP locked in a set of performance requirements for a fairly long time, coping with change could pose difficulties.[10] By 1968, in fact, enough data was becoming available to prove that, despite endorsements from civilian and government executives, TPP and fixed-price incentives had not notably improved the acquisition process. Why?

Inflation, Vietnam, and commercial competition for skilled labor and resources played their parts. But the critical misjudgment, most likely, was a misreading of how technology affected acquisition. Policymakers seem to have assumed that nothing comparable to the great technological leap of the 1950s, from bombers to missiles, would occur during the 1960s. Yet, arguably, the strides made during the 1960s were just as great even if they were not outwardly as dramatic. The difference between a single-warhead Atlas D and a Minuteman III carrying multiple independently targetable

reentry vehicles (MIRVs) was a technical leap on the order of the progress from a Ford Model T to a Lexus luxury sedan. A RAND study comparing aircraft design and development in Western Europe and the United States concluded that the Europeans were bringing out models faster that were equal to ours in all aspects save avionics.[11] By the 1970s, however, it had become clear that aircraft performance now needed to be measured by the capabilities of the avionics package, not by old standards like maximum speed and rate of climb.

A 1970 article by a North American Rockwell executive, which drew upon a study done by the Aerospace Industries Association, ably analyzed the impact of continuous technological advance upon defense procurement. Theoretically, fixed-price incentives encouraged technologically superior performances. In practical terms, contractors faced situations where rewards and penalties proved irrelevant to their ability to perform: "The technology of highly advanced systems is so soft that the contractor must work at his maximum effort and speed just to get the job done; an incentive designed to make him work harder and faster than he can is futile." The author distinguished "anticipated unknowns," whose costs at least could be roughly estimated, from the increasingly frequent and much more dangerous "unanticipated unknowns," whose costs could not be estimated at all. This "total uncertainty envelope" induced the government to press for definitive specifications even while it induced contractors to seek broad and flexible ones. Lockheed, for example, anticipated using carbon or alloy-steel brakes for the C–5; instead, it had to develop a system with costly beryllium brakes. Engineers at first saw the C–5 as a technological upgrade of the C–141, but it turned out to be more like a quantum leap. Moreover, an error in one estimate tended to amplify itself as development and production went forward. Under these conditions, the author concluded, profit and loss became "largely irrelevant to meritorious contract fulfillment."[12] The full dimensions of TPP's failure to control the C–5's costs were just beginning to unfold as 1968 ended. But enough soon would be known for a business executive to say without fear of contradiction at a 1971 DoD-industry symposium that "we must . . . never, never make the mistakes of the sixties again."[13]

How did McNamara's effort at centralization play out in terms of correlating acquisitions with strategy? Immediately upon taking office, the Kennedy administration replaced the strategy of Massive Retaliation with one of Flexible Response. There was no prior interagency study similar to Project Solarium of spring 1953 and no paper articulating the new concept comparable to the November 1953 statement of Basic National Security Policy in NSC 162/2. "Flexible Response" was perhaps more a mantra

than a strategy. What, for example, would be the threshold for employing nuclear weapons? No clear answer appeared.[14] President Kennedy prized a capacity to adapt strategy and tactics promptly to meet novel situations. He promptly eliminated the NSC Planning Board, which had played a central part in formulating and later revising the Eisenhower administration's "New Look" strategy. The result, probably unintended, was that the articulation of national strategy became the province of the Office of the Secretary of Defense. McNamara used draft presidential memorandums (DPMs) to spell out strategic concepts as well as propose and justify force levels. These DPMs grew in number from two in 1961 to sixteen by 1968. They grouped forces into functional categories such as strategic retaliatory, continental defense, general purpose, air and sealift, antisubmarine warfare, and underway replenishment. McNamara expected the services to start speaking this language and appraise acquisition decisions in these terms.

The 1963 DPM on strategic retaliatory forces set an objective of "assured destruction" of 30 percent of the Soviet population, 150 cities, and 50 percent of its industrial capacity, which became the justification for capping the Minuteman ICBM force at 1,000. The DPMs for general-purpose forces specified a capability for waging two wars, later increased to two-and-one-half; that definition justified sixteen (and later eighteen) active Army divisions as the Vietnam War escalated. McNamara declared that force levels would be determined by requirements, not by arbitrary budget ceilings as in the Eisenhower years.

Since McNamara defined strategy in terms of force requirements and determined all requirements himself, however, the Joint Chiefs of Staff (JCS) and the services ultimately felt marginalized. Military men came to see the DPMs' elaborate cost-effectiveness calculations by systems analysts as rationalizations for force levels that already had been chosen. In 1963, for example, McNamara cited an Index of Combat Effectiveness to claim that U.S. ground capabilities for defending Western Europe were greater than previously allowed. General Maxwell Taylor, the JCS chairman, countered: "The most important factors, courage, morale and leadership, are not subject to physical measurement. If as most soldiers believe, 'in war the moral is to the physical as three is to one,' only about a fourth of the determinants of victory are susceptible to the coefficient approach and they are variables undergoing constant change." McNamara did not change the DPM; he simply appended Taylor's critique as a footnote.[15] In another DPM, McNamara asserted that NATO's lead in payload delivery capability translated into superiority over Warsaw Pact air forces. The JCS denied that payload should be the determining factor in the equation and made a less optimistic appraisal. Were systems analysts stressing payload because it was

the category where NATO had a clear lead? By 1967, McNamara and the JCS were at loggerheads on practically every major force-level issue. The Air Force, for example, still made the achievement of air superiority its top priority and developed the F–15 for that purpose, winning approval of the F–15 contract definition after McNamara left office.[16]

When McNamara took office in January 1961, all of the services were oriented toward waging nuclear warfare. Long lead times, of course, ruled out any rapid reorientation of service capabilities toward limited war. However, the doctrinal and organizational obstacles to change often proved as great as the technological ones. Strategic Air Command dominated the Air Force to the point that, in 1959, consideration was given to abolishing the Tactical Air Command. According to Air Force manuals of that time, "The best preparation for limited war is proper preparation for general war." This institutional viewpoint was not easy to undermine; in August 1964, more than three years into Flexible Response and on the eve of escalation in Vietnam, the doctrinal manual devoted only two pages to counterinsurgency compared with thirteen for nuclear and conventional air operations in support of general war.[17]

While McNamara could fix force levels, the services retained a strong voice in determining how they would be equipped. The story of the F–111, which started life designated as the TFX, shows how the services were able to set limits on McNamara's bid for centralization. Acquisition, strategy, and doctrine were all tied together; in order to control any one of them, McNamara had to control all of them. Both the secretary and the services steadily escalated the stakes involved, making the F–111 probably the most publicized weapon system of the 1960s. The Air Force wanted a successor to the F–105, a plane that had been designed primarily for high-performance delivery of tactical nuclear weapons at low altitude. Emphasizing that capability made perfect sense under Eisenhower's strategic concept that the United States would not fight a limited, conventional war with the Soviet Union. Tactical Air Command specified that the successor plane should be capable of a long, low-level supersonic dash, so that TAC could compete with long-range missiles in delivering nuclear weapons.

After only three weeks in office, McNamara ordered the Air Force and Navy to start developing a joint tactical fighter, the F–111, tailored for a variety of conventional and nuclear missions. To him, the advantages in economy and efficiency seemed obvious and overriding. But service doctrines, rising costs and novel technology combined to raise almost insuperable obstacles. First, there was the matter of technological overreach revolving around the swing-wing. A series of "unanticipated unknowns" arose, aggravated perhaps by the speed with which McNamara moved to

set specifications. The variable swing-wing design looked good in theory, but hinging wings to the fuselage with large pins in a central yoke added weight and undermined structural integrity. The wing-mounted munitions-carrying pylons, which had to be swiveled so they still would point straight ahead when the wings moved, proved to be another serious technical obstacle. Greater than expected aerodynamic drag and fuel consumption meant that the supersonic dash had to be much shorter and at subsonic speed, yet a broad spectrum of design choices making the plane bigger and heavier had been keyed to a supersonic nuclear dash. And if the emphasis now was on conventional capability, why was a dash needed at all? As an added complication, program milestones were chosen to obtain a high degree of concurrency, overlapping the testing of prototypes with the start of series production. An early penalty was the stalling caused by engine-inlet incompatibility, which the government had to pay to correct. The F–111's Mark II avionics system promised much, but costs mushroomed and performance fell short. It seems inconceivable that even a man of McNamara's energy and dedication could have mastered so many intricate problems. Apart from all these "unanticipated unknowns," he had to contend with service opposition to the "one size fits all" approach embodied by the F–111. McNamara's choice of General Dynamics, which involved the almost unprecedented step of rejecting the Air Force-Navy Source Selection Board's recommendation of Boeing (the Air Force's long-time favorite) prompted congressional hearings that gave service critics powerful allies on Capitol Hill.

With the Navy, what McNamara faced was really not so much a doctrinal dispute as a tradition of autonomy, derived from the conviction that the Navy had a unique task that made it the best judge of its own needs. The Navy maintained that the plane was too heavy for carrier takeoffs and landings. Fundamentally, what the Navy disliked was the bi-service nature of the program. Thus, despite an aircraft weight reduction program carried out under McNamara's personal supervision, the Navy-controlled flight tests produced results that continued to rate the F–111B unfit for service.[18] After McNamara left office, the Navy did finally kill the F–111B and procured instead its own F–14. The Air Force's F–111A emerged as more a bomber than a fighter, lacking the acceleration and maneuverability necessary for a multipurpose aircraft. McNamara's second-best solution was to pressure the Air Force into canceling its F–107 and adapting the Navy's F–4H, which, as the F–4 Phantom fighter-bomber, became that service's mainstay for the next decade.

There was an important sense in which the Navy's victory in the battle over the F–111 proved to be a Pyrrhic one. McNamara had relied heavily on the service secretaries to push the F–111. Successive secretaries of the

Navy failed to justify his expectations. Navy obstructionism confirmed, in McNamara's mind, the pervasive influence of service parochialism as well as the persistence of an adversarial relationship between the OSD and the services. That helps explain why, in 1965, McNamara raised Alain Enthoven to the position of assistant secretary of Defense (Systems Analysis) and relied increasingly on his recommendations.

When McNamara turned his attention to the Army, which Flexible Response greatly elevated in importance, he found what he considered to be a sluggish and unimaginative organization as far as acquisitions was concerned. The proof seemed to lie in the Army's ten-year effort to develop, within its own arsenal system, a successor to the M–1 rifle. Most senior officers did not welcome the new emphasis on counterinsurgency and unconventional warfare; a regular soldier, they felt sure, could always defeat a guerilla. The great rifle controversy must be considered in the context of the Army's training and doctrine, which favored combat environments similar to those faced during World War II or in Korea. The Army's M–14 reflected that preference. Technologically, the M–14's principle improvement over the M–1 was a selector piece for automatic firing, a device reserved for squad leaders (a policy intended to conserve ammunition in the heat of battle). But that seemingly modest change was enough to create production line problems that brought rifle output to a halt. McNamara publicly labeled the M–14 program a "disgrace," noting that building a rifle was relatively simple compared to producing the ICBMs and SLBMs that had been developed and deployed in less time. McNamara sent out his own trouble-shooters and finally forced the Army to accept Eugene Stoner's lightweight AR–15, modified into the M–16.

Intervention by OSD only fostered more controversy. Civilian appropriation of the rifle decision upset some combat arms and ordnance officers. Army critics noted that the new rifle undermined the institution's traditions; the widespread introduction of M–16s virtually did away with rifle inspection, a crucial officer-enlisted man relationship for more than a century. In Vietnam, while the M–16 proved clearly superior to the M–14, controversy erupted over reports of deaths in combat caused by M–16 malfunctions. Although the blame for malfunctions could most likely be attributed to the Army's decision to modify the weapon and change the standard ammunition, the M–16's negative reputation was unshakeable in some circles.[19]

McNamara conceived the Main Battle Tank as the Army's equivalent of the TFX. In 1963, he and his West German counterpart agreed to a collaborative effort, the MBT–70, that he justified along the same lines as the F–111: "The pooling of ideas and sharing of costs should make for a

better end product at lower expense." But here, too, doctrinal differences between the two countries combined with technological difficulties to create insuperable obstacles. The M–60 in service was essentially the fourth-generation version of a late World War II medium tank design, heavier and better armed. The Army identified a requirement for a much more sophisticated successor capable of carrying the extremely complex Shillelagh, a beam-riding antitank missile that was still under development. The Army wanted Shillelaghs because its tank doctrine called for engaging enemy forces at 2,000 to 3,000 meters, a range at which rifled guns became less effective. The Bundeswehr's doctrine, by contrast, called for engaging at 1,000 meters or less—but 1,000 meters was the Shillelagh's minimum range. Since Central Europe was the likely battleground, one would think that the two allies could have come to agreement about how to fight there. But they did not, and OSD did not intrude; it is not clear whether McNamara understood the doctrinal issue and its importance. As an added complication, the Bundeswehr was ready to field the Leopard I tank, which it had taken only four years to develop. German engineers, unlike their American counterparts, retained all rights to completed inventions. Consequently, the Germans had no stake in an experiment like the Shillelagh, which proved very difficult to perfect. The price of collaboration was an agreement for the MBT–70 that was "more complex and risky than either army would have pursued if left to itself." Costs spiraled and the project finally collapsed.[20] The Leopard I entered service in 1965; the U.S. Army had to live with upgrades of the M–60 until 1979. Since armor was a mainstay of conventional defense in Europe, where McNamara wanted non-nuclear capability strong enough to serve as a firebreak against nuclear escalation, failure of the MBT–70 undercut his strategy.

McNamara prompted a study that led to creation, in 1962, of the Army Materiel Command (AMC). The Ordnance Department's poor record in tank and rifle development afforded ample reason for reining in the technical branches that had become almost like independent fiefdoms. The AMC's first commander, General Frank Besson, was under pressure to move quickly and felt he had no alternative to appointing forty-one program managers, seventeen of whom reported directly to him—an exceptionally wide span of control. What was AMC's contribution in terms of value added? Some senior officers thought that AMC became little more than Ordnance writ large. This claim deserves closer study. Besson pointed with pride to the vast expansion of ports, roads and depots in Vietnam between 1965 and 1968. His successor, General Ferdinand Chesarek, had a less sanguine view: "We used the push supply technique in Vietnam, the most wasteful war we have ever fought . . . because a man back here . . . is going

to push as much as he can get lift for, so that he will not be charged with a shortage. . . . Most was never used; finally ended up bulldozing it into big holes and burying it."[21]

McNamara's relations with the Navy seem always to have been strained. For example, he crossed swords constantly with Admiral George Anderson, who was Chief of Naval Operations from 1961–63. In an emotional interview in the mid–1970s, Anderson related how, early on, a German-born civilian analyst, Dieter Schwebs, had begun a cost-effectiveness study of attack carriers, leading Anderson to make a strong protest to McNamara. Of course, the analyses continued. McNamara looked upon antisubmarine warfare as the Navy's most important mission, in which carriers would not play a major role. The point of contention became whether carriers should be oil-fired or nuclear-powered. McNamara's directive to the Navy was couched in his trademark language: "As a general guide, I am interested in achieving the most efficient possible naval forces, defining efficiency as achieving the most beneficial military results for a given expenditure." The Navy, in 1963, concluded that a nuclear-powered carrier's superior performance would more than offset its slightly greater lifetime cost. McNamara, however, cast the choice in different terms: "I am absolutely certain of one thing," that having six conventional carrier task forces would be better than having five nuclear ones. Also, by raising concerns about the carriers' growing vulnerability, McNamara seemed to be diminishing the role of what the Navy still saw as the centerpiece of U.S. sea power.

Despite the efforts of Admiral Rickover and his congressional allies, McNamara got funding for the oil-fired *John F. Kennedy*. Then the Vietnam War intervened to preserve a force level of fifteen carriers, just as the Korean War had helped to save naval aviation. In a striking reversal of policy, McNamara recommended funding a nuclear-powered carrier in 1966, a decision informed in part by the fact that such a ship now would require two reactors, rather than the four proposed in the earlier design (hence the vessel passed the cost-effectiveness test). Whether to build nuclear-powered escorts remained a controversial issue, but the overall level of surface unit construction was the basic question. Instead of protected convoys, antisubmarine warfare began to center on P–3 patrol aircraft and especially on barriers of nuclear attack submarines that would dispatch Soviet submarines as they entered and exited the North Atlantic.[22] Scores of World War II ships were nearing the end of their useful lives; critics charged that McNamara was concealing the cost of Vietnam, in part, by postponing replacement construction. But production also was postponed because new anti-air systems promised much—and then "unanticipated unknowns" added more deferrals. The upshot was that the next administration had to cope with

the consequences of block obsolescence. McNamara's experience recalls a remark by President Franklin Roosevelt. Trying to change anything in the Navy, Roosevelt said, was like punching a pillow. You could punch and punch until you were exhausted, but the pillow's shape would remain the same.

There was one crucial area where McNamara successfully melded strategy, doctrine and acquisitions: strategic retaliatory forces. He imposed Mutual Assured Destruction under criteria, mentioned earlier, that allowed detailed cost-effectiveness calculations. In retrospect, McNamara looked on leveling off the Minuteman force at 1,000 missiles as his best and most important acquisition decision. By the mid–1960s he had become convinced that the best defense was a good offense. Let the Soviets spend $40 billion on ballistic missile defenses; we could negate their deployment by spending $10 billion on MIRVs, decoys, and penetration aids. "The cost in itself is not the problem," ran his 1967 rationale for rejecting heavy U.S. missile defenses; "the penetrability of the proposed shield is the problem." McNamara angered the Army by blocking Nike-Zeus; and the Air Force, by halting the B–70, holding the Advanced Manned Strategic Aircraft to concept formulation, and refusing to proceed with a large-payload ICBM development project. But his force-level and acquisition decisions have mostly stood the test of time; succeeding administrations continued adding more reentry vehicles rather than more silos, megatonnage, or missile defenses. David Packard later identified Polaris and Minuteman I as the two best-managed programs involving complex weapon systems and noted that they were done without OSD playing a major role. While this may be true, the cause and effect of that fact is far from clear. Moreover, Poseidon and Minuteman III were successful, even more complex, and accomplished with full OSD participation.

In *The High Priests of Waste*, Air Force analyst Ernest Fitzgerald waxed indignant about the huge cost of fixing Minuteman II's guidance system. Mean time between failures (MTBF) had fallen so low that 40 percent of the force was offline. The MTBF contract requirement was defined as a goal, not a specification; hence the government bore the expense. But the Air Force and OSD were dealing with "unanticipated unknowns"; their objective was assuring performance, not capping costs. Fitzgerald complained that, for Minuteman III, "contractual documents did not commit the contractors to do anything but did commit the government to pay them money up to a stated limit, called the limitation of cost. As the contractors' spending approached the cost limit, the compliant Air Force contracting officers would simply raise the limit to permit the contractor to continue. . . ."[23] Yes, but how else could a path-breaking project have kept moving forward?

The New Frontiersmen felt that they had inherited in the Single Integrated Operational Plan not a nuclear war plan but a "horrible spasm." McNamara wanted weapon systems that would permit a controlled, discriminating response, providing counterforce as well as countercity (or countervalue) options. The 1961 Hickey Report concluded that this was not achievable before 1971.[24] Polaris was strictly a counter-city weapon, and Minuteman I could not take out hardened targets. Minuteman II, however, made a great advance in accuracy and could qualify for counterforce use; so would the Poseidon C–3. Air Force Systems Command very much disliked what it saw as OSD's intrusion. So, reversing the question about the Army Materiel Command, the issue here is whether the Air Force Systems Command suffered some value lost. Looking strictly at ICBMs, there is no evidence that development and deployment were delayed or that performance suffered. Minuteman I's circular error probable shrank greatly in the Minuteman II, fielded only four years later. The MIRVed Minuteman III, well along when McNamara left office, qualified not as an evolution but as a new weapon system.[25] Here, then, McNamara could claim that acquisitions were turning his strategic vision into reality.

Vietnam, however, supplied McNamara's military and congressional critics with ample ammunition. The failure of Operation ROLLING THUNDER came to symbolize the shortcomings of centralization. Rejecting repeated military advice, McNamara stayed wedded to a strategy of graduated pressure against Hanoi and micro-managed the selection of targets during the ROLLING THUNDER bombing campaign. Both the air campaign in the North and the attrition campaign in the South failed to break the enemy's will. The bill of particulars against McNamara's management of the war grew steadily longer. As an example, iron bombs had to be repurchased from West Germany at higher prices because stocks ran low; this problem was emblematic of the kind that undercut the deference that Congress had shown toward McNamara in the early 1960s. Early in 1968, the seizure of the U.S.S. *Pueblo* followed by the Tet offensive presented the administration with two crises at a time when Vietnam deployments had drained away practically the entire CONUS strategic reserve. Available forces could not fight two wars, let alone the two-and-a-half required by national strategy. Here was proof that some of McNamara's force-level calculations and justifications were wrong.

Could technology have carried the day in Vietnam? In mid–1965, the director of Defense Research and Engineering, Dr. Harold Brown, approved about eighty projects for limited war and counterinsurgency, on such things as low-level aircraft, jungle equipment, and target acquisition beacons. However, Brown cautioned the Defense Industry Advisory Council that,

"he was not positive technology would provide the needed answers." Thus far, he admitted, technology had in fact provided "very little."[26] Precision guided munitions, the one thing that might have made ROLLING THUNDER much more effective, entered the inventory in quantity several years too late. The classic story tells of the Thanh Hoa bridge, which survived many attacks during ROLLING THUNDER but was taken out by one smart bomb in 1972.

Should centralization be labeled an acquisition failure? "Unanticipated unknowns" continually thwarted efforts to trade off cost against performance in setting requirements. Arguably, though, the public perception was worse than the reality. A wide range of weapon systems conceived during the 1960s were well regarded by the services when they came on line in the 1970s. Even the C–5A, once its wings were fixed, performed excellently during the October 1973 airlift and thereafter. Still, when McNamara left office in February 1968, centralization clearly had fallen out of favor. The Nixon administration kept important features of the Planning Programming Budgeting System, but returned considerable authority to the services. Yet in McNamara's mind, the purpose of systematizing had been to promote centralization. If the services could determine acquisitions, McNamara believed, then they would be able to define the strategy—more likely, the strate*gies*, because no service was sufficiently broad-gauged to see the whole national security problem objectively.

McNamara had moved to impose systematization and centralization promptly and by fiat. Whether he might have achieved more by moving slowly and building consensus is not clear. The Joint Chiefs of Staff and the services accepted the outer form of systematization but not the inner substance of centralization. The chiefs rearranged their Joint Strategic Objectives Plan (JSOP) so that its force-level recommendations were presented according to the program package format. Thus they started speaking the secretary's language, but it never became their native tongue. Under the new JSOP format, for example, the long-running dispute over whether tactical air should be primarily land-based or carrier-based went on unabated and unresolved. Strategic retaliatory forces, however, formed a large exception; thinking truly did shift from service over to program package terms. It is worth remembering, though, that McNamara built on a foundation laid by his predecessor, Thomas Gates. By establishing the Single Integrated Operational Plan and the Joint Strategic Target Planning Staff, Gates compelled the services to begin viewing that segment of strategy, doctrine, and acquisitions from wider perspectives. Otherwise, though, service cultures were entrenched firmly enough to prevent McNamara's push for centralization from reaching fulfillment.

NOTES

[1] Charles J. Hitch, *Decision-Making for Defense* (Berkeley: University of California Press, 1965); see also Alain C. Enthoven and K. Wayne Smith, *How Much Is Enough?* (New York: Harper & Row, 1971).

[2] Hearings, *DoD Procurement Presentation in Connection with the Committee's Study of Procurement Policies and Practices*, 8–9 February 1960, 24–25, & No. 67, 31 May 1960, 6045–75, HASC, 86th Cong, 2d sess.; also see *Army-Navy-Air Force Journal* 97 (30 July 1960): 11–28.

[3] Address by Assistant Secretary of the Air Force Robert Charles, 23 September 1964, OSD Historical Office, Box 604. However, a 1956 study of contracting with Atomic Energy Commission offered this defense: "The cost-plus-fixed-fee contract is the administrative contract par excellence. For the market mechanism, it substitutes the administrative mechanism. For the profit share of private entrepreneurs, it substitutes the fixed fee, a payment in lieu of profits foregone. And for the independent business unit, it substitutes the integrated hierarchical structure . . . of an agency . . . and its contractors." Richard A. Tybout, *Government Contracting in Atomic Energy* (Ann Arbor: University of Michigan Press, 1956), 175.

[4] Donald M. Patillo, *Pushing the Envelope: The American Aircraft Industry* (Ann Arbor: University of Michigan Press, 1998), 250.

[5] Logistics Management Institute Task 69-1, *Defense Industry Profit Review*, March 1969, 13, 14, 17, 23, 24.

[6] Report, RM-5700-PR by Irving M. Fischer, *A Reappraisal of the Incentive Contracting Experience* (Santa Monica: RAND, 1968).

[7] James N. Davis, interviewed by Elliot V. Converse III, and Walter S. Poole, U.S. Army Center of Military History, Ft. Lesley J. McNair, Washington, D.C., 29 June 2001.

[8] "Summary Minutes—Meeting of the DIAC," 10–11 June 1966, OSD Historical Office.

[9] Ernest Fitzgerald, *The High Priests of Waste* (New York: W. W. Norton, 1972), 94–95.

[10] Logistics Management Institute Task 67-3, *Total Package Procurement Concept: Synthesis of Findings*, June 1967, 64, 67, 74.

[11] Report, R-733-PR/ARPA by Robert Perry et al., *System Acquisition Strategies* (Santa Monica: RAND, June 1971), 30–32. We badly need a methodology for appraising the amount of technological change that various weapon systems incorporated. This study includes, on p. 13, a chart of "Technological advance ratings" on a scale of 1 through 20 with nine broader categories (e.g., "several weapon system elements require improvement and integration"). However, perhaps because of the particular

weapon systems that were chosen, I believe that the chart seriously underrates the technological advances of the 1960s and the difficulties that they presented.

[12] Hudson B. Drake, "Major DoD Procurements at War with Reality," *Harvard Business Review* (January–February 1970): 119–41.

[13] *Proceedings of Symposium on Major Defense Systems Acquisition*, 11–12 September 1971, NDU Library.

[14] The contrast can be seen in NATO strategy documents. MC 14/2, adopted by the North Atlantic Council in 1957, stated that NATO would employ nuclear weapons, regardless of whether the Soviets did so, in all cases save incursion, infiltration, or local hostile action. MC 14/3, ten years later, described both direct defense by conventional means and the threat of nuclear escalation.

[15] U.S. Dept. of State, *Foreign Relations of the United States: 1961–1963*, Vol. VIII (Washington, D.C.: GPO, 1996), 138 –52, 158–77, 545–71.

[16] Jacob Neufeld, "The F–15 Eagle," *Air Power History* (Spring 2001): 4–19.

[17] Conrad C. Crane, *American Airpower Strategy in Korea, 1950–1953* (Lawrence, Kans.: University Press of Kansas, 2000), 175.

[18] Robert F. Coulam, *Illusions of Choice* (Princeton: Princeton University Press, 1977), passim.

[19] James Davis, "How the Army Got Its Rifle Changed," 1986; Thomas L. McNaugher, *The M–16 Controversies* (New York: Praeger, 1984); William H. Hallahan, *Misfire* (New York: Scribner's, 1994), 445–521.

[20] Report, N-1680-RC by Thomas L. McNaugher, *Collaborative Development of Main Battle Tanks* (Santa Monica: RAND, 1981), 4–26.

[21] AMC Oral History Program, "Reflections of Former AMC Commanders," AMC History Office, Alexandria, Virginia, 1989.

[22] Thomas M. Roherty, *Decisions of Robert S. McNamara* (Coral Gables: University of Miami Press, 1970), 141–72. Systems analysts concluded that, "the key to future efficiency was large-scale production in a single yard, with standardization strongly enforced." U.S.S. *Spruance*, the first of thirty DD 963s, entered service in 1975. See Norman Friedman, *U.S. Destroyers* (Annapolis: Naval Institute Press, 1982), 221–25, 363–64, 369–77.

[23] Fitzgerald, *High Priests of Waste*, 115–22.

[24] *Foreign Relations: 1961–1963,* Vol. VIII, 196. The study was conducted by a group from the National Security Council Net Evaluation Subcommittee, headed by Lieutenant General Thomas F. Hickey, USA.

[25] Hearings, *Government Procurement and Contracting*, pt. 4, House Cmte on Gov't Operations, 91st Cong., 1st sess., 23 April 1969, 1122.

[26] "Summary Minutes—Meeting of the DIAC," 10–11 September 1965, OSD Historical Office.

Building Missiles: Concurrency and the Legacy of the Early Air Force ICBM Program

John Lonnquest

In the early 1950s, the rapid evolution of technology, coupled with the increasing tensions of the Cold War, forced the United States Air Force to reevaluate the way it developed weapons. Its immediate problem was twofold. The growing sophistication of high-speed jet aircraft and long-range ballistic missiles, both of which incorporated advanced power plants, sophisticated electronics, and high-speed airframes, taxed the abilities of the United States' most accomplished scientists and engineers. The designers' job was further complicated by the rapidly escalating tensions of the Cold War. As the arms race intensified, the Air Force wanted its new generation of weapons developed faster than ever before.

In an attempt to solve, or at least mitigate, the effects of this vexing dilemma, in the early 1950s the Air Force altered its approach to weapons development. First, it began developing its new weapons on a systems basis. This represented both a conceptional and organizational shift as the Air Force began concentrating less on building the components and more on integrating the pieces to form a fully operational weapon system. Several years after the introduction of the so-called systems concept, the Air Force also enthusiastically began using an aggressive new program management philosophy it called concurrency. Intended to accelerate the development process, concurrency was predicated on scheduling a high degree of overlap between the research and development, testing, and production phases of the development cycle. Both the systems concept and concurrency came of age on the Atlas Intercontinental Ballistic Missile (ICBM) program and both bore the indelible imprint of one man, General Bernard Schriever.

To understand the magnitude of the changes wrought by the introduction of the systems management concept, one needs only to examine the Army's aircraft development process prior to World War

II. The procedures had changed little over the previous thirty years. First, the Army determined the aircraft's technical and performance specifications and then, acting as its own general contractor, hired an airframe manufacturer to build the fuselage. Other contractors supplied the major components such as the power plant, avionics, and fire control system. The major subsystems were often developed independently of one another and were usually provided to the aircraft manufacturer as government furnished equipment.[1]

The results were often less than satisfactory. All too often the engineers trying to assemble the mismatched pieces found themselves with an aircraft that fell far short of the Army's requirements. Despite its many flaws, however, during the lean interwar years this cumbersome system was still a viable way of developing aircraft. With little money available to develop new aircraft, designers contented themselves with making incremental improvements to the existing technology. Moreover, there was little stimulus to produce new aircraft quickly. With few incentives to reform the system, Army aircraft development meandered along until World War II.

As one might expect, aircraft development changed rapidly under the pressures of the war. The Army Air Forces (AAF) Materiel Command, which at that time was responsible for research and development and procurement, staggered under the herculean task of designing and building tens of thousands of new aircraft. The old system was a product of the Materiel Command's functional organization: One laboratory controlled engine development, another supervised avionics, and a third produced the armament. Coordination between the laboratories was poor, and the system proved incapable of supervising the production of thousands of aircraft at dozens of new plants scattered across the country. Coordinating the development effort among the various contractors also proved to be a nightmare, revealing that the Army lacked both the personnel and a management system capable of monitoring all of its aircraft development programs.[2]

In an effort to streamline the development process, toward the end of the war the Army Air Forces began developing aircraft on what it called a systems basis. Under the new concept, the Army selected an aircraft manufacturer as the prime contractor and then made that firm responsible for developing the entire aircraft, from propeller to tail, plus all of the ground support equipment and specialized maintenance facilities necessary to make the aircraft operational. The Army first used the new development strategy on the B–29 bomber and P–61 night fighter.[3]

The results of the systems approach were encouraging, and the Air Force continued to experiment with it through the late 1940s.[4] At the same

time the program managers at Wright-Patterson AFB were experimenting with this new way of doing business, other far reaching organizational changes were in the offing in Washington. For years a small but influential cadre of officers had been arguing that the Air Force's Air Materiel Command (AMC), which was responsible for research and development, procurement, and maintenance, was simply too busy to wage the kind of rigorous, far-reaching research and development program the Air Force needed. Reflecting the culmination of years of behind-the-scenes lobbying, in January 1950 Air Force Chief of Staff Nathan Twinning accepted the recommendations of the Ridenour and Anderson reports and announced that he was creating the position of deputy chief of staff for Development (DCS/D) and would also soon establish an independent research and development command.[5]

Nearly a year and a half elapsed before the Air Research and Development Command (ARDC) was formed in April 1951. In the interim, the staff of the new DCS/D completed several studies to determine how the Air Force should conduct research and development (R&D) under the new command. One of the most influential studies was written in April 1951. The paper, titled "Combat Ready Aircraft: How Better Management Can Improve the Combat Readiness of the Air Force," was prepared under the direction of Colonel Bernard Schriever, the Assistant for Development Planning, DCS/D.[6]

Schriever's study was a critical examination of AMC's R&D structure and policies. He found major weaknesses in the AMC system and argued that because of certain "organizational and procedural flaws," it was ill-suited for developing complex weapon systems.[7] In making a case that weapons development needed to be conducted on a systems basis, Schriever argued that in the past, the Air Force had not always understood that a "complete weapon means not only the airframe and the propulsion, armament, and electronic systems within the airframe, but also the ground support equipment, facilities, and spare parts required for satisfactory service."[8] Timing was important, too. Not only did the components have to fit together perfectly, but they also had to be ready at the same time.

To fit all of the components together, Schriever noted, required not only a "degree of luck," but also weapon system planning, budgeting, and control. The problem with the current system, he found, was that a requirement for a new weapon, although originally established as a complete system, quickly lost its identity as such. The cohesiveness of the requirement evaporated as the responsibility for its components was assigned to various different commands. The development of the components became an end unto itself, and their relationship to the overall weapon system was a secondary consideration.[9]

To correct this organizational imbalance, Schriever proposed that at both the Air Staff and the field development agency levels, complete weapons system control should be vested in a new management level located one tier above the organizations specializing in the individual components. Equally important, the new management level must, as Schriever wrote, "not only have the responsibility but also the authority to plan, budget, program, and control the research and development effort."[10]

Schriever's study quickly gained the support of the special assistant to the Chief of Staff, retired Lt. Gen. Jimmy Doolittle. Doolittle was pushing for a broad-based reorganization of Air Force R&D, seeking to simplify the working relationship between ARDC and AMC project offices and also between the Air Force and its contractors.[11] As a part of that reorganization, in November 1951 Doolittle wrote to Lt. Gen. Earle Partridge, the commander of ARDC, telling him that he wanted to attain the organizational changes proposed in Schriever's study.[12]

With Doolittle's support, Schriever's study helped convince the Air Force to begin developing its weapons on a systems basis. The Air Force called the approach the weapons system management concept, and in December 1952 General Donald Putt, the vice commander of ARDC, ordered that all major development programs use it. Putt wrote "that the complete weapon system—the aircraft or guided missile, its components, supporting equipments, and USAF preparation for its implementation as a weapon—should be planned, scheduled, and controlled, from design through test, as an operating entity." The objective of the new system, Putt told the commander of the Wright Air Development Center, was to develop a "balanced and complete combat-ready weapon system. . . ."[13]

By early 1953 the weapon system management concept had emerged as the centerpiece of the Air Force's efforts to restructure its approach to R&D. The Air Force hoped that the new methodology would improve coordination between ARDC, AMC, and their contractors by forcing each organization to restructure its management efforts on a systems basis.

With the weapon system concept firmly established, in the spring of 1954 Schriever's career took a new turn. Since early 1953 Schriever, along with Trevor Gardner, the special assistant to the secretary of the Air Force for Research and Development, had been prodding the Air Force to accelerate the ICBM program. Together Gardner and Schriever assembled a group of influential advocates to lobby on behalf of the missile program. None was more influential than the brilliant mathematician John von Neumann, chairman of the Air Force's Strategic Missiles Evaluation Committee, commonly referred to as the Teapot Committee. In its February 1954 report, the Teapot Committee boldly concluded that "given the proper

direction and support," the United States could field an operational ICBM in six to eight years.[14]

In May 1954 Schriever and Gardner's efforts culminated in Chief of Staff Twinning ordering the Air Staff to accelerate the Atlas program to "the maximum extent technology would permit." The chief of staff also gave the missile program a 1–A development priority (the Air Force's highest), a generous budget, and a talented staff.[15] In another important development, in June 1954 Gardner selected Schriever to command ARDC's Western Development Division, the ICBM program management office located in Inglewood, California.

With the lessons of the "Combat Ready Aircraft Study" fresh in his mind, Schriever, who was about to embark on a development effort of unprecedented scope and complexity, recognized that despite his best intentions, the weapon system concept would quickly lose its cohesiveness if he lacked the authority to put it into practice. As a result, from the outset of the Atlas program Schriever was adamant that he had to have wide-ranging authority to enable him to administer the project on a systems basis.[16] He got much of what he asked for. ARDC commander Lieutenant General Thomas Power gave Schriever "complete control and authority over all aspects of the Atlas program."[17]

From his first day on the job, Schriever understood that Atlas would not be operational by 1960, the goal established by the Teapot Committee report, using the Air Force's standard development methodology. Without the time to develop the missile and its support facilities in a sequential, step-by-step fashion, Schriever elected to use a risky and controversial management technique he called concurrency. Designed to compress the development cycle, concurrency was predicated on overlapping the research and development, testing, and production phases with the goal of having all of the pieces of a fully operational weapon system ready at the same time.

Although the concept of concurrency came of age during the ICBM program, it was not born at the Western Development Division. The military had used it to develop weapons during national emergencies since World War I, when the Navy designed and produced depth charges concurrently. During World War II, the military used concurrency to speed the development of radar, the proximity fuse, and the atomic bomb.[18] The Army Air Forces also used concurrency to expedite the development of new aircraft, most notably the B–24 and B–29 bombers and the P–47 fighter-bomber.[19] However, after World War II ended and the defense budget was cut way back, the military curtailed its use of concurrency.

Hemmed in by the Teapot Committee's optimistic estimates, when Schriever took command of the Atlas program he had no choice but to

"undertake all phases of the design-to-production-to-operation cycle concurrently rather than sequentially."[20] Concurrency, said General Charles H. Terhune, the WDD's deputy commander, was not the easiest way to produce the ICBM quickly—it was the only way.[21] At Schriever's direction, during the summer and fall of 1954 the WDD planners set 1960 as the completion date and began working backward, establishing program milestones as they went.[22] "Concurrency," said Lt. Col. Richard Jacobson, the WDD deputy director for testing, "was not an intellectual exercise." We used it," Jacobson remembered, "as a way to back into our schedules."[23]

Schriever liked to describe concurrency as "moving ahead with everything and everybody, altogether and all at once, toward a specific goal."[24] It was a risky and complicated approach. Using concurrency and guided by a master schedule studded with carefully calculated milestones, the WDD was preparing to build the Atlas launch facilities and ground support equipment well before it finished designing the missile.[25]

The contrast between concurrency and sequential development was striking. In the normal development cycle missile production, crew training, and the construction of the vital support facilities did not begin until after R&D was completed and the design finalized. Not so with concurrency. Production, albeit of early prototypes, began during the R&D phase, as did training and the construction of the launch facilities. For example, data from the first flight tests was fed back into the production process. That resulted in a steady stream of carefully controlled design changes being incorporated into the missiles on the assembly line. But altering the missile was only the first step. Often the changes resulted in other time-consuming and expensive modifications: production lines had to be reconfigured, training programs changed, and missile silos rebuilt.

Concurrency was a complicated process, easy to describe yet extraordinarily difficult to understand. It had many faces, and depending on its applications, each one was different. To Atlas program manager Otto Glasser, concurrency was simply a collective description that incorporated many of the elements of the WDD's management process.

The term "concurrency" originated at the Western Development Division in 1955. During that hectic first year, as Schriever and his planners wrestled with the details of the first Atlas development plan, they frequently described overlapping or parallel tasks as happening "concurrently." Searching for a readily understandable way to describe the complicated development process, in early 1955 Schriever began calling it "concurrency."[26] It was a description intended only for public consumption. The term "concurrency" was rarely if ever used within the

walls of the Western Development Division.[27] Similarly, neither the Air Force nor its contractors ever used the term in any of their correspondence. James Dempsey, the president of Convair's Atlas division, said neither he nor his staff ever used the term "concurrency" when describing the missile program.[28]

How, then, could the WDD's staff, whom Otto Glasser said "lived with concurrency . . . and believed in it almost to the point of being a religion," not have talked about it?[29] In actuality they did, but never used the term "concurrency" to do it. That was because from their perspective, concurrency was not a single, unified management approach. Concurrency was only one element of the WDD's management process. In order for concurrency to be effective, the program management office also needed a high degree of centralized authority, adequate resources, and a talented staff. Concurrency did not exist separately; it was the sum of its parts.

Schriever, however, made concurrency the symbol of the Ballistic Missile Division's (Western Development Division changed its name in June 1957) entire management approach. In doing so, he equated concurrency exclusively with the overlapping development and production process and ignored the many contributing factors that made it work. Although this was a dramatic oversimplification, it served Schriever well. It allowed him to use concurrency as a buzzword, a simple, convenient way to describe the intricate development process to the uninitiated.[30] The result was that although Congress and the media still did not understand the Ballistic Missile Division's management methodology, through Schriever's stripped down explanation of concurrency, they thought they did.

Concurrency was also a superb public relations tool. It helped Schriever cloak the ICBM program in an aura of managerial expertise and reassure Congress that its money was being well spent.[31] When members of Congress visited the Ballistic Missile Division (BMD), Schriever briefed them in the heavily guarded Program Control Room (PCR). Schriever called the PCR the nerve center of his entire program, and it was there that all of the information from the BMD's comprehensive management control system flowed. Standing in front of a huge wall covered with more than 400 brightly colored charts showing the master milestones, hardware production records, and master weapon system configuration lists, Schriever was able to offer his visitors seemingly convincing evidence that concurrency worked.[32]

Concurrency was the most prominent component of the Ballistic Missile Division's development approach. Over the years its role in the ICBM program has been unduly praised and unjustly criticized. Perhaps the most realistic assessment of concurrency came from Brig. Gen. Osmand Ritland, the BMD vice commander. He said, "Bold as it is, the concept of

concurrency really embraces little more than the principle of teamwork, applied with modern management techniques and possessed by an attitude of urgency. . . . Simply speaking, concurrency implies progress in parallel fashion rather than in series fashion."[33]

Schriever remained an ardent proponent of concurrency throughout his career. Based on his experience with the ICBM program, he argued that concurrency was a practical and cost-effective way to develop weapons quickly and efficiently.[34] Despite Schriever's support, however, concurrency remained controversial and its effectiveness, measured in terms of producing an operational weapon system quickly and at a reasonable cost, was the subject of much debate within the Pentagon. The commonly shared sentiment among senior officials was that concurrency did indeed save time, but at a frightful cost. In 1961 Lt. Gen. Roscoe Wilson, the deputy chief of staff for Research and Technology, described concurrency as "useful but very wasteful" and said that the Air Force could only afford one or two such programs.[35] Harold Brown, the director of Defense Research and Engineering, told a House subcommittee that he thought concurrency was justified only on critical programs.[36] William Holaday, the director of Guided Missiles within the Office of the Secretary of Defense, had similar sentiments. In the past, Holaday said, concurrency was unnecessarily expensive and in the future should only be used on programs where compressing the development cycle was of the utmost priority.[37]

In retrospect, the Atlas program amounted to a test case for the weapon system management concept and concurrency. Before Schriever used them on the missile program they lacked both a track record and a constituency. The ICBM program changed that. Both weapon systems management and concurrency flourished on the Atlas program, and were also used in the follow-on Titan, Thor, and Minuteman programs. Later, senior Air Force personnel took the gospel of concurrency to NASA.

The Atlas program thrust the weapon system management concept and concurrency squarely into the national spotlight. Schriever was an effective advocate for both. Under his stewardship the missile program acquired a reputation for tough, astute, aggressive management. Schriever's genius lay in the application of the weapon system concept and concurrency. His principal contribution was in creating a development organization and an operational environment that allowed both to flourish. It was a three-step process. First, he secured an unparalleled degree of support, initially from the Air Force, and later from Congress and the White House, for the ICBM program. Next he translated that support, applied through the weapon system management concept, to define the far-reaching parameters of the Western Development Division's responsibilities. Then once all of the

program elements were defined and milestones were established, Schriever could arrange and re-shuffle them using concurrency. The often overlooked point here was that the systems management concept was an essential prerequisite for concurrency.[38] Also, had Schriever tried to use concurrency without the necessary preconditions, notably the systems managment concept, a talented staff, generous budget, and consistent political support, it would have likely been a disaster.

The Atlas program helped usher both systems management and the concurrency into the mainstream of weapons development. But what was their long-term legacy, or to put it another way, how have they fared since Atlas? The systems management concept has prospered and is now the accepted way of developing almost everything within the Department of Defense. Concurrency's legacy is less clear. Schriever's model of an all-encompassing, seamless management plan was clearly misleading. Also, contrary to Schriever's position, concurrency did not save money. Although it helped the Air Force produce an operational ICBM faster than would have been possible using sequential development, concurrency was frightfully expensive.

The Air Force always recognized concurrency's limitations, and in the early 1960s began reevaluating its stance on the controversial technique. Part of that was attributable to the changing climate for R&D. The tremendous push to develop the ICBMs, quickly and all costs, slackened. Another important factor was new management in the Department of Defense. Anxious to introduce a measure of centralized control into the weapons development process, Secretary of Defense Robert McNamara introduced phased planning in an attempt to curb some of concurrency's most egregious excesses.

Concurrency, however, did not disappear. It flourished under a variety of guises. In the early 1960s, for example, it made its way to NASA and the Apollo program in the form of "all-up" testing. Like concurrency, all-up testing was created to meet a pressing deadline, in this case the presidential mandate to land a man on the moon by the end of the decade. The idea behind all-up testing was simple. With the Apollo program already behind schedule and over budget, in 1963 NASA's new Associate Administrator George Mueller ordered the agency to abandon its carefully choreographed sequential flight test program in favor of all-up testing. Instead of making multiple test flights consisting of various combinations of the first, second and third stages, Mueller ordered that the first Apollo launch would test the entire missile and launch vehicle assembly. Despite considerable internal resistance, all-up testing proved to be successful and was in large measure responsible for getting the Apollo program back on track.

Although concurrency and all-up testing were risky and controversial, both later became symbols of their respective organizations' management prowess. In perhaps its longest and most controversial legacy, all-up testing became a model for other high-technology development programs that hoped to emulate NASA's success. Initially, Apollo's success appeared to confirm the benefits of all-up testing and, by inference, of concurrency. During the 1960s and early 1970s, experts from around the globe flocked to the United States to learn the secrets of systems management. But as later generations of program managers ruefully discovered, both concurrency and all-up testing were ill-suited to programs that lacked the generous budgets and consistent political support that the early Air Force and NASA programs enjoyed.

NOTES

[1] For a superb overview of the military's weapons development policies and the rise of systems engineering, see Stephen Johnson, *The United States Air Force and the Culture of Innovation 1945–1965* (Washington, D.C.: Air Force History and Museums Program, 2002).

[2] For an excellent account of the difficulties of World War II aircraft production, see I. B. Holley, *Buying Aircraft: Materiel Procurement for the Army Air Forces*, United States Army in World War II, Special Studies Series (Washington, D.C.: GPO, 1964).

[3] "Weapon System Plan Spurs Development," *Aviation Week* (17 August 1953): 83.

[4] Another factor that increased the Air Force's reliance on the systems concept was the growing complexity of missiles and jet aircraft. The systems concept streamlined the development process and also shifted much of the program management burden to industry, an attractive option at a time when the Air Force was having trouble recruiting qualified officers for R&D billets. Sterling J. Livingstone, "Weapon System Contracting," *Harvard Business Review* 37 (July–August 1959): 83.

[5] Air Force Scientific Advisory Board, "Research and Development in the United States Air Force" [the Ridenour report], 21 September 1949, Air Force Historical Research Agency (hereafter cited as AFHRA); and the Anderson Report, 19 November 1949, in the "History of the Air Research and Development Command, January 1950–June 1951," vol. II, June 1951, AFHRA, file K243.01.

[6] "Combat Ready Aircraft: How Better Management Can Improve the Readiness of the Air Force," staff study prepared by the Office of the Deputy Chief of Staff, Development, April 1951, AFHRA, Marvin C. Demler papers, file 168.7265–237, folder T–10.05, "Air Force Growth."

[7] Ibid., 3.

[8] Ibid., 23.

[9] Ibid., 14.

[10] Ibid., 15, 23.

[11] Letter, Doolittle to the commanders of ARDC [Putt] and AMC [Cook], subj: Briefings on Various Aspects of ARDC-AMC Relationship, 15 November 1951, 1–2, AFHRA, Earle E. Partridge papers, file K168.7014–4, folder, "cc August–December 1951."

[12] Letter, Doolittle to Partridge, subj: none [wants to attain the objectives established in Schriever's "Combat Ready Aircraft Study"] 15 November 1951, 1, AFHRA, Earle E. Partridge papers, file K168.7014–4, folder, "cc. August–December 1951."

[13] Letter, General Putt [vice commander ARDC] to Commanding General, WADC [Wright Air Development Center], subj: General Policy Guidance Using Single Prime for Developing Complete Weapons System, 18 December 1952, 1, AFHRA, Demler papers, file K168.7265, folder T–10.06: "Weapons System Policy."

[14] Recommendations of the Strategic Missiles Evaluation Committee, 10 February 1954, in Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945–1960* (Washington, D.C.: Office of Air Force History, 1990), 259. For more on the political and technological controversy surrounding the ICBM, see Edmund Beard, *Developing the ICBM: A Study in Bureaucratic Politics* (New York: Columbia University Press, 1976) and John Lonnquest, "The Face of Atlas: General Bernard Schriever and the Development of the Atlas Intercontinental Ballistic Missile, 1953–1960" (Ph.D. diss., Duke University, 1996).

[15] Memorandum, General Thomas White, Air Force vice chief of staff, to Air Staff, subj: Project Atlas, 14 May 1954, in Thomas S. Snyder and others, eds., *Space and Missile Systems Organization: A Chronology 1954–1976* (Los Angeles: Office of History, HQ Space and Missile Systems Organization, 1976), 19–20.

[16] General Bernard Schriever USAF (ret.), interview by the author, 27 August 1991, Arlington, Va.

[17] Memorandum, Lieutenant General Thomas S. Power, ARDC commander, to Schriever, subj: Assignment of Authority, Responsibility, and Accountability, 29 July 1954, Ballistic Missile History Office, Norton, Calif. (hereafter cited as BMO/HO), Basic Documents. Note: The Air Force closed the BMO in 1995 and transferred the history office's extensive document collection to AFHRA. The documents have yet to be accessioned, so I continued attributing them to BMO/HO.

[18] Wayne G. Glass, *Concurrent Weapons Development and Production* (Washington, D.C.: Congressional Budget Office, 1990), preface, 19–20.

[19] Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program* (Ithaca, N.Y.: Cornell University Press, 1992), 329.

[20] Bernard Schriever, "AFBMD: Catching Up With the Soviets," *Missiles and Rockets* (28 July 1958): 53.

[21] Major General Osmand J. Ritland, "Concurrency," *Air University Review* 12 (Winter–Spring 1960–61): 240.

[22] Colonel R. E. Hogan, "Management of the Atlas Weapon System," 12 October 1959, 5–6, AFHRA, file K243–012–53.

[23] Jacobson was in agreement with an internal Air Force report that found in practice concurrency begins with establishing an end date "and working backward in time for each major task . . . so that each area for action is clearly

delineated for management control purposes." Lieutenant Colonel Richard K. Jacobson, USAF (ret.), interview by the author, 24 August 1991, Washington, D.C.; Hogan, "Management of the Atlas Weapon System," 29.

[24] Bernard Schriever, "The USAF Ballistic Missile Program," in Lieutenant Colonel Kenneth F. Gantz, *The United States Air Force Report on the Ballistic Missile* (Garden City, N.J.: Doubleday & Co., Inc, 1958), 31.

[25] Claude Johns, Jr., "The United States Air Force Intercontinental Ballistic Missile Program, 1954–1959: Technological Change and Organizational Innovation" (Ph.D. diss., University of North Carolina at Chapel Hill, 1964), 121.

[26] Schriever interview, 27 August 1991.

[27] Colonel Bruce Arnold, a member of Schriever's personal staff, and Colonel Joseph Hale, the deputy manager on the Thor program, never heard the term "concurrency" used at the WDD. Colonel Bruce Arnold, interview by the author, Washington D.C., 16 January 1992; Colonel Joseph Hale, interview by the author, Raleigh, N.C., 5 November 1991.

[28] James R. Dempsey, interview by the author, 7 March 1992.

[29] Lieutenant General Otto Glasser, interview by the author, 13 August 1991.

[30] The author confirmed this in an interview with Schriever's former vice commander. Lieutenant General Charles Terhune, USAF (ret.), interview by the author, 5 August 1991.

[31] Harvey Sapolsky found a similar set of circumstance's on the Navy's Polaris missile program. See Harvey Sapolsky, *The Polaris System Development: Bureaucratic and Programmatic Success in Government* (Cambridge, Mass.: Harvard University Press, 1972); W. Henry Lambright, *Governing Science and Technology*, Public Administration and Government Series (New York: Oxford University Press, 1976), 53.

[32] Colonel Charles W. Getz, "Management Control in the Air Force Ballistic Missile Program," 1959, 5–10, BMO/HO, box F-8; Ernst G. Schwiebert, *A History of U.S. Air Force Ballistic Missiles* (New York: Praeger, 1964), 96. Note: At one point the milestone charts contained more than 9,000 items.

[33] Ritland, "Concurrency," 240.

[34] U.S. Congress, House, Subcommittee of the Committee on Government Operations, *Hearings, Systems Development and Management (Part 3)*, 87th Cong., 2d sess., (Washington, D.C.: GPO, 1962), 819; Bernard Schriever, "Systems Analysis: Useful, Yes—But Hardly a Panacea," *Air Force and Space Digest* 51 (May 1968): 59–60; U.S. Congress, House, *The Organization and Management of Missile Programs*, HR 1121, 86th Cong., 1st sess. (Washington, D.C.: GPO, 1959), 59.

[35] Robert Frank Futrell, *Ideas, Concepts and Doctrine: Basic Thinking in the United States Air Force, 1961–1984*, vol. II (Maxwell, AFB: Air University Press [1971], 1989), 169.

[36] Concurrency was justified, Brown said, only in those instances where the United States stood "in a very serious danger of failure of deterrent . . . or of an enormous loss of military power. . . ." U.S. Congress, House, *Hearings, Systems Development and Management (Part 3)*, 465.

[37] U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, Subcommittee on Governmental Organization for Space Activities, *Hearings, Investigation of Governmental Organization for Space Activities*, 86th Cong., 1st sess. (Washington, D.C.: GPO, 1959), 551.

[38] For more on the relation between systems management and concurrency, see Eugene Emme, ed., *The History of Rocket Technology* (Detroit, Mich.: Wayne State University Press, 1964), 148; Robert L. Perry, "The Atlas, Thor, and Titan," *Technology and Culture* IV (Fall 1963): 471; Michael E. Brown, *Flying Blind: The Politics of the U.S. Strategic Bomber Program* (Ithaca, N.Y.: Cornell University Press, 1992), 175; Lonnquest, "The Face of Atlas," 160–74; Stephen Johnson, *The United States Air Force and the Culture of Innovation 1945–1965* (Washington, D.C.: Air Force History and Museums Program, 2002).

Seeds of a Revolution: Maritime UAVs in the 1960s

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In the remarkable but obscure history of unmanned aerial vehicles (UAVs), the decade of the 1960s (in which they were called "drones") marks their noteworthy emergence as useful combat aviation systems. Yet it was also a decade of frustration, as common knowledge about combat drones remained miniscule due to secrecy, and because no UAVs survived this period to become a regular part of U.S. military operations. As unmanned aerial vehicle technology continues to mature in the twenty-first century, the acquisition community can distill some important lessons from the "first UAV decade" that can, in turn, lead to more efficient, effective unmanned aircraft operations in the future. The key, as this paper will outline, is to understand the distinct patterns of acquisition behavior that influenced the development of early UAVs. This paper examines the efforts of the U.S. Navy and Marine Corps to build and deploy drone systems and explores the institutional behaviors and technical factors that shaped—and eventually doomed—early naval drone systems.

Long before any other nation contemplated the combat use of unmanned aircraft specifically designed for return and reuse, Americans conceived and fielded them on a broad scale. During the 1960s, the U.S. military developed the first land combat drone, the first fielded weapon-delivery drone, and what remains the most successful combat drone in history. These historical facts, unknown to most, actually obscure the broad scope and remarkable technological reach of the many U.S. combat drone programs of the 1960s, ranging as they did from cheap, visual-range aircraft for troop spotting to ultra-sophisticated, Mach 3+, intercontinental versions built to conduct intelligence operations deep in denied territory. What follows are service-specific tales of American weapon system exceptionalism that contains useful, policy-relevant lessons for the present.

The Naval Services and Unmanned Aerial Vehicles

This paper covers the UAV programs of the naval services, the U.S. Navy and Marine Corps. By the end of the 1980s, the Navy and the Marines could claim the world's only fielded weapons delivery UAV (DASH) and the most fully integrated UAV in the U.S. military (Pioneer). Yet despite these successes, the naval services have a weak record of UAV development from a dollar-investment point of view and have shown extraordinarily weak uniformed UAV advocacy since fielding these landmark UAVs. Lacking the external stimuli that boosted Air Force UAVs (support of the country's strategic reconnaissance and intelligence-gathering agencies) and the persistent internal desire for UAVs in the Army, the naval services developed UAVs to address very limited tactical shortfalls—and then only when pushed by strong-willed service executives.

The various UAV programs chronicled here were stymied by stiff resistance to drone development in the Navy and Marine Corps. This resistance came from two primary sources: functional impediments due to the inability of technology to withstand the fierce maritime operating environment and, in the case of the Navy, a feudal organizational structure. This structure put Marine aviation programs under the Navy budget, which, in turn gave little incentive to the Marine Corps to develop UAVs. This arrangement also allowed naval aviators to obstruct or ignore UAV development because they could depend on the surface line to accept more risk in this area. Both functional and structural issues intermix in the fascinating story of the first helicopter—of any kind—to operate from small Navy surface vessels, and the only fielded weapons-delivery UAV in history—the drone antisubmarine helicopter (DASH).

The Drone Antisubmarine Helicopter (DASH)

Long forgotten and unknown even to some modern UAV devotees, the DASH remains the only weapons-delivery UAV ever fielded—a truly revolutionary step. Moreover, DASH was the first U.S. helicopter of any kind assigned duty on small surface combatants. Its program history reveals the importance of a powerful advocate in launching UAV efforts, the difficulties a UAV encounters when operated by nonaviators, and the technical and cultural limitations of unmanned platforms relative to missiles and manned aviation.

The Navy pushed DASH into the fleet too quickly, causing substantial operational problems. The Navy never was able to get beyond those early developmental troubles for lack of a powerful internal constituency and

because of more palatable alternative systems. The Navy curtailed DASH after less than four years and allowed it to limp along for another four before the craft passed into obscurity. The paragraphs that follow reveal the unique obstacles to UAVs that existed—and persist—in the Navy.

DASH was a small helicopter with twenty-foot counterrotating (coaxial) rotor blades.[1] The short blades made it easier to fit the tight space constraints of a naval destroyer. Still, it could lift an astonishing 1000 pounds, enough to hoist two Mark 44 (later, one more capable Mark 46) antisubmarine torpedoes off its launch platform—a special deck installed on refurbished World War II-era destroyers. DASH cruised at eighty knots for twenty-five minutes with low engine noise and almost no vibration due to the counterbalanced propeller blades.

With its parent destroyer, DASH was the premier antisubmarine warfare (ASW) weapon system of its time. DASH allowed the destroyer to remain outside enemy submarine torpedo range while holding the hostile contact at risk with its own torpedoes. When in receipt of sonar contact with an enemy submarine, a topside drone operator launched DASH, then handed off flight control electronically to the ship's combat information center (CIC), where operators directed the craft toward the hostile contact using its radar return. Officers in the CIC dropped DASH's torpedoes by remote control. With this method of employment, the radio control system required line-of-sight from the destroyer's antenna to the air vehicle. Line-of-sight range restrictions lay well within the detection range of early 1960s–era sonar systems and, as such, were not an issue. The Navy made a substantial investment in DASH—746 air vehicles and associated materiel cost the Navy over a quarter of a billion dollars, or approximately $1.4 billion in 1999 dollars.[2]

DASH's creation stemmed in part from the rising military enthusiasm for helicopters in the mid–1950s. The Navy, Marine Corps, and Army invested in numerous helicopter programs during this period, much of it stimulated by the growing need for air power in all warfighting venues, the advantages of vertical takeoff and landing, and Air Force domination of fixed-wing aviation.[3] The Navy had long been interested in helicopters but had not operated them from small ships as a normal capability due to the unreliable nature of helicopters in that era.[4] The Canadian Navy actually led the world in manned helicopter operations from escort ships, and the U.S. Navy kept a close watch on that experiment.[5] Even before that, however, the Navy and Army commissioned a joint helicopter project that resulted in experimental droned versions.[6] The eventual DASH vehicle originated in the Marine Corps, which had been working on helicopters for battlefield mobility.[7] Navy experiments demonstrated more robust manned and unmanned helicopter operations from the U.S.S. *Mitscher* off Newport,

Rhode Island, in 1958, leading to the modification of the U.S.S. *Hazelwood* for drone helicopter trials in the spring of 1959.[8]

Two additional external influences stimulated the creation of the DASH. The first of these was technological breakthroughs in sonar design; the second was the growing Soviet submarine force. In World War II, the standard U.S. Navy QHB sonar ranged out to 1,500 yards, and, at this short range, "hedgehogs" (depth charges catapulted 200 yards from the ship) or dropped depth charges did the job—the destroyer basically had to place itself over the targeted submarine to achieve a kill, placing itself in jeopardy.[9] To address this range problem, the Navy developed a 5,000-yard, rocket-assisted torpedo (RAT) in 1945 that proved unreliable and inaccurate.

While weapons lagged, sonar improved. By 1955, the radically improved SQS–4 sonar allowed contacts out to 8,000 yards (4.5 miles), further emphasizing the critical weapon range shortfall. To fill that gap, the Navy explored an enhanced nuclear depth charge-capable system called the antisubmarine rocket (ASROC).[10] Eventually, the RAT gave way to ASROC, which had been modified to deliver a conventional torpedo. Yet, even ASROC experienced reliability, accuracy, and weight problems during its long, seven-year development period, so the Navy continued to search for alternatives, and DASH was one of them.[11]

Even as 1950s U.S. sonar technology improved by leaps and bounds, the Soviet Union rapidly expanded its submarine force, stimulating what naval historian Norman Friedman described as an "ASW mobilization" in the U.S. Navy.[12] The improved speed of new Soviet submarines like the *Foxtrot* class made long-range ASW weapons even more important and accentuated the requirement for accurate weapon delivery.[13] The ASW weapon range and accuracy shortfall drove the Atlantic Destroyer Force to propose a drone-assisted torpedo (DAT) in 1956, the forerunner of DASH.[14]

The Chief of Naval Operations, Admiral Arleigh Burke, played a dominant role in the development of DASH. Burke occupied the CNO's office for an unprecedented six years from 1955 to 1961 and ruled over the U.S. Navy with an iron fist backed by his superhuman work ethic, strong personality, and sterling wartime reputation as "31 Knot Burke."[15] Although he presided over monumental naval innovations such as nuclear-powered submarines and ships, guided missile escorts, and submarine-launched ballistic missiles, Burke stayed close to his destroyer roots by declaring antisubmarine warfare the Navy's top priority. In a letter to Admiral Nimitz in 1956, Burke wrote, "Our greatest technical problem now is anti-submarine warfare due to the tremendous submarine-building program of the Soviet Union."[16] The destroyer was central to Navy ASW operations,

and Burke took aggressive steps to shore up the antiquated World War II destroyer fleet. His fleet rehabilitation and maintenance (FRAM) program extended the life of more than one hundred World War II destroyers until new models could be built. Burke planned to deploy both DASH and its competitor, the upgraded ASROC, on FRAM destroyers.[17] With Burke's influence, FRAM (and by association, DASH) enjoyed a priority comparable to the huge Polaris missile program.[18]

Analytically, Burke represents an example of a very senior change agent with monarchic powers. This observation flies in the face of the characterization of the Navy as a feudal or decentralized organization. Organizational scholar James Q. Wilson addressed apparent contradictions like this directly when he wrote, "A certain proposal might be more easily adopted if it is dealt with by [one] sub-unit rather than by the organization as a whole because in the sub-unit there are fewer wills to concert."[19] As one might expect, the submarine community remained out of the picture, limiting subgroup diversity for this weapon system decision, but the carrier admirals would likely give voice to their skepticism. It is entirely plausible that because Burke was both an unusually charismatic and powerful two-term CNO—he also served as the surface warfare "super-baron" during the period of DASH's introduction—he could deal directly with the powerful carrier lobby.[20]

Innovation theorist Everett Rogers provided further insight by suggesting that the bureaucratic inferiority of Burke's community (relative to the aviators) provided a stimulus for innovation. Innovators, in Rogers's formulation, can be high risk-takers because they are willing to accept setbacks to net great gains—they have less to lose because they "may not be respected by the other members of a social system."[21] The surface community had suffered a grievous wound on 7 December 1941 when battleships lost the mantle of supreme capital ship of the line to the aircraft carrier. The surface warfare community had to battle back by adopting the tactics of the weak—they took upon themselves such countermissions as antisubmarine warfare and antiair warfare. The UAV (and ASROC, for that matter) provided them a golden opportunity to appropriate air power while maintaining autonomy in their subunit, while at the same time achieving ascendance within the naval hierarchy. All of these conditions facilitated the introduction of a radical innovation into the Navy.

Unfortunately, this "sweet spot" in time was ephemeral. Burke's iron grip did not last, his community proved too inflexible for an aviation asset, and the march of technology rendered a pilotless aircraft vulnerable to an aviation community incursion. The narrative that follows describes the ascent and demise of an innovative weapon system.

The World's First Armed Drone

The 1958 specifications for the DASH system called for putting the fully armed drone (two torpedoes) within 200 yards of a hostile submarine contact at a range of 10,000 yards and 20,000 yards when carrying one Mark 43 torpedo. At that early date, the carrier aviators asserted themselves by demanding that their Bureau of Aeronautics build the helicopter. They announced a competitive contract for a prototype drone antisubmarine helicopter in that year. The developer of the Marines' bizarre one-man *Rotorcycle* won the lucrative DASH contract on 31 December 1958.[22] The first prototype model, the DSN–1, started trials at the Naval Air Test Center, Patuxent River, Maryland, in the summer of 1960 after unanticipated development troubles.[23] Although early tests of the first DASH prototypes were piloted, the first unmanned operations from the destroyer U.S.S. *Hazelwood* took place on Pearl Harbor Day 1960, sometime after the first ships modified for DASH operations had rolled out of refurbishment.[24] With Burke's FRAM destroyers coming out of modification, the Navy was anxious to get them outfitted with their new helicopter as soon as possible.

DASH development did not progress fast enough to keep up with the FRAM modification schedule. It was hoped that DASH could now launch with two Mark 44 or one Mark 46 torpedo, or even the nuclear depth charge, in conditions ranging up to sea state six ("high sea," thirteen- to twenty-foot swells).[25] Burke pushed DASH through a turbine engine upgrade (DSN–2) and to what the destroyer community believed would be its operational version, the DSN–3, by April 1961.[26] Program delays centered on problems with the electronic control system, which used an off-the-shelf 1940s–era target drone control setup to save money.[27] The antiquated control system and the Navy's reluctance to upgrade it became DASH's Achilles heel.[28]

DASH Losses by Year

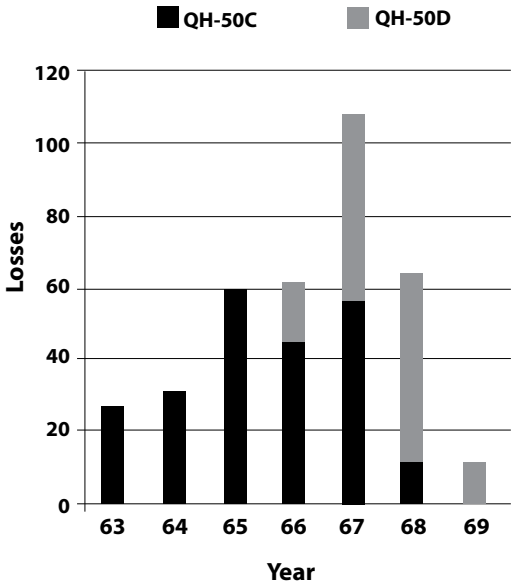
DASH's prime advocate, Admiral Burke, retired as CNO on 1 August 1960 and was replaced by naval aviator Admiral George W. Anderson, Jr.[29] Burke's replacement by an aviator came at a bad time, for a very new, highly innovative program like DASH could scarcely survive its developmental weaknesses in the harsh maritime operating environment without a champion. Still, Burke's urgency to see the drone helicopter in the fleet undoubtedly rushed development to match the FRAM schedule. The detailed congressional oversight of weapon system testing that characterized military development after Vietnam did not apply in the 1960s, so the services could rush a system to the field and hope for later upgrades to systems already in

the fleet. A government investigation later found that the DASH program, planned for a seven-year development timeline, was "telescoped" to three years due to the mismatch between DASH development and the FRAM program.[30]

Admiral Anderson decelerated the drone due to electronic control problems. The Navy finally unveiled the remarkable but flawed drone in 1963 in a naval firepower demonstration attended by President John F. Kennedy.[31] The media exposure did not help, for the QH–50C immediately experienced problems in the fleet and attracted negative media attention. In less than two months after its appearance in the fleet in November 1962 (two years after the first FRAM destroyer emerged from modifications) the Navy grounded DASH for six months.[32] In congressional testimony that year, one Navy official admitted, "we did not put enough flight hours on it before we tried to introduce it into the fleet."[33] Naval analyst Norman Polmar observed that off-the-shelf electronics could not withstand the rigors of shipboard operations.[34] UAV researcher Louis Gerken agreed, saying DASH had problems, "because the requirement for advanced electronic technology could not be met."[35] Despite the developmental slowdown, DASH still did not achieve an acceptable operational configuration. The period from late 1962 to the deployment of the improved QH–50D in 1965 amounted to prototype development using the fleet as the test directors—a risky proposition. Immediately, the drones started crashing and the fleet voiced its objections.

DASH's reputation in the fleet dipped as failures mounted. Sailors called it the "fire and forget" weapon because the DASH would fly away and not come back. Some said the robot helicopter "had a will of its own."[36] Numerous groundings and stand-downs caused skippers to wonder why this odd-looking craft cluttered their decks. Because many mishaps occurred out of sight and nonaviators had little flight experience, confusion reigned as to the cause of the crashes. Although C–model losses peaked in 1965, the much-improved D–model also crashed at a high rate during 1966, the crucial year in which the program was unfunded by the Department of Defense (see graphic). As if to confirm that decision, crash rates got even worse after cancellation until deployed numbers and usage diminished enough to improve loss statistics.

The Navy fell victim to the mistaken belief that a drone could be a low-cost, high-volume program. As long-time naval UAV acquisition officer Richard Friichtenicht later observed, "controlling a helicopter RPV was more of a technology challenge than they thought."[37] The Navy's reluctance to develop a modern (expensive) flight control system was reflected in a decision to upgrade such airframe components as the engine and



rotor blades, but to neglect improvement of DASH's antiquated off-the-shelf flight control componentry.[38] The DASH system had a new-age air vehicle but a World War II electronic control system, and the engineers at the Navy's Bureau of Aeronautics never zeroed in on this crucial flaw.[39]

During this dismal period of crashes and investigations, destroyer captains learned to fear and despise the drone. Aviation and destroyer cultures clashed as the Bureau of Aeronautics demanded in-depth investigations (DASH was treated as a naval aircraft) of each crash, anathema to the "black shoe" (surface warfare) culture. Command of a ship at sea has a "zero defects" mentality that makes risk-taking in peacetime a bad idea, and DASH embodied risk. Some skippers received letters of censure for crashes, a career-ending mark. The "gouge" spread quickly: DASH was career death.[40]

Interviews conducted with the captains of two DASH-equipped ships buttress this claim. George Walker, skipper of the FRAM destroyer U.S.S. *Arnold J. Isbell*, remembers that many of his peers received letters of caution or reprimand for DASH losses leading to a self-imposed constriction of flight hours that hurt flight crew proficiency and led to a negative spiral of more DASH accidents.[41] "When I took command [of the *Isbell*], this [DASH] was a thing the crew never used, but you had to train with DASH to be good at it," said Walker.[42] Ted Baker, a rare DASH skipper (U.S.S. *Bronstein*) who enjoyed having the system onboard, recalls great resistance among his peers, who already knew that "you had to be lucky to survive ship command, and there was a sense that flying the DASH was another way of screwing up."[43] One of the last ships in the Navy with DASH, the U.S.S. *Bronstein* benefited from an unusually competent DASH operator (a young lieutenant, junior grade) who understood the idiosyncrasies of DASH electronics. Additionally, Baker operated in an elite, experimental ASW unit in which he had the lone DASH-capable ship, making it a point of pride for the young crew.[44] DASH took a special crew chemistry to make it work, and

one cannot build a constituency for an alien weapon system by depending on the efforts of a few exceptional skippers like Walker and Baker.

Even these DASH hands experienced moments of terror when DASH wandered away unexpectedly, however. During one fleet exercise, *Bronstein's* DASH controller lost radar contact with the drone, so Baker had his lieutenant command the aircraft to hover and they lined up all available escort ships to sweep the ocean for the wayward drone—the entire fleet became immersed in finding *Bronstein's* DASH. The flagship (aircraft carrier) commanding officer "went nuts" and sailed away to recover his aircraft where the drone could not possibly interfere. With the incentive of three days' leave to the sailor who spotted his DASH, Baker's "eagle-eye" chief quartermaster located it—hovering patiently above the wave tops as if waiting for its master. Baker positioned his ship under the drone while his DASH pilot lowered it safely aboard. To the crew and especially the captain of the *Bronstein*, a $125,000 drone (about $580,000 in today's dollars) was an expensive article that they were not about to lose.[45] To the carrier battle group, the DASH provided more of a distraction and a threat than a valued capability.

Although carrier admirals did not care for DASH, surface warfare community adaptation problems explain the vast majority of the problems with DASH. With an innovative weapon system, the man and the machine must find an accommodation. DASH marks yet another case of a nonaviation community desiring unmanned air capability, yet failing to come to terms with the needs of aviation technology. The following paragraphs highlight one of the largely unexplored reasons for DASH's poor operational record: the unsatisfactory technical training of DASH personnel.

The surface navy did not underestimate the requirement for very smart, highly trained people to operate this system. They just failed to deliver it to the fleet. Shore-based DASH training billets were never permanent and came out of the destroyer fleet's manpower list, and operational commanders were unwilling to rob the operational fleet to institutionalize DASH training. As a result, training units suffered manning shortages and experienced high turnover rates. The Pacific Fleet commander told the CNO that the current system provided only "stop-gap training" and that a permanent training cadre "remains inherent to the success of DASH."[46] The CNO, Admiral David L. McDonald (another aviator who took the helm in August 1963) agreed, but instead of taking precious billets from other areas to shore up this vital need, asked Secretary of Defense McNamara for extra billets and urgent minor construction funds, even though DASH was already in the fleet and experiencing problems.[47] In a post-Burke regime dominated by the secretary of Defense and his cost analysts, that decision never came. More than likely,

it soured McNamara and his slide-rule set on the cost efficiency of the system because DASH was already crashing at an unsatisfactory rate.

Not only did the Navy fail to upgrade the DASH training system, it never assigned the right people to DASH duty. The original plan called for a DASH crew to include a jet mechanic, two aviation electronics technicians, and engine specialist—all in the experienced ranks of E–5 or E–6 (ranging from twenty-two to thirty years of age).[48] Yet an internal Navy document written during the height of DASH deployment noted, "the average age of technician trainees assigned to DASH is approximately eighteen and a half years." The memo revealed that trainees received an unsatisfactory ten to fourteen weeks of training and contrasted their performance with that of the DASH contractor, whose highly trained technical people lost only three drones out of 534 in rigorous flight checks prior to fleet delivery.[49] By mid–1965, Atlantic Fleet reported that only 42 percent of shipboard DASH crews and 16 percent of crews in training met rank standards and blamed "low experience level of shipboard controllers and maintenance personnel" as a primary contributor to crashes.[50] DASH required a sailor with superior electronic and mechanical capabilities, but the most talented went to the carrier fleet, and the fatally short-changed training program could not recover.[51]

As noted above, surface warfare officers also proved to be inadequate DASH pilots, a result in many ways beyond their control. The deck control officer required highly developed piloting skills to conduct tricky launch and recovery operations, which required some degree of inborn talent, intensive training, and constant repetition. DASH controllers attended a seven-week training course lacking deck motion simulation and experienced unacceptable time lags from the completion of training until deployment. As long-time Navy UAV expert Jay Bornfleth noted, "Loss of a DASH was almost always blamed on the ops control officer, so his career path was basically hopeless or dead."[52] For fear of losing an aircraft and undergoing an investigation, skippers often restricted DASH pilots from flying at night, in rough sea conditions, or during electronic countermeasures exercises, further minimizing drone controller proficiency and contributing to pilot error.[53] Both DASH skippers interviewed for this study commented that they were lucky to have had exceptional DASH operators, but an operational aviation system—manned or unmanned—cannot survive on exceptions. The surface warfare community simply failed to provide the training and environment DASH required.

Carrier aviators contributed to the poisoned environment surrounding DASH operations, for the robot flew in "their" airspace. George Walker could not fly his helicopter around the carrier because "aviators did not

want to be in the air with that crazy thing."[54] Carrier aviators made Baker "go way out in the boonies, I mean many miles away," to practice with his DASH. He later recalled, "The carrier hated it when we put DASH in the air, all the pilots were afraid of flying into a drone."[55] Norman Polmar remembers that DASH operators were generally not allowed to operate on the outbound cruise of a carrier battle group due to the possibility of electromagnetic interference and constant carrier flight operations. Carrier admirals allowed DASH operations on the way back from a cruise, and then only during minimal or no manned flight operations. Accidents due to operator error tended to happen on the return cruise.[56] As with any aviation asset, flight skills diminish quickly, perhaps even more quickly for the nonaviators who operated DASH.

What was the aviator's answer to DASH operations they feared so much? Not long after aviators assumed the post of CNO in 1961, the Navy began pursuing a manned alternative called the Light Airborne Multipurpose System (LAMPS), which, unlike DASH, came equipped with a powerful bureaucratic constituency.[57] Aviators pushed LAMPS along while DASH went through its difficulties in the fleet. Ironically, the surface navy paved the way for LAMPS by building bigger destroyers to accommodate all the electronic and missile gear, a move that allowed easier incorporation of the much larger manned helicopters.[58] When the Navy reduced the number of DASH-configured destroyers in June 1966, Deputy Chief of Naval Operations for Air (air "baron") Vice Admiral Paul Ramsey, testified in front of the Senate Armed Services Committee that the Navy should use manned helicopters for the DASH mission because, "unfortunately, in robots you can't build judgment."[59] Thus, even as the dominant aviation community acted as a brake on DASH's integration into normal fleet operations, they planned for its replacement.

Although carrier aviators may have had a hand in DASH's decline, their efforts were not without warfighting merit. ASW technology advances, which had created the sensor-weapon mismatch that prompted DASH, now opened the door for LAMPS. The SQS–26, a huge bow-mounted sonar that produced submarine contacts out to thirty miles, created an ASW shortfall that DASH could not address.[60]

Where the critical ASW shortfall had been weapon delivery *range*, sonar range increases changed the problem to weapon delivery *accuracy*. Although the new sonar provided very long-range contacts, it could not provide an operationally lethal torpedo release plot from the ship, only a localized search area. The range limitations of the torpedo and the speed of Soviet subs required a highly accurate torpedo release point so that the torpedo could acquire and catch a fleeing submarine. Unfortunately, DASH

depended on the ship's sonar and radar to achieve release accuracy. The inability of the ship to provide an accurate weapon release point meant the airborne attack platform had to get its own finely tuned target fix.

The only type of platform that could feasibly take its own updated sonar measurement (using a dipped sonabuoy) and deliver a torpedo inside a lethal range was a manned helicopter. As naval historian Norman Friedman observed, "This [the SQS–26] was finally a sensor well in advance of existing weapons; the problem had been solved only with the development of LAMPS."[61] This became apparent in the mid–1960s just as DASH was experiencing severe reliability problems. In contrast to DASH's limited capability, the LAMPS Mark I helicopter carried a surface-search radar to detect a snorkel or periscope, a magnetic anomaly detector to localize a sonar contact, electronic intercept equipment, fifteen sonabuoys, a data link to feed sonabuoy data to the destroyer, and a human crew to operate the equipment beyond line-of-sight if required.[62] The human pilot and crew on LAMPS provided expanded ASW capability as well as a much-needed ferry, communications relay, and resupply platform.[63]

Even though integrating LAMPS personnel aboard surface ships caused some problems initially, LAMPS actually solved a cultural problem for the black shoe navy. With the LAMPS aviation contingent onboard, the senior pilot assumes responsibility for flight operations, distancing the captain from the messy investigations and career-ending letters of reprimand associated with DASH. Thus a kind of symbiosis emerged from the clash of naval subcultures. The skipper returned to a focus on traditional concerns and essentially outsourced his air power, while the aviation community expanded its pilot billets and budget. Moreover, from an overall threat perspective, LAMPS addressed a critical ASW shortfall. The only losers in the transition to LAMPS were the Soviet Navy—and DASH.

The reasons for LAMPS eclipsing DASH are reasonable enough from an operational perspective, but DASH also fell victim to the antisubmarine rocket in the 1960s shakeout of ASW weapon systems. ASROC, which Norman Friedman called "the white hope" of the destroyer force when it was first proposed, almost did not survive the competition with DASH.[64] In the original FRAM discussions, Navy planners talked of removing ASROC due to redundancy, weight, and poor test performance, but ASROC performed in all weather conditions and DASH did not.[65] ASROC also carried nuclear weapons and although DASH had a centerline station for the nuclear depth charge, it was never certified to deliver that weapon.[66] ASROC lacked both range and accuracy, but the key to its long life was its configuration as an expendable standoff rocket. ASROC fit more easily into traditional surface warfare modes of operation. Expendable munitions like

ASROC affected the ship little more than the five-inch gun, thus posing a minor challenge to convention.[67] ASROC required no flight operations data links. Practice with ASROC hardly improved its performance, and anyway it was too costly per shot—$5,000 for the rocket booster alone—to practice with the same regularity as that required by DASH.[68] ASROC's explosive rocket fuel concerned ship captains but less than DASH's spinning rotors as it descended precariously to their pitching deck. Since ASROC's precarious start, the Navy built more than 12,000 rounds and finally ended ASROC's long run after more than thirty years of service.[69] Despite its many faults, ASROC's inherent technical qualities demanded little adaptation from destroyermen, giving it great staying power in the fleet.

Based on a thorough review of the DASH program, Secretary of Defense Robert McNamara ended DASH's short career. In December 1966, he rejected a Navy request for $31 million to further rehabilitate the DASH fleet, citing "higher-than-expected peacetime attrition and lower-than-expected performance."[70] His decision canceled further DASH procurement and relegated remaining systems to FRAM II destroyers and a few late-model destroyer escorts.[71] The small but vocal band of DASH backers, mainly the project office and the contractor, rushed to defend the program, but it was clear their words would fall on deaf ears.[72] The Navy did not protest McNamara's decision, for it is likely it helped ease DASH out to make room (mainly in the form of manpower billets) for LAMPS. Indeed, earlier that year, the Navy announced that the originally planned 240-ship deployment would be cut back to more than one hundred ships.[73] McNamara merely delivered the final stroke. Immediately, the Navy removed DASH from FRAM I destroyers that also had ASROC onboard. DASH accidents on remaining ships soared and continued at high rates for the rest of its operational life. According to Peter Papadakos, the executive director of the Gyrodyne Historical Foundation, the FRAM destroyer U.S.S. *Keppler* (DD–765) reported to North Island Naval Air Station (San Diego) on 15 June 1971 and transferred its two QH–50Ds (DS–1710 and DS–1749) to Building 865 for transfer to the Military Aircraft and Disposal Center at Davis-Monthan Air Force Base, Arizona (the so-called aircraft boneyard), bringing to an end DASH's Navy fleet deployment.[74] DASH spent eight years in the fleet, its prime legacy being the bad taste it left in the Navy's mouth concerning UAVs.

The U.S. Navy DASH program illuminates a number of important analytical issues. A rising Soviet submarine threat, rapid increases in sonar range, and weak alternative weapons delivery platforms in the mid–1950s drove the Navy to explore UAVs as a ship-based torpedo delivery platform. Destroyerman and CNO Arleigh Burke launched the innovative DASH

program, linking it to a ship rehabilitation scheme that he hoped would revitalize his weak surface warfare community. Rushed into the fleet to keep pace with that program, DASH suffered the fate of the Army's SD–1 Falconer—it performed so poorly that destroyer sailors never accepted it. In keeping up with the FRAM schedule, the Navy failed to adapt the machine adequately (especially in the area of electronics) to the demands of the fleet.

Or was it the other way around? The foregoing DASH narrative also argues that the surface community failed to take adequate measures to adapt itself to DASH, failing to train its operators and technicians to the standards required by such a craft even though it was within its power to do so. These feeble efforts were complicated by the carrier aviation community, which stayed well clear other than to restrict flying hours and enforce manned aircraft standards on nonaviators. Competitors for the ASW mission also diminished internal adaptation efforts, both from the direction of the manned aviation community (through LAMPS) and from standoff munitions (ASROC). Ultimately, the surface navy reached a comfortable accommodation with both without Herculean internal transformation, retaining its ways while maintaining superior warfighting capability.

That is how DASH lost its Darwinian struggle for survival within the U.S. Navy: the man and the robotic helicopter failed to achieve a symbiosis. Stripped of its senior advocate and exposed to the elements, DASH limped through some eight years of crash-prone service on obsolescent ships before retiring to the Davis-Monthan boneyard. That failure meant future UAVs would face even stiffer barriers to inclusion in the only viable Navy customer, the surface warfare community.

The Cheap, Expendable Marine Corps UAV: Bikini

The Marine Corps also pursued drone concepts with some enthusiasm in the 1960s.[75] The Marines' thrifty and technophobic nature led them to explore more spartan systems that minimized drone personnel requirements, both numerically and in terms of required technical proficiency. They found, however, that the combination of low cost and easy maintenance left them with a drone lacking meaningful capability. This section shows the beginning of a strain—almost an obsession—in Marine Corps unmanned aviation that persists to this day: the pursuit of a very cheap, expendable UAV.

Stimulated by the Army's ambitious SD series during the late 1950s, the Marine Corps decided to pursue its own drone to look over the next ridge.[76] Marines examining the Army's UAV development efforts judged the approach to be too tactically cumbersome and logistically ponderous.

On 20 August 1959, the Marine Corps Landing Force Development Center formally submitted a requirement to the Commandant for a "BLT [battalion landing team] Drone System" that would be much lighter, cheaper, and more mobile than any planned by the Army.[77] Major P. X. Kelley in the intelligence section of the Marine Corps Landing Force Development Center oversaw the program, which competed a conventional, very small aircraft design against a motorized hang glider. The hang glider crashed in all of its test flights and the Marines had problems ascertaining the location of the airplane, so despite the conventional design's comparative promise, Major Kelley recommended the cancellation of both craft.[78]

The small aircraft design, however, hung on due to the advocacy of one lieutenant colonel in the Marine Corps intelligence community, and the concept took on an official designation as the Lightweight Battlefield Surveillance Drone System.[79] It was better known by the name Bikini. This program reveals what the Marine Corps wanted from a drone and illustrates the technological limits that stood in the way of those desires. The attempt to build a UAV on the cheap left the Marines with one that could not carry out a meaningful military task.

The Lightweight Battlefield Surveillance Drone System requirement languished until 1964, when it became the personal interest of Commandant of the Marine Corps General Wallace M. Greene, Jr., who, in a *Marine Corps Gazette* article, famously described Bikini as "a small item that covers large areas of interest."[80] The design was based on the construction techniques used by the radio-controlled airplane hobby industry. Bikini had a conventional propeller-driven airframe with a small, eight-foot wingspan, sixty-pound launch weight (one man portable), and a top speed of 120 miles per hour carrying a fifteen-pound payload. A 4½-horsepower, two-cycle chainsaw engine provided thrust.[81] The operator maintained visual contact at all times for the aircraft did not have its own stabilization system and remotely activated the parachute recovery system upon termination of the mission. To limit costs, the contractor used old military parts and off-the-shelf model airplane components.[82] One system, which included two aircraft, two cameras, one jeep, and a trailer-mounted launch station, cost about $80,000 ($380,000 in 1999 dollars) and required only two operators.[83] Every effort was made to make the system economical in design and operation. Under the proposed organizational arrangement, the drone platoon with one officer, thirty-two enlisted men, and twelve drone systems would be attached to the division reconnaissance battalion.[84]

Only months after the Marine Corps chose Bikini, it conducted a limited operational test at the naval test facility in Vieques, Puerto Rico.[85] Based on the results of that test and about two years of work by the contractor,

the Development Center ran a more comprehensive one-year troop test and evaluation at Camp Lejeune, North Carolina. Those tests showed that the maritime environment posed problems for Bikini's minimalist design and that it was ill-suited for combat operations. The drone could not be operated in twenty-knot winds and salt water corroded its light magnesium wings and internal electronics.[86] Recovery problems plagued the test; the simple drone had no data link, therefore recovery of the camera was of paramount importance. The project officer called parachute recovery "the most serious deficiency in the entire test program."[87] On several occasions, the parachutes popped out for no apparent reason, a problem finally traced to federal revenue agents in the local hills using radios on the same frequency, a bad portent should a determined enemy conduct electronic countermeasures.[88] Parachute problems resulted in ten of the twenty-two test aircraft crashing, and by the end of the test, only six aircraft remained.[89] Bikini's range limitations caused problems as well. In tests to determine the utility of launching Bikini from an offshore landing craft for beach reconnaissance, the 1,200-yard visual range limitation brought the landing craft within easy reach of enemy small artillery, making the drone platform what the project officer called "an excellent target."[90] Despite all these problems, the project officer thought the drone had real promise and asked for more improvements and testing.

General Greene retired on 31 December 1967 before all the required modifications were made. Bikini lost its sponsor, and the program began to unravel. Additional requirements added enough weight to the system that a jeep could no longer pull the launch trailer. The Vietnam War was in full swing and the Army had canceled its drone programs and turned to manned reconnaissance aircraft, so the general environment for battlefield drone systems was gloomy. In one of his early decisions as Commandant, General Leonard F. Chapman, Jr. canceled Bikini.[91]

Based on the experience with Bikini, the Marine Corps decided it needed a drone with more capability. It wanted at least four hours of endurance, greater payload capacity, an infrared imager, and moving target indicator (MTI) sensors.[92] The greater range required a much more sophisticated autopilot in order to gain greater location accuracy. All this meant more money. Unwilling to develop that capability on their own, the Marines waited until an acceptable UAV landed in their lap. For now their brief foray into unmanned aviation ended with a whimper.

It is of great analytical interest that, in contrast to the Army, which first designed its SD series UAVs to perform a certain mission, then let requirements for manning and logistics evolve, the Marine Corps laid down its very slim manning and weight requirements and waited to see how much

drone it could get. This early Marine Corps attempt to fashion a drone system in its image defined the limits of its willingness to adapt. It revealed that if Marines wanted more drone capability, they would have to endure greater organizational distortions, distortions they were unwilling to face in the absence of strong backing from the commandant.

In keeping with its penchant for economy, the Marine Corps tried hard to hold down cost and weight. The Marines had to accede to the fact that a bigger, more complex UAV system was needed to do meaningful combat tasks. They were not immune to UAV requirements expansion, but they were unwilling to develop a proper system. The cheap, expendable UAV embodied by Bikini could not deliver militarily useful service in any but the most optimal circumstances, a lesson the Marines had to relearn numerous times in years to come.

Conclusion

This short article covers the landmark sea service drone acquisition programs of the 1960s and emphasizes how each of those programs led to technical breakthroughs and institutional enthusiasm, only to be followed by disillusionment and program failure. Contrary to popular mythology about the "white scarf syndrome," in which pilots overtly obstruct drone acquisition for fear of losing their jobs, the obstructionism of the aviation community—although reinforced by cultural prejudices—stemmed from practical concerns about limited drone capabilities.

Acquisition professionals in the Navy and Marine Corps faced a drone dilemma that was shared by industry: drone designs were found to be either phenomenally expensive (and hence inefficient), or inexpensive and militarily ineffective. As such, there was much more to the failure of these systems than the entrenched hostility of aviators. Technological immaturity in key elements of drone design meant that no acquisition team could find a way to overcome the problems that marked drone development.

In addition to the real technological limitations on these early drone programs, however, the military services demonstrated unique patterns of behavior in drone development and integration that shaped each program outcome, sometimes leading to unnecessary obstruction. Those service-specific patterns of weapon system innovation behavior constitute the most important message in this paper and suggest that the informed acquisition official must understand the special functions, organizational structures, and cultures of the military services to best guide a system through the acquisition maze. In the final analysis, the various drones of the 1960s that were developed by the sea services were seductive technological

systems that failed to bridge the gap between developmental innovation and operational realities. An innovative system must find consonance with the operational rhythms of its primary customer in order to graduate to legacy status. In the end, neither DASH nor Bikini could make that claim, and after their demise it would take decades before another system (Pioneer) would make comparable inroads.

NOTES

[1] A coaxial helicopter uses counterrotating rotor blades to neutralize rotational forces and provide freedom from vibration. With a conventional helicopter, the tail rotor provides steering and opposition to main rotor torque. The Gyrodyne Company of America pursued the coaxial rotor concept while others settled on the single-blade-with-tail-rotor design due to problems with coaxial auto-rotation or power-off descent. Jack Kestner, "DASH Nest Becoming Haven for Ghosts," *Long Island Ledger-Star,* 28 September 1971: B-1.

[2] This figure does not include the cost of converting destroyers with landing decks, storage, etc. Jack Pappas, Navy officer assigned to initial DASH detail, e-mail to the author, 25 February 1999; Jack Kestner, "Navy Dumps DASH After $250 Million Cost," *Long Island Ledger-Star*, 27 September 1971: B-1.

[3] The growth of helicopter aviation, an innovative weapon system in its own right, contrasts with that of UAVs. The lack of congressional scrutiny in the 1950s allowed the services to pursue overlapping programs that advanced the state of the art and helped the services come to terms with the newfangled machines. The Air Force did not materially suppress the expansion of rotary winged aviation, and because helicopters (DASH excepted) required pilots, all the services developed internal constituencies. Helicopters gained a foothold in all three services and remain a part of their operational designs.

[4] Helicopter aviation in the Navy started in 1912 with an investment of $50 for helicopter models constructed by a machinist's mate from the U.S.S. *West Virginia*. Although the Navy bought an autogyro (a propeller-driven aircraft using rotary blades for lift—technically a rotary-winged aircraft) in 1931, the first conventional naval helicopter was a Sikorsky YR–4B (Navy designation, HNS–1) for air-sea rescue, accepted in 1943. Roy A. Grossnick, *United States Naval Aviation 1910–1995*, 4th ed. (Washington, D.C.: Naval Historical Center, 1997), 8, 79, 131.

[5] The first experimental naval helicopter operations were conducted by the British Navy in 1947, but the Canadian Navy was the first to deploy operational manned helicopters on its escort vessels in the late 1950s. It bears noting that U.S. naval aviators allowed another country to be the innovators in a form of aviation (helicopters) they found to be inferior. This same "wait and see" attitude confronted the UAV, perhaps with a longer waiting period attached. Edward A. Morgan, "The DASH Weapons System," *Naval Institute Proceedings* (January 1963): 151–52. Lieutenant Morgan was the DASH project officer for the U.S.S. *Hazelwood*. Ironically,

the article following Morgan's piece in *Proceedings* was titled, "Neglect of the Human Element."

[6] The joint Army-Navy (Kaman-built) HTK performed the first unmanned helicopter flight from a ship on 30 July 1957 after a two-year development program. Grossnick, *United States Naval Aviation*, 219; "Drone Helicopter," *Military Review* (May 1955): 67; "Variety of Missions Seen for Copter Drone," *Army-Navy-Air Force Journal* 21 (July 1956): 11. Naval historian Norman Friedman gives the date of the HTK–1's flight from the U.S.S. *Mitscher* as May 1957. Norman Friedman, *U.S. Destroyers: An Illustrated Design History* (Annapolis, Md.: Naval Institute Press, 1982), 281.

[7] The Marine Corps pushed for helicopters after the Korean War to gain the operational mobility required for amphibious operations in a nuclear environment. Peter B. Mersky, *U.S. Marine Corps Aviation 1912 to the Present* (Annapolis, Md.: Nautical and Aviation Publishing Co., 1983), 123–28, 192.

[8] The project was called Operation Fly-Swatter. John C. Devlin, "'Copter-Destroyer Team Shown as New Navy Submarine Killer," *New York Times,* 23 August 1958: A24.

[9] The QHB sonar worked out to 1,800 yards at twenty knots, but an attack solution required a depth-determining fire control sonar (Mk 102, linked by analog computer using 2,300 vacuum tubes) with a 1,500-yard range. Friedman, *U.S. Destroyers,* 279. These highly sophisticated sensor-computer systems forced the surface warfare community to undergo a cultural shift in which it either had to embrace technology or continue in relative decline in the naval hierarchy. The technological dynamism of the default anti-submarine mission catapulted the "black-shoe" navy into the information age. For a clear, accessible explanation of sonar signal processing over the years, see Norman Friedman, *Submarine Design and Development* (Annapolis, Md.: Naval Institute Press, 1984), 149–50.

[10] Chuck Hansen, *U.S. Nuclear Weapons: The Secret History* (Arlington, Tex.: Aerofax, 1988), 208.

[11] ASROC was not fully developed until production started in 1961. That first model sported a one-kiloton nuclear warhead. Some 574 nuclear ASROCs were built between 1961 and 1968. Hansen, *U.S. Nuclear Weapons*, 208.

[12] Like many of the Soviet scares of the day, this one stemmed more from hysteria and attempts to capture budget share than from hard facts. In fairness, hard facts were tough to come by. The Office of Naval Intelligence grossly overestimated the Soviet submarine threat even as the Soviets

cut back their submarine force due to internal economic tradeoffs. We now know that the Soviet submarine force reached a peak of 473 boats (much lower than projected) in 1957 when Nikita Khrushchev cut back submarine production as part of a de-emphasis on non-nuclear weapon-firing platforms. Norman Friedman, *Submarine Design and Development,* 101. Ironically, U.S. systems procured as a result of these scares (e.g., Minuteman ICBMs, B–52 Stratofortresses, ASW helicopters, sophisticated sonar) performed yeoman duty when Soviet military spending expanded in the post-Khrushchev era.

[13] Soviet submarine designers emphasized underwater dash speed over quieting, which has some operational advantages. Although detectable, the submarine could simply outrun a short-range torpedo if ASROC or DASH dropped it far enough away from its location. For an excellent description of the operational and technological variables in ASW, see Friedman, *Submarine Design and Development*, 171–80.

[14] Ibid., 280.

[15] The Burke legend came from his ability to coax maximum speed from his destroyers. Admiral Nimitz tagged Burke with the "31 Knot" moniker after an incident during World War II. E. B. Potter, *Admiral Arleigh Burke* (New York: Random House, 1990), 102–03.

[16] He added, "We must detect, identify, and destroy a submarine at 10,000 yards [5.7 miles] with an integrated weapon system." Ken Jones and Hubert Kelley, Jr., *Admiral Arleigh (31 Knot) Burke: The Story of a Fighting Sailor* (New York: Chilton, 1962), 187–88.

[17] FRAM Mark I extended the life of forty-nine destroyers by eight years by rebuilding superstructures, rehabilitating engines and electronics, and installing ASROC launchers and DASH at a cost of $7.7 million per ship. FRAM II extended 113 destroyers' useful lives five years by installing a new sonar and the drone anti-submarine helicopter (DASH) at a cost of $4.5 million per ship. Only eight destroyers underwent FRAM Mark III modifications. Friedman, *U.S. Destroyers*, 285–90. The ASROC is a ship-launched ballistic missile that carries an ordinary acoustic homing torpedo. The missile has a range of about ten kilometers. After it is fired, it follows a ballistic trajectory to the vicinity of the target, guided by an onboard computer. At that point, the rocket and torpedo separate. The torpedo is lowered by parachute to the ocean and, once submerged, follows a regular search pattern. Kosta Tsipis, *Tactical and Strategic Antisubmarine Warfare* (Cambridge, Mass.: MIT Press, 1974), 32; see also Norman Polmar, *The Ships and Aircraft of the U.S. Fleet*, 12th ed. (Annapolis, Md.: Naval Institute Press, 1981), 332.

[18] Friedman, *U.S. Destroyers,* 285; Pappas interview.

[19] James Q. Wilson, "Innovation in Organization: Notes Toward a Theory," in James D. Thompson, ed., *Approaches to Organizational Design* (Pittsburgh, Pa.: University of Pittsburgh Press, 1966), 204.

[20] Burke presided over an amazing transformation of naval technology. During his watch the Navy incorporated digital computers, the first guided-missile frigates and destroyers, nuclear-powered cruisers, the first nuclear-powered aircraft carrier, submarine-launched ballistic missiles—as his biographers put it, "new ships, new equipment, new strategy, new tactics." Jones and Kelley, *Admiral Arleigh (31 Knot) Burke*, 186–87.

[21] Everett M. Rogers, *The Diffusion of Innovations*, 3d ed. (New York: The Free Press, 1983), 248.

[22] Friedman, *U.S. Destroyers*, 281; United States General Accounting Office, "Adverse Effects of Producing Drone Anti-Submarine Helicopters Before Completion of Development and Tests" (Washington, D.C.: GAO Report B-160877, 31 December 1970), 8.

[23] Morgan, "The DASH Weapons System," 152; Friedman, *U.S. Destroyers*, 281; John W. R. Taylor, ed., *Jane's All the World's Aircraft 1970–1971* (New York: McGraw-Hill, 1971), 539.

[24] GAO Report B-160877, 10. Norman Polmar reported the first flights took place one day later on 8 December. Norman Polmar, "Ups and Downs of the Drone Helicopter," *Aerospace International* (April 1967): 24.

[25] The term *sea state* comes from the Beaufort Scale, created in 1805 by Sir Francis Beaufort. Each numerical sea state, or force, from zero through 12, equates to a wind speed and wave height, zero being complete calm and 12 being hurricane conditions. DASH could only be recovered in sea state 3 (moderate sea, four-foot waves); however, the contractor was exploring a cable system for reeling in the drone in high seas. Larry Booda, "DASH Will Be Operational in December," *Aviation Week & Space Technology* (1 July 1963): 32.

[26] The turbine (jet) engine allowed the use of heavy fuel (kerosene-based jet fuel, or diesel), which proved critical to shipboard UAV operations, as it poses much less fire hazard than does aviation gasoline. It does contain less energy per unit volume, however. The Mark 44 was the first standard size ASW torpedo, weighing in at 425 pounds. The newer Mark 46 weighed 568 pounds and became the standard, with a 12,000 yard range at 45 knots. The nuclear depth charge scheduled for DASH, called "Lulu," was actually in service with the Navy from 1957–1971. Lulu had a 5–10 kiloton (selectable) fission warhead (the B57) with a depth pressure fuze. Friedman, *Submarine Design and Development*, 173–74, 177; Thomas B. Cochran, William M. Arkin, and Milton M. Hoenig, *Nuclear Weapons Databook,* Vol. 1 (Cambridge, Mass.: Ballinger, 1984), 63.

[27] Polmar, "Ups and Downs," 24–25.

[28] Jack Pappas, still an ardent DASH advocate, says the control system was archaic and could not withstand the rigors of sea duty. Pappas interview.

[29] President Kennedy requested Burke stay on for yet another two years, but he refused, naming Anderson as one of his potential replacements. Anderson had served his first three years on a cruiser as a surface sailor, but transferred to flight school and remained in the carrier navy thereafter. Lawrence J. Korb, "George Whalen Anderson, Jr., 1 August 1961–1 August 1963," in *Chiefs of Naval Operations*, ed. Robert William Love, Jr. (Annapolis, Md.: Naval Institute Press, 1980), 321–30.

[30] GAO Report B-160877, 8–9.

[31] Booda, "DASH Will Be Operational," 32.

[32] GAO Report B-160877, 16.

[33] Ibid., 17.

[34] Polmar, "Ups and Downs," 25.

[35] Louis C. Gerken, *UAV—Unmanned Aerial Vehicles* (Chula Vista, Calif.: American Scientific Corporation, 1991), 7.

[36] Ted Baker, skipper of the frigate U.S.S. *Bronstein* (FF–1037), the last ship in the fleet outfitted with two DASH air vehicles, interview with the author, 8 April 1999. The "will of its own" quip comes from a 250-page treatment of ASW aircraft in which the DASH system received but one sentence despite its eight-year service. Alfred Price, *Aircraft Versus Submarine: The Evolution of the Anti-Submarine Aircraft 1912–1972* (Annapolis, Md.: Naval Institute Press, 1973), 245.

[37] Richard Friichtenicht, Navy RPV program manager, 1976–1978, interview with the author, 10 September 1998.

[38] A Bureau of Weapons memo listed the approved upgrades to the "C"-model DASH as 1) a new engine; 2) larger gas tank; 3) elimination of tail section; 4) various cosmetic modifications to fuselage, relay box, and repositioning of avionics for balance purposes. BUWEPS Notice 13100, "Model QH–50D Aircraft; establishment of model designation," 17 August 1964 (NHC archives, QH–50C file). The General Accounting Office also hinted at this problem, stating "many of the [electronic] deficiencies found in the QH–50D were of the same type found in the QH–50C during its Board of Inspection and Survey trials." GAO Report B-160877, 14; Pappas interview.

[39] As happened in the Army's Aquila program where Aviation Systems Command originally built the airframe, the Navy's Bureau of Aeronautics built DASH even though the system was operated by surface community officers. The surface community's Bureau of Ships handled installation of DASH hangars and equipment aboard FRAM destroyers.

[40] "Gouge" is a maritime slang term meaning, loosely, "the inside word."

[41] When his crew flew DASH, Walker wore one black shoe (of the surface warfare community) and one brown shoe (of the aviation community). George Walker, Captain (U.S. Navy, retired), skipper of the U.S.S. *Arnold J. Isbell*, DD–869), interview with the author, 23 March 1999.

[42] Ibid.

[43] Baker blames his youth (he was only a lieutenant commander) for his enthusiasm for DASH. "I was very young and wet behind the ears," Baker said, "and we [the crew] had a lot of spirit, we wanted to be the best with DASH, and we were." Baker interview.

[44] Ibid.

[45] Ibid.

[46] Message, CINCPACFLT to CNO, "DASH WEAPONS SYSTEM SUPPORT, PERS REQMTS (U)," 31 July 1964 (NHC archives, DASH folder).

[47] Message, CNO to CINCPACFLT and CINCLANTFLT, "DASH PROGRAM (U)," 4 August 1964 (NHC archives). Admiral Anderson did not receive the customary request for a second two-year term as CNO due to his acrimonious relationship with Secretary of Defense Robert McNamara. Korb, "George Whalen Anderson, Jr.," 329.

[48] Bill Weesner, "Dam Neck Trains DASH Crews," *Naval Aviation News*, March 1964: 19. The DASH operator was not an aviator, yet flying the drone involved tremendous aviation skill. "It took more than electro-mechanical skill to fly one of those things well," says DASH operator Jack Pappas. "It took courage to land that thing, to stand out there with helicopter blades spinning 600 miles per hour not far from your head, with two torpedoes loaded, negotiating the burble [air currents flowing around the ship's superstructure], with the ship rocking all over the place. Every flight was exciting." Pappas interview. Given these challenges, it is not hard to understand how, with more than 100 DASH systems in the fleet, the percentage of DASH crews truly proficient in its operation was very, very low.

[49] Jack Pappas, "Rebuttal to McNamara Statement" (personal files), ca. 1967.

[50] He recommended the DASH introduction rate be reduced to one per month to address the training deficiencies. Naval Message, COMCRUDESLANT to CINCLANTFLT (no title), 10 May 1965, 2130Z (NHC archives, DASH folder).

[51] In-born skill, intensive training, and many flight hours made a huge difference with DASH, as it does in all flight operations. Society makes the first quality rare, but the Navy failed to supply the second and third.

Two DASH ship captains agree. Baker only allowed his one lieutenant (Ammens) to operate DASH because others, although technically qualified, did not have the gift for it. "He was rare—he would be good at computer games if he was a kid today." He also made a point to fly the DASH often despite the threat it posed to his career. Baker interview. George Walker had a rusty DASH crew when he took over the U.S.S. *Isbell*, but he flew the helicopter whenever possible, even maintaining a DASH in the air continuously for forty hours at one point. Walker interview. Neither skipper lost a DASH on his watch.

[52] Jay Bornfleth, e-mail, 13 August 1998.

[53] Polmar, "Ups and Downs," 26.

[54] Walker interview.

[55] Baker interview.

[56] Norman Polmar, interview with the author, 12 May 1998. Ironically, one of the reasons flight operations are heavy early in the cruise is to improve pilot and carrier crew proficiency, which obviously came at DASH's expense.

[57] "Manned Helicopters May Replace DASH," *Aviation Week & Space Technology* (3 February 1964). The original manned helicopter project was called the light airborne attack vehicle (LAAV), but aviators added the mission of Styx missile defense in addition to its ASW duties to make it more palatable, thus the "multi-purpose" in its acronym. Norman Friedman, *U.S. Naval Weapons* (London: Conway Maritime Press, 1983), 110.

[58] The World War II-era FRAM destroyers averaged 3,000 tons and 380 feet long, whereas their replacements displaced 4,100 tons and measured almost 440 feet in length. Polmar, "Ups and Downs," 24.

[59] The article notes that manned helicopter operations from Navy destroyers started in Vietnam in August 1965 in various rescue and utility duties and that the Navy was more comfortable with the concept. "Navy Cuts Purchases of Drone Antisub Helicopter; ASROC Favored," *Aviation Daily* (21 June 1966): 1.

[60] The SQS–26 sonar allowed contacts using direct path (traditional) sonar, convergence zone (windows of detection due to wave bending), and bottom bounce. Convergence zone and bottom bounce modes proved tactically challenging and difficult in practice. Like DASH, the concept was sound but problematic in practice. Unlike DASH, the sonar did not crash. Friedman, *U.S. Destroyers*, 284; Baker interview.

[61] Friedman, *U.S. Destroyers*, 284. The U.S.S. *Bronstein* was built for the SQS–26 and was commissioned on 15 June 1963. Norman Polmar et al., *Chronology of the Cold War at Sea: 1945–1991* (Annapolis, Md.: Naval Institute Press, 1998), 79.

[62] Friedman, *U.S. Destroyers*, 283. The data link was too large to fit on DASH and too unreliable and weak to transfer all the required information to DASH remote operators. LAMPS Mark I had a two-man crew, a pilot, and an airborne tactical officer. DASH backers did attempt to deploy a sonabuoy called LORELI that failed due to DASH's inherent payload limitations. Friedman, *U.S. Naval Weapons*, 129.

[63] Even the latest ASW helicopter, LAMPS Mark III, came onboard largely because new passive, towed sonar arrays in the 1970s pushed detection out even farther, requiring a larger, even more capable helicopter. John R. Bush, "Aviation Squadron Organization: Development of the Navy's Light Airborne Multi-Purpose System (LAMPS) Mk III" (DTIC ADA113863) thesis, Naval Postgraduate School, 1981: 14, 23; Friedman, *Submarine Design and Development*, 149.

[64] Friedman, *U.S. Destroyers*, 286.

[65] Ibid., 129. This decision looks specious in light of the terrible accuracy ASROC would achieve in bad weather with the tossing and turning of the ship throwing off its delivery. Nevertheless, due to this decision ASROC was able to act as a plausible bridge to LAMPS.

[66] The record on this count is murky. Contractor paperwork revealed that by 1970 "[E]ngineering and tests to provide the [DASH] with the capability to carry a special weapon were successfully completed." Peter J. Papadakos, Letter to C. M. Bailey (GAO), 4 May 1970, in Appendix I of GAO Report B-160877, 40. The Navy conducted only one live nuclear ASROC shot on 11 May 1962, just prior to the enactment of the Nuclear Test Ban treaty. Friedman, *U.S. Destroyers*, 286; Pappas interview.

[67] ASROC's one claim to innovative status might be its nuclear capability.

[68] A cost analysis showed DASH cost $650 per attack compared to the expensive ASROC. Friedman, *U.S. Naval Weapons*, 129.

[69] The Navy retired the last nuclear ASROCs in 1989. Norman Friedman, *The Naval Institute Guide to World Naval Weapons Systems 1991/92* (Annapolis, Md.: Naval Institute Press, 1991), 690. ASROC was cut from the 1993 budget and left the fleet soon thereafter.

[70] GAO Report B-160877, 18; 90th Cong., 1st sess., U.S. Senate, "Hearings Before the Subcommittee of the Committee on Appropriations" (Washington, D.C.: GPO, 1967), 106; Jack Kestner, "Navy Dumps DASH After $250 Million Cost." The *Ledger-Star* was the hometown newspaper of VU–3, the DASH squadron.

[71] GAO Report B-160877, 18.

[72] A project office memorandum challenged the reliability charge, saying the drone exceeded standards established in two 1961 studies

upon which the drone was accepted into the fleet. Pappas, "Rebuttal to McNamara Statement."

[73] In 1963, Secretary of Defense McNamara had approved DASH funding for 600 air vehicles, 2½ for each of 240 destroyers and other escorts. Booda, "DASH Will Be Operational," 32. The Navy reduced DASH deployments sharply in June 1966, just prior to McNamara's announcement, listing ASROC as "a better way of doing [ASW]." "Navy Cuts Purchases of Drone Antisub Helicopter; ASROC Favored," *Aviation Daily* (21 June 1966): 1.

[74] Peter P. Papadakos, executive director, Gyrodyne Helicopter Historical Foundation, e-mail to author, 11 January 2004.

[75] Among them was a DASH modified with a real-time television data link to provide Marine artillery spotting in Vietnam called Snoopy. "Derivatives of DASH," Appendix I, GAO Report B-160877, 42.

[76] Whereas Army literature is replete with references to "looking over the next hill," Marines typically want to "look over the next ridge." Ron Rivers, "What's Over the Next Ridge?" *Marines* (May 1986): 22–23.

[77] "Operational Evaluation of the Lightweight Battlefield Surveillance Drone System, Final Report" Quantico, Va.: Marine Corps Landing Force Development Center, 1964 (DTIC ADB211944), 2; John B. Moriarty, Project Officer, "Troop Test of the Lightweight Battlefield Surveillance Drone, Final Report," Quantico, Va.: Marine Corps Landing Force Development Center, August 1967 (Moriarty personal records), 4.

[78] According to Kelley, "We never knew where the hell the thing was," so they used a stopwatch and the airplane's nominal eighty-knot airspeed to calculate its position on a map. They also employed an expert radio-controlled aircraft pilot who could make the aircraft do acrobatic maneuvers, but Kelley doubted whether Marines could be trained to an acceptable level of proficiency. P. X. Kelley, General, USMC (retired), commandant of the Marine Corps and former test manager for both drone programs, interview with the author, 8 February 2000.

[79] Ibid.

[80] L. P. Charon, "Front-Line Photo Drone Ready for Robot Recon," *Marine Corps Gazette* (August 1966): 38; Wallace M. Greene, Jr., General, USMC (retired), commandant of the Marine Corps from 1 January 1964 through 31 December 1967, interview, 2 April 1999. The Office of Naval Research initiated a feasibility contract with Republic in 1960 and flight tests commenced by early 1962. The early tests focused on radar tracking for the drone in order to increase its range, but the Marine Corps judged the additional equipment as being too cumbersome. "History and Description of Marine Corps Battalion Landing Team Aerial Drone Reconnaissance

System (U)," Farmingdale, N.Y.: Republic Aviation Corporation (DTIC AD344655), 5 February 1963: 1.

[81] Most modern UAVs power onboard systems using an alternator, which robs some thrust to provide electrical power. Bikini powered its camera and flight actuators using batteries. When the batteries ran low, the drone popped a recovery parachute. Battery problems plagued early prototypes, so the contractor (Republic) added a much larger, 4½-horsepower engine and alternator which caused weight growth and affected overall performance and portability. "Operational Evaluation," 4; Moriarty, "Troop Test," 2.

[82] John W. R. Taylor, ed., *Jane's All the World's Aircraft 1966–67* (New York: McGraw-Hill, 1966), 375. Bikini appeared in *Jane's All the World's Aircraft* through the 1968–69 edition. The design used a standard AN/M–4 flame-thrower compressor to provide launch power and a Sidewinder missile 28-volt alternator. John B. Moriarty, project test officer, Lightweight Battlefield Surveillance Drone System, interview with the author, 6 April 1999.

[83] The approximate cost for each component was as follows: aircraft—$7,500 ($36,000 in 1999 dollars); camera—$7,500; launcher—$50,000. A planned film processing station would have added additional cost. Moriarty interview.

[84] Moriarty, "Troop Test," Appendix E.

[85] This first operational utility test was conducted 6–14 October 1964. "Operational Evaluation," 2.

[86] Moriarty, "Troop Test," A-8-5, C-2-1.

[87] Ibid., C-3-1.

[88] Moriarty interview.

[89] The drones averaged 14.9 flights before crashing, falling just below the required threshold of 15. Moriarty, "Troop Test," B-1, B-2.

[90] Ibid., A-24-1.

[91] Moriarty interview.

[92] J. H. Brown, R. G. Ollila, and R. D. Minckler, "A Survey and Technical Systems Assessment of Drone Aircraft for Tactical Reconnaissance and Surveillance," Vol. 1, Battelle Columbus Laboratories Tactical Technology Center, Columbus, Ohio: Advanced Research Projects Agency Report 1541 (February 1972), E-1.

PART III

Retrenchment and Reform

Defense Acquisition in the 1970s: Retrenchment and Reform

Shannon A. Brown with Walton S. Moody

Marked by high-profile procurement controversies, political and economic fallout from a postwar drawdown, and numerous reform and realignment efforts championed by the executive branch and Congress, the 1970s can be characterized as a decade of retrenchment and reform for the defense acquisition community. During the 1970s, defense acquisition was subjected to intense scrutiny and criticism by both the government and the American public, with reform proposals coming from diverse sources. These criticisms had a role in bringing about changes to the defense acquisition process that were meaningful departures from the established approach to developing and buying weapons. These changes included new management, oversight, and reporting requirements that reflected the evolving priorities of the Department of Defense (DoD) after the Vietnam War.

During the 1970s, the acquisition process was shaped by periodic efforts on the part of both the government and private industry to streamline the linkages between commercial firms and the Defense Department, but these measures often proved to be uneven prescriptions of administrative decentralization and fiscal retrenchment that reflected the political predilections of Congress and the Nixon, Ford, and Carter administrations. Other considerations influenced the acquisition process. New research, development, and production demands emerged as the country adopted a strategic orientation that gave renewed importance to the NATO alliance and other overseas commitments. By the end of the decade, such terms as "prototyping" had been introduced (or, in some instances, reintroduced) into the acquisition lexicon, and the community was working hard to improve the overall process and embrace these new requirements and priorities. At the same time, defense acquisition programs were enhanced by new computer and manufacturing technologies but undermined by the

fiscal austerity and inflation that came to characterize the latter half of the decade.

This chapter examines the pressures on the acquisition community to perform ever more complicated tasks amid increasing public and government scrutiny—and the responses to this changing situation that the Office of the Secretary of Defense (OSD), the services, Congress, and industry devised to navigate among them. This decade of reform and retrenchment in many ways focused and renewed the acquisition community, bridging the previous years, whose legacy seemed clouded in scandalously lax practices, and the high-tech, high-dollar decades that lay ahead. Changes in policy, practice, and technology all contributed to this transformation of the community.

The Nixon Doctrine

1970s acquisition reforms were set amid external changes that put additional pressures on the acquisition community, which consisted of industrial firms, subcontractors, and consultancies, as well as government offices. New U.S. foreign policies, undertaken as the United States was reducing its commitments to Southeast Asia, affected the acquisition community early in the decade. In his State of the Union address delivered on 20 January 1972, President Richard M. Nixon stressed his Realistic Program of Foreign Assistance, which included provisions for loans and grants-in-aid, foreign military sales (FMS), military technology licensing, and technology transfer to key allies. Nixon's pledge of support to allies was reflected in the FY 1973 Annual Report, in which Secretary of Defense Melvin R. Laird noted that "for the first time, planning for FY 1973 military assistance and credit sales took place within the Department of Defense Planning, Programming, and Budgeting System."[1] The Nixon Doctrine, as this broad international security assistance program became known, had important ramifications for the American defense industrial base. Defense companies that faced sales problems as the Department of Defense reduced hardware inventories or limited purchases got some relief from overseas sales. As retrenchment measures curtailed defense spending, inflation and the post-Vietnam War drawdown ate away at the bottom lines of leading prime contractors. Licensing, foreign sales programs, and technology transfer programs were expanded, with the effect of keeping some U.S. defense companies solvent.

Encouraged by the Nixon Doctrine, "coproduction" programs were one form of overseas assistance that had implications for U.S. acquisitions. In 1973, for example, the U.S. Air Force and the Northrop Corporation

promoted the "Peace Tiger" and "Peace Alps" coproduction schemes in Taiwan and Switzerland, respectively. The two programs were different in approach and execution, but had similar objectives: to allow foreign states to manufacture F–5 fighter aircraft.

In the Taiwanese case, a manufacturing facility was established at Taichung to produce, from raw materials, fuselage sections of the F–5. Engines and technical support were provided by the U.S. Air Force through a government-furnished equipment arrangement, while Northrop provided the Taiwanese factory with airframes, equipment, and tooling under direct contract with the government of the Republic of China. The initial Peace Tiger studies were conducted in the summer of 1973; within a few years, "when Northrop had high production runs to satisfy many customers, the Taiwan coproduction line was treated as another part of the Northrop production line, tied by a rather long umbilical cord."[2] By this innovative approach of decentralized international aircraft production, the U.S. defense acquisition community found itself providing management and technical assistance to foreign engineering teams working on American-designed, locally manufactured hardware. The Taiwanese logistics system was, in fact, modeled on the Air Force Logistics Command (AFLC), and the co-production agreement allowed Taiwanese representatives to requisition items from AFLC's inventory.[3]

Military sales and transfers to other Asian countries had more far-reaching implications for the defense acquisition community and changed much more than the practice of acquisition. Technology transfers to Japan, which were made through direct sales and licensing deals authorized by OSD transformed the island nation from a client into a competitor for U.S. defense industrial base firms.[4] Similarly, Singapore benefited from the transfer of technology and defense industrial base-related work to the Pacific Rim, as U.S. firms secured a foothold in the "Lion City," first in support of U.S. operations in Southeast Asia and subsequently to provide services to the growing Singapore armed forces. It was during the mid- to late 1970s that the economy of Singapore, bolstered by inflows of foreign investment, could support a military modernization program. The United States (as well as Great Britain and Israel) moved to provide Singapore with the resources and materiel necessary to create a modern force.[5]

In the Middle East, the United States also found a ready market for military technology, and U.S. suppliers were happy to act on the Nixon Doctrine to provide support to Saudi Arabia, which was, despite tensions over increasing oil and energy prices, a key U.S. ally in the region. Widely cited as a bulwark against the radical Islamic fundamentalism and corrosive socialist ideologies that were taking hold in the Middle East, Saudi Arabia

obtained approximately $34 billion in American military hardware between 1973 and 1980, through foreign military sales programs and transfers. The technology obtained by the Saudis was far from obsolescent; during the 1970s, the Saudi air force modernized with F–5s and, at the end of the decade, far more advanced F–15s. One observer noted that the Saudi military buildup was so rapid that, by 1977, "even if Saudi Arabia were to receive no more military equipment it would take six years for existing personnel to be able to use already bought technology."[6] Such massive procurement programs had a definite influence on the U.S. acquisition community, as both the market and the production of defense materials became increasingly international during the 1970s.

Fitzgerald and Packard

In keeping with the received wisdom on the Nixon presidency in general, the well-conceived, even innovative, international sales arrangements contrasted sharply with the domestic defense acquisition situation. As it happened, when Nixon took office in 1969, the acquisition community was already in turmoil, the result of a high-profile controversy that began in mid–1968, when A. Ernest Fitzgerald, deputy for Management Systems in the Office of the Assistant Secretary of the Air Force for Financial Management, first testified before Congress about cost overruns on the C–5A cargo aircraft program. His appearances before congressional panels resulted in a series of investigations that proved to be very embarrassing for the Air Force and the Lockheed Corporation, prime contractor for the C–5A. Subsequent allegations were made that, after testifying, Fitzgerald was the subject of career reprisals by the Air Force's senior leadership. These accusations only drew more public attention to the controversy.[7] Before long, William Proxmire (D–WI), the chair of the congressional committee that had summoned Fitzgerald to testify, was calling for more direct legislative oversight of *all* major acquisition programs and insisting on a follow-up investigation of Fitzgerald's treatment at the hands of the Air Force.[8]

The C–5A drama was heightened by Fitzgerald's public portrayal as a dedicated civil servant who signed on as an Air Force cost analyst in order to root out fraud and waste, presumably with the support and blessings of his superiors. He had earned a solid reputation as a cost analyst while working on the Minuteman II program in the early 1960s, and his efforts were rewarded with a senior civil service appointment in the Air Force under Assistant Secretary Robert Charles.[9] The image of the resolute analyst, striving to expose bureaucratic waste and military hubris, resonated

with a public that was already openly critical of antiballistic missile (ABM) spending and the ongoing war in Vietnam. Fitzgerald's testimony was lauded by the news media and in several books that were subsequently written about the scandal.[10] The Proxmire hearings revealed serious flaws in the acquisition process, and it fell to the civilian leadership in OSD to address these problems and repair the public's confidence in a process that was widely regarded as broken.

In this connection, President Nixon appointed David Packard, one of the founders of the Hewlett-Packard Corporation and a veritable legend in American business circles, to the post of deputy secretary of Defense in January 1969. With an extensive business background and a hands-on management style that stood in stark contrast with that of former Defense Secretary Robert McNamara, Packard seemed like a logical choice to tackle the problems of defense acquisition by revising policy and working closely with subordinates to repair the cultural rift that had developed between the services and OSD during McNamara's tenure.[11] One observer, writing in 1972, suggested that Packard was the embodiment of a "cult of personality in reverse," a hero called upon to "put things right for the future."[12] Although some expected Packard to follow through on many of McNamara's policy and management goals, he did not seek to preserve McNamara's approach to acquisition. Instead, he began a high-profile reform effort aimed at quieting critics and restoring the public's confidence in the Defense Department.[13]

Deputy Secretary of Defense Packard, speaking before a group of defense industrial managers on 20 August 1970, acknowledged this crisis of confidence when he confessed, "Frankly, gentlemen, in defense procurement, we have a real mess on our hands, and the question you and I have to face is what are we going to do to clean it up?"[14] His honesty was brutal and to the point, and the question no doubt struck a chord with the men and women in attendance. After all, these concerns were not limited to a small but vocal minority; many within the Department of Defense were equally concerned and quietly critical of the acquisition process—a process that had been recast by Robert McNamara in the 1960s to give more direct policy and program control to the Office of the Secretary of Defense.

One of Packard's first major reform gestures was a memorandum, issued on 28 May 1970, which outlined eight basic principles that could be reduced to simple phrases to serve as signposts for acquisition professionals:[15]

- Help the services do a better job.
- Have good program managers with authority and responsibility.
- Control cost by trade-offs.

- Make the first decision right.
- Fly before you buy.
- Put more emphasis on hardware—less on paper studies.
- Use the type of contract appropriate for the job.
- Eliminate Total Package Procurement.

Some of these memo points appeared to be tailored to address criticisms made of the C–5A program. The ban on Total Package Procurement (TPP), for instance, effectively prohibited the contracting arrangement that many associated with that troublesome aircraft.[16] Taken as a whole, however, the memo's guidance was written to be sweeping and apply to all acquisition activities. The services took immediate notice and hailed the memo as an important reform step. One commentator, amused by its reception within the halls of the Pentagon, noted that "one is led to believe that this memorandum . . . did as much for the history of defense procurement as President Nixon's subsequent visit to mainland China did for the history of the world."[17] The Packard memorandum was widely reprinted in service and defense acquisition program manager publications, and it became the focus of countless management discussions and program improvement articles, serving as a kind of blueprint for reforms to the acquisition process during the 1970s.

Less than a year after issuing the memorandum, Packard testified before the House Appropriations Committee about its favorable impact. During his presentation, Packard provided Congress with a progress report, pointing out that the services were implementing the memo's "fly before you buy" language and that acquisition executives were doing their best to observe the memo's contracting guidance. Packard reported that, true to his recommendations to the armed forces, the use of Total Package Procurement, presumably the root of the C–5A problem, was being discontinued except in rare cases "where a contractor obviously has adequate resources to absorb . . . loss." The services were issuing contracts that were in compliance with his view that "development contracts for new major weapons systems should almost always be cost-incentive contracts."[18] Packard identified the AX acquisition program, as well as the AWACS, F–15, and B–1 aircraft programs, as models of effective management and "fly before you buy" (FBYB) evaluation.[19] In his concluding remarks about ongoing and pending changes to the defense acquisition process, Packard was characteristically understated: "I won't claim that this is a managerial revolution—but it is an improvement."[20]

Revolution or not, Packard made other important and lasting changes to the defense acquisition process before leaving OSD to return to the

private sector in late 1971. Shortly after taking office, Packard had formed the Defense Systems Acquisition Review Council (DSARC) as an advisory body reporting to the secretary of Defense. The council, formed in May 1969, established three progress milestones for acquisition programs, an important enhancement to the acquisition process. The milestones were defined as "program initiation decision," "full-scale development decision," and "production decision." A significant redirection of the acquisition process, such aircraft programs as the F–15 and AX (A–10) were managed with this milestone approach. The DSARC was part of a longer-term scheme to promote a kind of "decentralized centralization" over defense acquisition activities.[21] OSD retained oversight authority over new acquisition programs, but Packard wanted the services to assume a larger role in the management of the acquisition process, with many functions devolving to the services. The original DSARC memorandum that Packard issued in May 1969 emphasized that the "primary responsibility for defense systems acquisition and its management on a particular program must rest with the cognizant service and program manager (PM) it designates."[22]

The spirit of "decentralized centralization" also could be found in the language of the landmark May 1970 memo, in which Packard articulated new principles for managing acquisition in the coming years. "The prime objective of the new policy guidance is to enable the services to improve their management of programs . . . . [T]he services have the responsibility to get the job done," wrote Packard. "[I]t is the responsibility of OSD to *approve* the policies which the services are to follow, to *evaluate* the performance of the services in implementing the approved policies, and to make decision on proceeding into the next phase in each major acquisition program."[23] After Packard's departure, the promotion and implementation of this broad vision fell to others, especially William P. Clements, Jr., who assumed the position of deputy secretary of Defense in late January 1973, replacing Packard's successor, Kenneth Rush; Dr. John S. Foster, Jr., director of Defense Research and Engineering; and Barry Shillito, assistant secretary of Defense for Installations and Logistics.

Senior OSD officials continued to promote changes to the management of the acquisition process. Packard's widely circulated May 1970 memorandum became the basis for the 5000 series of acquisition policy directives, which further articulated the changing relationship between OSD and the services, and demarcated the roles and responsibilities of each. DoD Directive 5000.1, "Acquisition of Major Defense Systems," identified the need for decentralized responsibility and authority in the conceptualization and development of defense systems. Acquisition oversight would be provided by OSD (through the DSARC and other means), while the

services took responsibility for determining requirements, development, and production.[24] Subsequent 5000 series directives were written to provide additional guidance on the management of major defense systems: DoD Instruction 5000.2, "Decision Coordinating Paper (DCP) and the Defense Systems Acquisition Review Council (DSARC)," was issued 21 January 1975; and DoD Directive 5000.4, "OSD Cost Analysis Improvement Group," was issued 13 June 1973.[25]

Packard-inspired changes to the *process* of acquisition programs included a policy that required unit cost thresholds to be declared in the DCP—development concept paper or decision coordinating paper, as it came to be known after 1971—submitted to the deputy secretary of Defense before an acquisition program could be initiated. According to policy, the statement of cost in the DCP effectively committed the acquisition program manager to stay under the declared cost threshold (a formality that had a range of acquisition practice consequences).[26] As the acquisition process evolved during the 1970s, this "design-to-cost" approach became fully integrated into service acquisition regulations, and cost commitments became formally articulated during the second DSARC review.[27] Now, by the late 1970s, the DCP no longer functioned as a contract between OSD and the services; this function became the purpose of the Secretary of Defense Decision Memorandum, or SDDM. Instead, the DCP evolved into a management statement that summarized program scheduling, system alternatives, and other matters related to the acquisition strategy.[28] Still, in terms of decentralized centralization, the DCP remained an important part of the ongoing effort (on the part of OSD and the services) to manage better the overall acquisition process.

Making lasting and meaningful acquisition process changes, however, required new approaches to the *practice* of developing and producing weapons. Prototyping, cost-overrun avoidance, and waste elimination were identified as important acquisition practice reforms that deserved the full attention of OSD and the services.[29] Parametric cost estimating was identified as one solution to the problem of cost overruns. Packard had been dismissive of older cost estimating practices as a kind of "wishful thinking" and encouraged the use of parametric costing, combined with prototyping, to reduce overrun risk.[30]

Source-selection reform was another acquisition practice issue, discussed by Packard on a number of occasions, which drew the attention of OSD and the services. Simplifying requests for proposals (RFPs) was an important first step. In the case of the Lightweight Fighter Prototype Project (which Packard initiated), the source-selection process was dramatically shortened by establishing a limit on the length of the actual proposal (fifty

pages for the technical proposal and ten pages for the cost proposal) and changing the scoring system used by the proposal evaluators. Air Force Systems Command welcomed this streamlined approach and anticipated using these kinds of limits and restrictions in all future competitions in order to speed up the selection process.[31] Similarly, Maj. Gen. George Sammett, Jr., deputy chief of Research and Development for the Army, envisioned using a similar method for Army acquisition in order to reduce the hardware acquisition time span from eight or ten years to six. He predicted that this time savings could be accomplished through streamlined source-selection and expedited decisionmaking on the part of Army program managers, a prediction that was based on an assumption that more authority over acquisition practices would devolve to the services in the future.[32]

Other acquisition practices deserved scrutiny and reform, in Packard's view. One such problem was acquisition staffing. Ensuring that acquisition program personnel, especially managers, were qualified to hold their positions was an important issue. Professionalization of the acquisition workforce was imperative, in Packard's view, if the services were going to assume more responsibility for the development of weapons systems. As such, professionalization appeared as an important part of the management guidance laid out in the May 1970 memorandum. Packard's approach was two-pronged: first, reevaluate "the overall structure of the program management function in all services;" and "put capable people into management, give them the responsibility *and the authority* and keep them there long enough to get the job done."[33]

True to his goal of improving the acquisition workforce, Packard took on promoting acquisition education when he accepted the advice of a review group on acquisition management training, which proposed moving the Defense Weapon Systems Management Center at Wright-Patterson AFB, Ohio—home to the only DoD educational curriculum for program management training—to Washington, D.C. In mid–1970, Packard approved the relocation of the program, and this move led directly to the establishment of the Defense Systems Management School (DSMS) at Fort Belvoir, Virginia, in July 1971. A subsequent deputy secretary of Defense, William P. Clements, Jr., carried Packard's vision further when he issued a DoD acquisition career management directive in 1974 that called on the services to send program manager candidates (or program managers recently assigned to their jobs) to DSMS. To enhance the prestige of the DSMS program—and advertise the quality of the curriculum offered by the school—Clements changed the name of the school to the Defense Systems Management College.[34]

By the mid–1970s, many of the acquisition practice improvements suggested by Packard were being implemented. Prototyping, parametric cost estimating, and source-selection reform were becoming commonplace. Some of the services were aggressively carrying out Packard's guidance; the Air Force, for instance, established a "murder board" approach to writing RFPs, defined as "an eleventh-hour last critical check of a new defense system procurement before the defense contractor enters the picture."[35] Composed of officers and civilians drawn from the technical, legal, financial, and operational communities, the murder board was hailed as an important new step in the reform of acquisition practice. These service-specific reforms were supplemented by the creation of the Cost Analysis Improvement Group (CAIG), which was formed in January 1973 to "provide improved independent cost analysis in the military services and OSD."[36]

Although he served for only nineteen months, David Packard left an indelible mark on the acquisition community. After taking steps to address the public and internal criticisms of the C–5A program Packard charted a course for defense acquisition in the 1970s. Despite clear guidance, however, the challenges of retrenchment and the struggle to define "reform" continued to plague the acquisition community.

Scandal, Suspicion, Reform

Although hardly a universal sentiment, there was sufficient public frustration with defense spending and acquisition that the issues filtered into the popular culture of the 1970s. Woody Allen's farcical film *Sleeper*, released in 1973, depicted a fascist future state bent on crushing individual freedoms but stymied by overcomplicated and unreliable weapons. With a more serious tone, Joe Haldeman's landmark science fiction novel *The Forever War* (1974) used an endless interstellar conflict to frame an allegory for the Vietnam War, complete with subplots that addressed the catastrophic impact of military spending on social structures, the cultural alienation felt by soldiers returning home from decades-long campaigns, and the problems associated with expedited technology acquisition programs.

Even before ineffective defense institutions became grist for popular culture, senior OSD officials were well aware of burgeoning "anti-defense" feelings that were more than just fallout from the C–5A hearings.[37] As early as mid–1971, Packard had acknowledged the problem in public, warning his colleagues that "there will certainly be continuing pressures on the defense budget over the next few years. . . . [T]hese pressures have built up in part because of the growing attitude in the country" that

defense spending was the worst kind of government waste. To fix the problem, Packard called on the acquisition community to "do a better job in the future."[38] The momentum for change slowed some after Packard's departure from the Department of Defense, but reform efforts continued, some based in part or in whole on work initiated during Nixon's first term. To do a better job, however, the executive branch and Congress had to come to some kind of agreement on what "reform" meant. Fortunately, the government and private industry had initiated studies of these matters that were underway even as David Packard was being confirmed as deputy secretary of Defense.

The Blue Ribbon Defense Panel (also known as the Fitzhugh Commission), for example, had been put together by Secretary of Defense Melvin Laird in 1969. Headed by Gilbert Fitzhugh, chairman of the board of the Metropolitan Life Insurance Company, the panel provided an early blueprint for some acquisition reforms, even though acquisition activities were not the focus of the commission's final report. The panel's final report, released in summer 1970, included more than 100 recommendations for change.[39]

"Fly before you buy" was among the Fitzhugh recommendations, a finding that echoed the policy that Packard adopted shortly after taking office. As such, some critics dismissed the finding as repetitive. Nonetheless, the Fitzhugh report was widely cited as an important acknowledgement that there were serious problems with acquisition (Fitzhugh himself confessed "wonder" that the Pentagon worked at all). The Fitzhugh Commission's other suggestions included establishing a Defense Test Agency to improve the operational test and evaluation of new systems; creating formal job categories and structured training and career opportunities for acquisition professionals, both uniformed and civilian; and, in the management and oversight of acquisition programs, reducing the emphasis on cost and schedule in favor of quality and mission performance.[40]

In an address to the Armed Forces Management Association, Packard celebrated the release of the Fitzhugh Commission report, announcing "Secretary Laird and I intend to move ahead as quickly as possible to put most of the 113 recommendations into effect." Packard was sanguine about the state of defense acquisition, declaring that "in defense procurement, we have a real mess on our hands…. [W]hen we are not in a hurry to get things done right, we over-organize, over-man, over-spend, and under-accomplish."[41] He continued by pointing out that there was plenty of blame to go around: "Too frequently, we have been wrong in listening to you, and more frequently you have been unable to deliver on either of these promises—what it would do or what it would cost."[42]

Similarly, the National Security Industrial Association (NSIA) funded a private study of defense acquisition and, on 1 July 1970, released its findings as the *Defense Acquisition Study*.[43] The study acknowledged the Fitzhugh Commission, then ongoing, and the congressional Commission on Government Procurement (also established in 1969, discussed below) but expressed concern that recent government studies were products of "the emotional backlash resulting from instances of misjudgment or oversight."[44] Undertaken to provide an "objective review" of defense acquisition and the role of contractors in the process, the NSIA *Defense Acquisition Study* featured sweeping recommendations, including a call to rewrite the 1947 Armed Services Procurement Act; a suggestion that the federal government take the real costs of research and development into account when evaluating technical and cost proposals for major acquisition programs; and a demand that Congress and the Department of Defense establish reporting standards—"a common means of surveillance"—so that miscommunications would not be interpreted by the legislative branch as improper conduct on the part of defense contractors.[45] The NSIA report also called on Defense Department to slow the implementation of the 1962 Truth in Negotiations Act (Public Law 87–653), noting that "overzealous and duplicative" implementation had "led to a costly loss of productive manpower and time."[46]

In the most sweeping and arguably the most important of the studies, Congress opted to examine defense acquisition through the creation of the Commission on Government Procurement, established by Public Law 91–129, in November 1969. The commission was made up of members of Congress, the executive branch, and private citizens appointed by responsible federal authorities. Headed by E. Perkins McGuire, a consultant and corporate executive, and Rep. Chet Holifield (D–CA), the commission was the first of its kind to concentrate on acquisition matters. After several years of contemplation, the commission produced a massive four-volume report, released in December 1972, which covered almost every aspect of procurement and acquisition. The 149 recommendations set out in these volumes were far-reaching in scope and influence over both acquisition process and practices, and the action taken by Congress on some of the more important proposals contained in the report fundamentally reshaped defense acquisition.[47]

The Commission on Government Procurement proposed, among other things, the creation of an Office of Federal Procurement Policy (OFPP) within the Office of Management and Budget. In 1974, such an office was established by federal statute.[48] The OFPP was organized with the understanding that it would have directive authority over all federal

procurement agencies and activities, and that the staff of the office would be a "small, highly competent cadre of seasoned procurement experts."[49] The OFPP was chartered to "formulate government-wide acquisition policies and regulations and to monitor government-agency acquisition practices."[50]

The commission proposed doing away with the Armed Services Procurement Act of 1947 (applicable to military acquisition) and the Federal Property and Administrative Services Act of 1949 (which governed nonmilitary government procurement), and replacing the Byzantine laws and regulations promulgated by these acts and countless revisions with a "uniform, government-wide system, under the Direction of the Office of Federal Procurement Policy."[51]

Other recommendations made by the commission were incorporated into subsequent acquisition policies, if not always in practice. These included measures to promote competition among industrial base firms at the beginning of an acquisition program, formal efforts to encourage small- and medium-sized companies to offer alternatives to large defense systems in order to promote the involvement of smaller contracting concerns in the acquisition endeavor, and management streamlining on the government side of the acquisition relationship. The commission also proposed that the government take steps to favor the use of private research and development facilities and services and rely less on government resources. Finally, the commission called on the executive branch to develop processes that would enhance information sharing and improve the transparency of major acquisition programs so that Congress could exercise more informed authority over defense acquisition activities.

Some attempts at transparency, however well intentioned, were doomed to failure by the exigencies of acquisition practice. In 1977, Congress made an effort to obtain a better understanding of the acquisition process by monitoring, through a database, the use of subcontractors by major defense companies. This gesture was an expression of the legislature's long-standing desire to establish reliable means of acquisition surveillance. Congress directed the Department of Defense to compile subcontractor statistics from businesses awarded more than $500,000 in prime contracts. The defense industry did not readily comply with this requirement, and enforcement (the responsibility of the Department of Defense) was lax. In 1981, the subcontract reporting requirement was abandoned by Congress.[52]

The views of the executive branch, private industry, and Congress were articulated on the pages of three reports, each with nuanced views on what measures had to be taken to reform defense acquisition. Through compromise and confrontation, many of the proposals in these reports were carried out. Of these three groups, however, it was Congress that emerged

from a decade of reform negotiations with a more activist role in defense acquisition.

Landmarks and Milestones

As the decade wore on, Congress took a stronger role in defense acquisition—both in terms of oversight authority and direct control over programs. A number of important legislative acts, supported or augmented by executive decisions made during the 1970s, redirected the acquisition process. These changes took place against a backdrop of retrenchment in government spending, and many of the reforms that were made to the acquisition process in the mid–1970s were authored to strengthen Congress's role vis-à-vis the executive branch in the federal budget process. Thus through retrenchment and reform, the legislative branch sought to obtain more control over acquisition, a defense activity that had become more decentralized and, as a consequence of creeping inflation, more expensive.

Cost and Budget

Congress took steps to ensure that, despite the best efforts of the services to promote additional decentralization of acquisition activities, the civilian leadership secured an increasing amount of oversight power over defense acquisition processes. Cost and budget were used to promote this expansion of congressional involvement, and new fiscal management tools were introduced to enhance the legislature's control of public spending. For example, in 1970, after a lengthy debate in Congress during hearings to amend the 1950 Defense Production Act, the Cost Accounting Standards Board (CASB) was created to act as an agent of Congress, working independently of DoD, to establish rules that included accounting requirements for defense contractors doing business with the federal government.[53] The CASB issued cost accounting standards that were intended to address, among other issues, indirect cost improprieties, an issue that gained prominence when Admiral Hyman Rickover made the allegation in the late 1960s that contracting firms were grossly overcharging the government because of a lack of uniform cost accounting standards.[54] A 1970 General Accounting Office (GAO) study, "Report on the Feasibility of Applying Uniform Cost-Accounting Standards to Negotiated Defense Contracts," suggested that federal cost accounting standards could be used to the benefit of the government in determining realistic cost estimates for both fixed-price and cost contracts.[55] To this end, the CASB began issuing directives in 1972 and continued to make accounting standards policy throughout the decade.

In addition to important cost accounting practice changes, there were a number of critical adjustments made to the mechanics of federal budgeting during the 1970s. These changes fundamentally altered the relationship between Congress and the defense acquisition community, increasing the involvement of the legislature in acquisition program reviews. The 1974 Congressional Budget and Impoundment Control Act (Public Law 93–344) was landmark legislation that had serious implications for the Department of Defense and the defense acquisition community. Generally speaking, the purpose of this legislation was to encourage the standardization of accounting and funding request processes, improve the position of the Congress vis-à-vis the executive branch on matters of impoundment and recisions (special requests for funding or funding deferrals), and standardize reporting across the government to improve oversight. The act aligned the civilian budgeting process with the DoD Planning, Programming, and Budgeting System (PPBS) and the Five-Year Defense Plan (FYDP). The act also changed the fiscal year from 1 July–30 June to 1 October–30 September.[56]

Some of the 1974 Budget Act's terms had special implications for defense acquisition. Title VII of the act, for instance, authorized congressional committees to conduct their own analyses of research, development, and procurement programs. Title VII also increased the audit and evaluation authority of the GAO.[57] For acquisition program managers, the new budgeting deadlines and requirements established by the act created additional process and practice burdens; if so requested by Congress or the GAO, detailed program justifications and cost analyses had to be prepared before additional moneys would be allocated to support an acquisition program. Because the act lengthened the horizon for budgeting, failure on the part of a program manager—or OSD—to respond to a congressional request for information might endanger several years of funding for an acquisition program.[58] The act was part of a larger trend toward additional congressional involvement in the acquisition process, and the services' existing acquisition review and budgeting practices had to be adjusted accordingly.[59]

Even more adjustments had to be made to the process of budgeting for military acquisition programs—indeed, for the entire Department of Defense—when President Jimmy Carter made the decision to adopt Zero-Based Budgeting (ZBB) for the executive branch when he took office in 1977. Described as both a budgeting approach and a management technique, President Carter had employed ZBB as governor of Georgia and made a campaign pledge to impose ZBB on "all federal departments, bureaus, and boards by Executive Order."[60] President Carter did in fact

issue such an order, and the 1979 fiscal year budget was prepared with ZBB.[61]

Reformers were encouraged by the president's decision to adopt ZBB. Proponents praised the technique as a rational, objectives-based approach to spending money. As a management technique, ZBB required constituents to review the need for existing programs and established a means for new programs to compete with older programs for resources. Competition over monies forced reviews and justifications at the lowest levels of management. For defense programs, the introduction of ZBB required the active involvement of managers from the bottom-up and increased the reporting burden of the lowest echelons of the defense acquisition community.

Critics of ZBB noted that the technique generated enormous amounts of paperwork (a fact duly noted by acquisition officials) and placed undue pressures on the lowest levels of management, who could no longer dedicate total attention to the day-to-day operation of their offices and programs. The centralizing effect of ZBB—and the invasive review and justification processes it required—also unsettled some, while others questioned the utility of turning a process that was political at heart into an exercise in micro-management.[62]

Objections notwithstanding, ZBB forced fundamental changes to the acquisition budgeting process, increased the involvement of managers and other acquisition officials in the contentious justification process (many for the first time), and further involved Congress in the management of system acquisition.

Rules and Regulations

In April 1976, the director of the Office of Management and Budget (OMB), working in concert with the first administrator of the newly created Office of Federal Procurement Policy (OFPP), issued a policy guidance paper on acquisition. Known as OMB Circular A–109, "Major Systems Acquisitions," the policy was modeled on the existing DoD 5000 series regulations, and specifically engaged many of the proposals and recommendations made by the 1972 Commission on Government Procurement.[63] Most significantly, A–109 formally defined a "major" defense program as one that had estimated research and development costs in excess of $100 million or production costs in excess of $500 million. According to the language of A–109, programs with such anticipated costs required that involvement of the highest levels of agency management in determining the connections between acquisition plans

and requirements. A–109 also directed that agencies adopt a systematic approach to "establishing mission needs, managing programs, budgeting, and contracting."[64]

The supervision for this balancing act would come from within DoD. After the directive was issued, the secretary of Defense appointed the under secretary of Defense for Research and Engineering to work in a "dual-hatted" capacity as the defense acquisition executive (DAE). The DAE would serve as the principal adviser to the secretary of Defense on matters of defense technology and equipment. The directive also extended the "mission-based" approach to acquisition to contractors, encouraging DoD to employ task-oriented funding that would provide long-term support to industrial base firms during the periods between acquisition program decision points. According to OFPP and OMB, such an approach would facilitate the continuity of personnel and contribute to the stability of defense programs that could span many years.

For the defense acquisition community, continuity was something to be hoped for as the decade came to an end. During President Carter's four years in office, inflation and reduced defense spending continued to have serious implications for the acquisition community—indeed, defense spending and defense jobs were key campaign issues during the run-up to the presidential election in November 1979—and the combination of domestic market instability and more open export and technology transfer rules (a legacy of the Nixon Doctrine) resulted in increased foreign competition, especially in spare parts and electronic components. As the decade came to a close, even more overseas competition led to the slow degradation of the U.S. defense industrial base, and spare parts manufacturers working under subcontract with major U.S. corporations were hit especially hard.[65] On the technology front, however, international cooperation and exciting new developments held promise for the acquisition community, and the Department of Defense was keen to develop new capabilities.

The Shape of Things to Come: New and Emerging Technologies

On 15 January 1976, the RCA Corporation declared that its Harrison, New Jersey, vacuum tube factory would cease operations by mid-year. This plant closing was one of many that occurred during the 1970s, actions that can now be regarded as historical footnotes in the story of the transition from tube technology to solid state electronics. Tastes, both consumer and military, were changing rapidly as electronics technology matured and became more widely available, but the changeover from tube to transistor was slow for the defense establishment. To the Department of Defense, the

plant closing was further evidence of the gradual erosion of the established defense industrial base; after all, RCA was a sole-source provider of 110 different types of receiving tubes used in military hardware.[66]

Rapid technological change was an important theme in engineering discussions during the 1970s, and DoD engaged change head-on. Transistors, semiconductors, and other small electronic components were being married to produce relatively inexpensive computers, devices that were within the reach of many acquisition programs and, by mid-decade, the Defense Department was adopting new technology development tools, including computer-aided design and engineering (CAD–E). The earliest CAD–E results reported by the Army were promising; an improved fusing system for the 2.75-inch rocket system used on the Cobra helicopter and the initial designs for the squad automatic weapon (SAW) were developed with the aid of CAD–E technologies.[67] One army officer, speaking before an audience at West Point, made a prediction about the importance and future of CAD–E technology: "it . . . will become the way of life in the same manner that the slide rule, desk calculator, and other current engineering aids have. . . . It will become so woven into our existence that no conscious stimulus will be required to use CAD–E. It will be the routine rather than the exception."[68] As the decade progressed, the defense acquisition community rapidly embraced computer technology, which found ready application in research and development, test and evaluation, and manufacturing—indeed, the entire spectrum of acquisition activities.

Rapid changes to the state of the art in electronics technology had important implications for the management of acquisition programs, a point not lost on members of the community; by the end of the decade, some observers were beginning to question whether design-to-cost—one of the guiding principles of acquisition program management during the 1970s—could be sustained in the coming years as new technologies outstripped the pace of conventional acquisition. A concept first proposed in the late 1960s, design-to-cost became formal DoD policy in 1975, when Deputy Secretary of Defense Clements issued Directive 5000.28. The goals of design-to-cost were straightforward: recognize that system cost was as important a consideration in the development of a new system as technical requirements and scheduling; and identify and establish cost elements as management goals in order to balance life-cycle cost, performance, and schedule.[69] Taking all of these costs into consideration—including maintenance and support expenses for twenty to thirty years—was a difficult enough proposition without having to factor in the rapid advance of technology and the inevitable (and possibly accelerated) obsolescence of even the most sophisticated weapons.

Alternative approaches to design-to-cost acquisition were proposed as this problem became more widely recognized. One such alternative was "design *to* technology," a risky proposition that involved determining the future state of technology and developing systems around capabilities that were based on expectations of emerging technologies. Another concept, "design *for* technology," involved creating equipment that was, in contemporary terms, modular: large systems that could be easily improved by replacing small components that might be subject to rapid obsolescence. Other proposals were less radical; maintaining long-term contractor support was a logical short-term solution to a longer-term problem. With this approach, DoD could minimize long-range system life-cycle costs by using the original contractor's "facilities and know-how to obtain spare parts and support." This approach assumed that somebody—either the government or the prime contractor—would shoulder the costs associated with maintaining the facilities in question and preserving the know-how. Another concept, which placed more pressure on commercial companies, was to require warranties on systems, but this strategy required the prime system contractor to assume a great deal of long-term risk. In essence, under such a development approach, the contractor guaranteed that the system would perform reliably and meet requirements for a specific period of time; in order to fulfill this guarantee, the designer would have to "strive to achieve a level of reliability that [would] minimize item return for service."[70]

Whatever approach taken, it was becoming clear by the end of the decade that reforms to the acquisition process would not be enough to guarantee that the armed forces would continue to have the most modern systems. Indeed, there would have to be fundamental reforms to practice of acquisition, and in the process of making these reforms, the community—perhaps the entire government—would have to accept new approaches to system development, as well as the fiscal and technical growing pains that would accompany such reforms.

In a remarkably prescient article written in 1971, years before alternatives to design-to-cost were given consideration in the technical press, director of Defense Research and Engineering, Dr. John S. Foster, Jr., identified several emerging technologies that had revolutionary—as opposed to evolutionary—implications for the U.S. armed services. In his estimation, the escalating costs of developing new weapons—and maintaining large standing forces to man those systems—would soon outstrip the resources available to DoD, and such revolutionary weapons as smart bombs, forward-looking infrared systems, ground sensors, communications systems, and telecraft (unmanned armed vehicles) held considerable promise as long-term, low-cost alternatives to the expensive advanced weapons being

contemplated by DoD. "[W]e must have more defense for less dollars," Foster wrote, because "the cost of people in the Defense Department have increased significantly, so that now these costs consume more than half our money . . . [I]mmediate attention to evolutionary improvements [to our defense systems], though mandatory, is not enough. Our current national needs also requires approaches that will be *revolutionary* in nature. . . . I define a revolutionary weapon as one which meets a military requirement in a new way—and a cheaper way."

Since writing those words, many of the systems that Foster identified have reached maturity, but the cost issues he identified have yet to be resolved. New technologies adopted by the acquisition community in the 1970s did not alleviate the pressures of inflation or reduce technology development costs.

Conclusion

The 1970s were marked by retrenchment and reform for the acquisition community, conditions that were inspired in part by public pressure to reduce defense spending and reform the acquisition process, a changing American strategic posture, and external economic pressures that affected the American industrial base. Retrenchment meant that budgets were smaller for acquisition activities, and that Congress became more of an activist in its oversight of the acquisition endeavor.

The term "reform" came to mean different things to different constituencies during the 1970s; to David Packard and others within DoD who shared his vision of decentralized acquisition program management, guided by minimal OSD supervision, reform meant returning power and authority to the services, and permitting those in uniform to make important decisions about matching mission requirements with technology. For Congress, reform meant oversight and transparency and more direct involvement in the management of the acquisition process.

The reforms in question, although shaped by retrenchment, were initiated because of long-standing questions about the proper role of the myriad players involved in the acquisition endeavor. After revisiting the tensions between those who favored centralized control of acquisition and those who preferred decentralization, Congress and the executive branch arrived at compromises that set important precedents for acquisition activities in the 1980s and 1990s. These compromises took the form of laws and directives, many of which remain in place to this day.

Landmark rules and regulations written during the 1970s set the course for acquisition for the next two decades. The DSARC, a creation of David

Packard, remains an important OSD management tool. The 5000 series regulations have been continuously updated, revised, and reissued since the mid–1970s, and continue to serve as cornerstone documents for acquisition policy across DoD. A–109 remains as important today as it was in the late 1970s; indeed, many of the findings of the Commission on Government Procurement, issued in 1972, influenced acquisition policy well beyond the 1970s. The 1984 Competition in Contracting Act, for instance, drew heavily on the competitiveness recommendations of the 1972 commission report, and the lineage of the Federal Acquisition Regulations, or FAR, can be traced directly to the work of the Commission on Government Procurement, which created the Office of Federal Procurement Policy which, acting on the advice of the commission, in turn drafted the Defense Acquisition Regulations.

A confluence of factors shaped defense acquisition during the 1970s: attempts to reform the process, technologies adopted to improve the practice, and external economic and political pressures—both domestic and internal—all contributed to the evolution of the acquisition endeavor. It is an interesting paradox to consider the extent and legacy of the reforms undertaken during this key decade—and the fiscal pressures that contributed to the urgency to reform the system—that served as a backdrop for the creation of one of the United States' most sophisticated weapon systems, the Stealth fighter.

NOTES

[1] Lieutenant General George M. Seignious, II, USA, "Defense Security Assistance Agency: DoD Organizes to Meet New Challenges of Security Assistance Program," *Defense Management Journal* 8 (April 1972): 56.

[2] Captain R. Kenneth Bowers, USAF, "Coproduction: The U.S. F–5E in Taiwan and Switzerland," *Defense Systems Management Review* 2 (Spring 1979): 39.

[3] Ibid., 40.

[4] On the matter of U.S.-Japan military hardware co-production, see Richard J. Samuels, *"Rich Nation, Strong Army": National Security and the Technological Transformation of Japan* (Ithaca: Cornell University Press, 1996), 228–31. For a quick discussion of 1970s and early 1980s technology transfer and licensing arrangements between the United States and Japan, and the political context for those developments, refer to Michael J. Green, *Arming Japan: Defense Production, Alliance Politics, and the Postwar Search for Autonomy* (New York: Columbia University Press, 1995), 82–85.

[5] For details on the 1970s modernization of Singapore's military, refer to Tim Huxley, *Defending the Lion City: The Armed Forces of Singapore* (Crows Nest, NSW: Allen and Unwin, 2000), 19, 21.

[6] Madawi Al-Rasheed, *A History of Saudi Arabia* (Cambridge: Cambridge University Press, 2002), 142.

[7] See William Proxmire, *Report from Wasteland* (New York: Praeger Publishers, 1970), 36–38.

[8] Ibid., 38–39.

[9] These matters are discussed in detail in A. Ernest Fitzgerald, *The High Priests of Waste* (New York: W. W. Norton, 1972).

[10] See, as an example, Berkeley Rice, *The C–5A Scandal* (Boston: Houghton-Mifflin Company, 1971), 32–36, 89–100.

[11] Interview, Maurice Matloff and Alfred Goldberg with Melvin Laird, 2 September 1986, 5–16; Interview, Alfred Goldberg and Maurice Matloff, with David Packard, 9 November 1987, 1–2. Both interviews are retained by the Historical Office, Office of the Secretary of Defense, Arlington, Va.

[12] Herbert Roback, "Congress and the New Procurement Wisdom," *Defense Management Journal* 8 (July 1972): 22.

[13] Joseph Alsop, journalist and foreign policy commentator, declared upon Packard's nomination to the post of Deputy Secretary of Defense, "[H]e is a man of . . . McNamara's general stripe, well-equipped to maintain and continue the great McNamara reforms in the Defense Department." See *Current Biography* 1969 (New York: H. W. Wilson, 1970), 320.

[14] "Address by the Honorable David Packard, Deputy Secretary of Defense at Armed Forces Management Association Dinner, International Hotel, Los Angeles, Calif., Thursday, August 20, 1970," *Defense Management Journal* 6 (Summer 1970): 61.

[15] Memorandum for deputy secretary of Defense to the secretaries of the Military Departments, director of Defense Research and Engineering, assistant secretaries of Defense, general counsel, assistants to the secretary of Defense, and director of Defense agencies, subj: "Policy Guidance on Major Weapon System Acquisition," 28 May 1970. For a reprint of Packard's 28 May 1970 memorandum, "Policy Guidance on Major Weapon System Acquisition," see *Defense Management Journal* 6 (Summer 1970): 56–59. For an abstracted version of the memo, see David Packard, "Policy and Perspective," *Defense Management Journal* 7 (Fall 1971): 2.

[16] Refer to Fitzgerald, *High Priests of Waste*, especially chapters 1 and 2.

[17] Roback, "New Procurement Wisdom," 22.

[18] See David Packard, "Toward Better Management of the Development and Acquisition of New Weapons Systems," *Defense Management Journal* 7 (Fall 1971): 6–7. This article was a digested version of Packard's testimony before the House Appropriations Committee on 18 March 1970.

[19] The AX program was initiated in spring of 1970. Six aerospace companies responded to the Air Force Request for Proposals issued in May of 1970 for a close air support aircraft. On 18 December 1970, two of the six respondents, Fairchild and Northrop, were selected to participate in a prototype competition. Although the program was managed by the Air Force, the U.S. Army had an important role in the requirements determination process, and participated in the prototype evaluation process. In March of 1971, as Packard was testifying before Congress, both companies were preparing for the fly-off competition, which was held between October and December of 1971. On 18 January 1973, Fairchild's AX prototype, the A–10, was selected for production. For a discussion of the decision to incorporate prototyping in the AX competition, refer to David C. Aronstein and Albert C. Piccirillo, "The F–16 Lightweight Fighter: A Case Study in Technology Transition," in Jacob Neufeld, George M. Watson, Jr., and David Chenoweth, eds., *Technology and the Air Force: A Retrospective Technology Assessment* (Washington, D.C.: Air Force History and Museums Program, 1997), 207–08. David Packard's remarks on the F–15, AX, and AWACS programs (as variations on the "fly-before-you-buy" approach) can be found in Packard, "Toward Better Management," 7. For a more detailed discussion of the Lightweight Fighter (F–16) program, see Albert C. Piccirillo and David C. Aronstein,

The Lightweight Fighter Program: A Successful Approach to Fighter Technology Transition (Reston, Va.: American Institute of Aeronautics and Astronautics, 1997).

[20] Packard, "Toward Better Management," 7.

[21] David D. Acker, "The Maturing Defense Acquisition Process," *Defense Systems Management Review* 3 (Summer 1980): 35–36.

[22] David Packard, Memorandum to the secretaries of Military Departments, director of Defense Research and Engineering, assistant secretaries of Defense, subj: "Establishment of a Defense Systems Acquisition Review Council," 30 May 1969.

[23] Memorandum for deputy secretary of Defense to the secretaries of the Military Departments, director of Defense Research and Engineering, assistant secretaries of Defense, general counsel, assistants to the secretary of Defense, and director of Defense agencies, subj: "Policy Guidance on Major Weapon System Acquisition," 28 May 1970.

[24] U.S. Department of Defense Directive 5000.1, "Acquisition of Major Defense Systems," 13 July 1971.

[25] See U.S. Department of Defense Instruction 5000.2, "Decision Coordinating Paper (DCP) and the Defense Systems Acquisition Review Council (DSARC)," 21 January 1975; U.S. Department of Defense Directive 5000.1, "Acquisition of Major Defense Systems," 22 December 1975 (revision of 1971 guidance); U.S. Department of Defense Directive 5000.4, "OSD Cost Analysis Improvement Group," 13 June 1973.

[26] Packard, "Toward Better Management," 7.

[27] Edmund Dews and Giles Smith, Acquisition Policy Effectiveness: Department of Defense Experience in the 1970s, R-2516-DR&E, October 1979, A Report Prepared for the Under Secretary of Defense for Research and Engineering (Santa Monica, Calif.: RAND, 1979), 10.

[28] David D. Acker, *Acquiring Defense Systems: A Quest for the Best* (Fort Belvoir, Va.: Defense Systems Management College Press, 1993), 170.

[29] David Packard, "Improving R&D Management Through Prototyping," *Defense Management Journal* 8 (July 1972): 3–5.

[30] Ibid., 4; Donald W. Srull, "Parametric Cost Estimating in Systems Acquisition Decisions," *Defense Management Journal* 8 (April 1972): 2.

[31] Lieutenant General James T. Stewart, USAF, "Source Selection Process Faces Winds of Change," *Defense Management Journal* 9 (January 1973): 13–15.

[32] General Henry A. Miley, Jr., USA, "CAD-E: A Key to Cost and Time Reduction," *Defense Management Journal* 9 (January 1973): 33.

[33] Memorandum for deputy secretary of Defense to the secretaries of the Military Departments, director of Defense Research and Engineering,

assistant secretaries of Defense, general counsel, assistants to the secretary of Defense, and director of Defense agencies, subj: "Policy Guidance on Major Weapon System Acquisition," 28 May 1970.

[34] Acker, "The Maturing Defense Acquisition Process," 38; see also Acker, *Acquiring Defense Systems*, 171.

[35] Major General Edmund F. O'Connor, USAF, "AFSC Procurement Evaluation Panel: New Check in Defense Systems Acquisition," *Defense Management Journal* 8 (April 1972): 12.

[36] James R. Schlesinger, "FY 1975 Defense Budget: Settling Down for the Long Haul," *Defense Management Journal* 10 (April 1974): 6.

[37] In his critical article, "Gilbert Fitzhugh's Golden Fleece," A. Ernest Fitzgerald cites a memorandum sent from Secretary of Defense Melvin Laird to his assistants, in which the secretary of Defense decries "allusions in the press and elsewhere to runaway costs on such key programs as the C–5A" and their corrosive effect on public opinion. See A. Ernest Fitzgerald, "Gilbert Fitzhugh's Golden Fleece," *Washington Monthly* (November 1970): 46, reprinted in Hearings Before the Subcommittee on Federal Spending Practices, Efficiency, and Open Government of the Committee on Government Operations, U.S. Senate, 94th Cong., 1st sess., part 2 (Washington, D.C.: GPO, 1975), 117.

[38] David Packard quoted in Dr. John S. Foster, "Defense Systems Acquisition—As Seen by the Director of Defense Research and Engineering," *Defense Management Journal* 7 (Fall 1971): 8.

[39] See Blue Ribbon Defense Panel, *Report to the President and the Secretary of Defense* (Washington, D.C.: GPO, 1970).

[40] *Defense Acquisition: Major U.S. Commission Reports (1949–1988), Volume 1*, Committee on Armed Services, House of Representatives, 100th Cong., 2d sess., 1 November 1988 (Washington, D.C.: GPO, 1988), 11–13.

[41] "Address by the Honorable David Packard, Deputy Secretary of Defense at Armed Forces Management Association Dinner, International Hotel, Los Angeles, Calif., Thursday, August 20, 1970," *Defense Management Journal* 6 (Summer 1970): 61.

[42] Ibid., 62.

[43] The Defense Acquisition Study was preceded by a number of other industry-sponsored studies of specific acquisition or procurement problems. These included the Aerospace Industries Association, *Essential Technical Steps and Related Uncertainties in DoD Weapon Systems Development, Phase II: Final Report* (Washington, D.C.: AIA, 1968); Aerospace Industries Association, *Essential Technical Steps and Related Uncertainties in DoD Weapon Systems Development, Phase III: Final Report* (Washington, D.C.:

AIA, 1969); and Industry Advisory Council, Panel A, *The Major Systems Acquisition Process*, *Study for Deputy Secretary of Defense* (Washington, D.C., 1969).

[44] National Security Industrial Association, *Defense Acquisition Study* (Washington, D.C.: NSIA, 1970), xi.

[45] Ibid., x, 72.

[46] Ibid., ix.

[47] See *Report of the Commission on Government Procurement to the Congress*, 31 December 1972.

[48] PL 93–400, "The Office of Federal Procurement Policy Act."

[49] *Defense Acquisition: Major U.S. Commission Reports (1949–1988), Volume I,* Committee on Armed Services, House of Representatives, 14.

[50] Acker, "The Maturing of the Defense Acquisition Process," 42.

[51] *Defense Acquisition: Major U.S. Commission Reports (1949–1988), Volume I,* Committee on Armed Services, House of Representatives, 14. This suggestion to reform the government's procurement system was later carried out with the codification of the Defense Acquisition Regulations (DAR), first issued in 1980. The DAR was, in turn, consolidated with the Federal Procurement Regulation and acquisition regulations for the National Aeronautics and Space Administration in 1984 as the Federal Acquisition Regulations.

[52] Kenneth R. Mayer, *The Political Economy of Defense Contracting* (New Haven: Yale University Press, 1992), 34.

[53] Section 719 of the Defense Production Act of 1950, as amended (PL 91–379, 50 U.S.C. App. 2168).

[54] William Proxmire, *Report from Wasteland* (New York: Praeger Publishers, 1970), 9.

[55] General Accounting Office, "Report on the Feasibility of Applying Uniform Cost-Accounting Standards to Negotiated Defense Contracts," 19 January 1970.

[56] James A. Francis, "The Congressional Budget and Impoundment Control Act of 1974: Implications for Program Managers," *Defense Systems Management Review* 1 (Winter 1976): 11–12.

[57] Lieutenant. Colonel Paul B. Demitriades, USAF Reserve, "Zero-Based Budgeting and Sunset Legislation," *Defense Systems Management Review* 1 (Autumn 1977): 39.

[58] James A. Francis, "The Congressional Budget and Impoundment Control Act of 1974: Implications for Program Managers," *Defense Systems Management Review* 1 (Winter 1976): 12–13.

[59] James A. Francis notes that the Defense Department was preparing for the act well before it was signed into law. Briefings were prepared for

key DoD decision makers, in which ten key problems or complications were identified and explained. Most of the problems outlined in the briefing had to do with the immediate transition from the old budgeting process to the new process. Deadlines, especially those related to overall Service budgets, had to be taken into consideration. The new reporting requirements were also noted: "one informed source noted that 4,180 pages of justification material had been submitted by OSD for the FY76 Research and Development Account alone . . . this compares to 1,787 pages submitted for FY70." See Francis, "The Congressional Budget and Impoundment Control Act of 1974," 17.

[60] Zero-based budgeting was developed by Peter A. Pyhrr at Texas Instruments, Inc., in 1968. Jimmy Carter was attracted to the resource-management potential of the ZBB concept, and he introduced its use in state budgeting in 1971 while serving as governor of Georgia. See Demitriades, "Zero-Based Budgeting and Sunset Legislation," 37.

[61] President Jimmy Carter, "Memorandum to the Heads of Executive Branch Agencies, subj: Zero-Based Budgeting," 14 April 1977.

[62] Acker, "The Maturing Defense Acquisition Process," 54–55.

[63] Office of Management and Budget Circular A–109, "Major Systems Acquisitions," 5 April 1976.

[64] Acker, "The Maturing Defense Acquisition Process," 53.

[65] On the effects of internationalization on the U.S. industrial base during the late 1970s, especially the impact on spare parts suppliers and defense subcontracting firms, refer to Jacques Gansler, *The Defense Industry* (Cambridge: MIT Press, 1980), 156–57. See also Green, *Arming Japan*, 81. Green notes that a cornerstone of the 1979 "New Policy on R&D" promulgated by the Japan Defense Agency was "to increase Japan's technology level up to—or possible beyond—that of the United States and Europe in certain of the most advanced military technologies; and to use this new higher level of technology as background to maintain leverage in negotiations with the United States over military technologies." This policy was informed by the belief—widely held in some Japanese defense circles—that America's military-industrial base was faltering as evidenced by America's slowing GNP growth.

[66] Carroll Eugene Garrison, "Technological Progress in Electronic Components: A Life Cycle Support Problem," *Defense Systems Management Review* 1 (Winter 1976): 26.

[67] General Henry A. Miley, Jr., "CAD-E: A Key to Cost and Time Reduction, Tool of the Future," *Defense Management Journal* 9 (January 1973): 39–40.

[68] Colonel Joseph E. Fix III, quoted in Miley, "CAD-E: A Key to Cost and Time Reduction," 39.

[69] U.S. Department of Defense Directive 5000.28, "Design-to-Cost," 23 May 1975.

[70] Garrison, "Technological Progress in Electronic Components," 30.

Money, Management, and Manpower: Important Variables in the Design and Acquisition of *Oliver Hazard Perry*-Class Frigates[1]

Timothy L. Francis

During the late 1960s, the Navy's surface fleet faced three significant problems: unsustainable operating tempo, rapid capital depreciation, and a growing shortage of operating funds. The combination of rusting and worn-out ships, stagnant technology, and tight financial strictures eventually forced the U.S. Navy to create a new type of platform, the patrol frigate. The program incorporated many new ideas and approaches in its construction, technology, and procurement, policies that had a continuing impact on later programs.

In the first instance, combat operations off Vietnam placed great strains on many cruisers and destroyers. High demand for gun line services wore-out ships and gun barrels. During crisis periods, at-sea time approached 85 percent and regular maintenance and overhauls were often deferred. The heavy allocation of ships, ammunition, and supplies to Vietnam also lengthened deployments elsewhere, worsening the wear and tear on Atlantic Fleet ships as well.

In regards to technology, the Navy received a wake-up call when the Egyptian Navy sank the Israeli destroyer *Eliat* with two cruise missiles. The success of the Russian weapons indicated the postwar revolution in digital computer and missile technologies had finally arrived in the Soviet Navy. At the same time, the increasing size and capabilities of the Soviet surface fleet suggested the large numbers of World War II-era destroyers and escorts still in the U.S. inventory faced block obsolescence. Even with Fleet Rehabilitation and Maintenance (FRAM) updates, many of these warships were unable to counter the new nuclear-powered Soviet submarines and had little defense against air- or sea-launched cruise missile threats. Given

the global responsibilities of the U.S. Navy, these ships had to be replaced with new destroyers and frigates to escort and protect shipping, cover task forces, and hunt for enemy submarines.[2]

At the same time, however, congressional disaffection for the Vietnam conflict and the ensuing defense spending retrenchment by the Nixon Administration combined to shrink Department of Defense (DoD) outlays as a percentage of gross domestic product. From a high of 7.8 percent of GDP and 39.4 percent of federal spending in 1970, DoD outlays fell to 5.5 percent of GDP and 28.8 percent of federal spending by 1974.[3] This pattern of congressional spending was in sight in mid-1970, when Admiral Elmo R. Zumwalt, Jr., was sworn in as Chief of Naval Operations (CNO). Although the analogy is perhaps simplistic, Secretary of Defense Melvin Laird and Secretary of the Navy John Chafee chose Zumwalt for reasons similar to the Royal Navy's decision to make Jackie Fisher First Lord of the Admiralty in 1904. Zumwalt's intended role, like Fisher's, was to shake up the organization and revise the Navy's force structure to meet the new threats. Most importantly, he was required to accomplish these tasks—which included building new escorts—while still saving money.[4]

The initial response to the new Soviet challenges had been to design the nuclear-powered DLGN–36s for air defense and the *Spruance*-class destroyers for antisubmarine warfare (ASW). These were both excellent platforms. Before the Aegis system, *California* (DLGN–36) was the most capable anti-air platform in the fleet. The *Spruance*s, with the new SQS–56 sonar, extensive quieting, and space for a passive towed array, were impressive ASW ships. Unfortunately, these platforms suffered from the usual cost escalation experienced by cutting-edge warships and were very expensive. The lead *Spruance*, initially proposed as a "modest escort vessel," went through numerous design alterations, and the new missile and sonar systems helped increase her size to 8,040 tons full load—the largest destroyer ever built to that point. Follow-on destroyers ran about $80 million each in FY 1968. The DLGNs were in a class of their own, but the cost—about $200 million apiece—and high reactor maintenance requirements meant only six were ever built.[5] Both warships also absorbed a lot of manpower, with 603 crewmen on the DLGNs and 262 on the destroyer. The latter figure is deceptive, however, as planned upgrades eventually boosted that number to 346 crewmen. This cost was significant, as personnel absorbed more than half of every dollar spent on defense in the early 1970s, a sum projected to rise after 1973, with the all-volunteer force.

Confronted with declining budgets on the one hand and cost escalation in warship construction on the other, Zumwalt scrapped most of the obsolete escorts in the Reserve Fleet—which dropped from 267 ships to

70—to free up money for new procurement. Even with these measures, the Navy still could not replace the old escorts with new *Spruance*s on a one-for-one basis. Without a cheaper design, escort force levels were projected to fall to 160 in 1980, at a time when the minimum requirement was expected to exceed 200 escorts. The solution was the Patrol Frigate (PF) program.[6]

Concept Approval

On 9 September 1970, as one of the many reforms coming out of Project Sixty, Zumwalt initiated a feasibility study for fifty new patrol frigates. The designed mission for the PF was "[T]o provide self-defense and effectively supplement planned and existing escorts in the protection of underway replenishment groups, amphibious forces, and military and mercantile shipping against sub-surface, air, and surface threats; and to conduct ASW operations in conjunction with other sea control forces tasked to ensure our use of essential sea lines of communications." Given the budgetary constraints inherent in the domestically oriented Nixon Doctrine (announced in February 1970), the frigate's equipment needed to be relatively simple, and complex hardware/software systems were avoided. By using previously established equipment, it was thought unit cost could be kept under $50 million, and the escort could be rapidly delivered to the fleet.

On 1 June 1971, after almost nine months of concept exploration, the CNO approved moving into the design phase. After a briefing detailing cost-reduction alternatives on 14 October, Zumwalt decided on the following design constraints. Hull size was limited to 3,400 tons full-load displacement, crew size was held to 185, and follow-on unit costs could not exceed $45.7 million (in FY 1973 dollars). These parameters were unusual in that they set restrictions on the initial concept, thus making the PF the first design-to-cost procurement ever attempted by the Navy.

As part of the design process, several steps were taken to limit cost growth. First, the future characteristics change margin—a legacy of World War II building programs—was deleted. Any major equipment addition to the ship would have to be compensated by removing some other item. While a useful limit on the designers, this restriction led to an overly small allocation of space for the crew and supplies, which led to metacentric height problems later. Second, emphasis was placed on using or adapting existing equipment rather than designing new and perhaps uncertain technology. In a sense, this approach was an early version of government-off-the-shelf (GOTS) procurement policies. Third, the

propulsion and weapons systems were to be tested at land-based sites early in the shipbuilding cycle. This "fly-before-you-buy" approach theoretically would work out many of usual shakedown problems associated with new designs and prevent "rip-outs" of faulty equipment. Finally, contracts were structured so that the Navy would not be committed to a block purchase of ships until any cost, schedule, or technical problems were overcome. On 12 April 1972, two cost-plus-fixed-fee contracts were awarded to support this Ship System Design Support program: one for the designated lead yard at Bath Iron Works; and the second, to Todd Shipyards Corp., a potential follow-on builder.[7]

Design and Development

Given budget and manning constraints, Zumwalt's parameters meant the PF should complement existing forces rather than become another "jack-of-all-trades" warship. Given the advanced ASW capabilities of the *Spruance*s as well as the *Knox*-class FF–1052s, the PF designers concentrated on anti-air and -surface capability. For this reason, preeminence was given to the Mk.13 missile launcher—capable of firing Standard (SM–1) and Harpoon missiles—and the relatively new AN/SPS–49 air search radar and Mk.92 fire control systems. The latter was an American version of the Dutch WM.27, an integrated network found in the Belgian, Dutch, and German navies.[8]

As in any new warship, modifications took place as paper ideas met concrete reality. In order to make room for the missile launcher, the designers did not include an antisubmarine rocket (ASROC) launcher. Without the ASROC launcher, the frigate did not need the large and expensive AN/SQQ–23 detection and tracking sonar (found on *Spruance*s, for example) and the designers initially selected a medium-sized Canadian SQS–505 sonar to take its place. Although less capable, the size and cost savings of the smaller sonar enabled the expansion of hangar facilities aft to support two helicopters. This was only possible because the SH–2 Seasprite helicopter took up space a mere 12 feet 3 inches wide; 38 feet 4 inches long; and 13 feet 7 inches high.

Several features in the PFs represented new capabilities. The helicopters themselves were the light airborne multipurpose system (LAMPS I) under development in the early 1970s. The idea was to increase the frigate's sphere of influence through over-the-horizon target detection, classification, and engagement. The helicopters—equipped with submarine detection gear and torpedoes—used a computer data link to operate with the frigate as a submarine hunting team. In addition, the radar and ESM gear on the SH–2

Seasprite would detect surface threats well beyond the frigate's surface-search radar range, allowing advance warning of missile threats and over-the-horizon targeting for the frigate's Harpoons. Consistent with the policy of saving money, the Naval Sea Systems Command (NavSea) settled on the Canadian "Beartrap" helicopter landing system until an American variant could be developed.[9]

Although the SM–1s were used for antiaircraft and, theoretically, antimissile defense, some sort of point defense weapon was also needed. Initially, this weapon was a twin 35-mm. gun but it suffered from a short barrel life. This fact ran against the grain of keeping the maintenance cycle under control, and NavSea eventually decided on an Italian Oto Melara 76-mm. mount. It was lighter and less plagued with trouble than the 3-inch/50 mounts used in Vietnam-era destroyer-escorts, only required a crew of three (compared with fourteen for the 3-inch/50), and had a high rate of fire (one shell a second).[10]

In keeping with CNO's request for simplicity, NavSea also chose two LM–2500 gas turbines instead of a traditional steam plant. These gas turbines were marine versions of the TF 39 jet engine used to power the C–5A transport aircraft and DC–10 commercial airliners. They were more economical than steam plants, especially as they required fewer personnel to operate, did not suffer the same age-related breakdowns, and required much less work to overhaul. Two turbines were placed amidships, topped by an air intake system, two exhaust stacks, and connected to a main gear transmission unit.[11] Along with smaller and simpler engines, NavSea reduced shock protection redundancies and—much to the consternation of sailors who would serve in yawing frigates—removed a hull-fin stabilization system from consideration. [12]

In order to lower construction costs, the Naval Ship Engineering Center, in company with Bath Iron Works, Todd Shipbuilding, and Gibbs & Cox, developed a relatively simple ship construction format. The idea, in contrast to the highly sophisticated "total package" process by which *Spruances* were constructed, was to allow any warship-capable shipyard the opportunity to bid on the project. Like the prototype destroyers of the 1950s, this approach would offer significant replacement advantages in the event of a future global war. As part of this process, the ship was broken into sixteen prefabricated units, each requiring a lift of only 200 tons. These sections could be assembled at various locations in most shipyards and brought together in a sequence best suited to the space, equipment, and workers of any particular yard.[13]

In addition to platform cost restrictions, the Navy also implemented an integrated logistics support plan. Its purpose was to minimize shipboard

maintenance, which, in addition to saving money, would help limit overall crew size. In order to accomplish this goal, off-the-shelf equipment was installed where possible (for ease of replacement) and legacy systems avoided. On the operational side, because the gas turbine was all electric, the need for the lengthy industrial periods required by steam plants was not required. It was hoped a restricted availability of four weeks every two years would replace the three- to four-month regular overhauls required by steam-driven ships.[14]

On 24 October 1972, the Office of the Chief of Naval Operations (OPNAV) approved a design for a 445-foot long, 45 foot wide frigate with a full-load displacement of 3,400 tons. Powered by two gas-turbine engines, the frigate had a single drive shaft with a controllable reversible pitch propeller, and was capable of twenty-eight knots sustained speed. The tightly fitted design had a crew capacity of 185, a single 76-mm. gun mount, an SM–1 and Harpoon capable missile launcher, ASW torpedo tubes, and hangers for two SH–2D helicopters and supporting gear. [15]

Testing, construction, and delivery

As part of the "fly-before-you-buy" philosophy, the Navy began a major test and evaluation program. The long-range SPS–49 air search radar was tested on U.S.S. *Dale* (CG–19) during 1974 while the Mk.92 gun-and-missile fire control system and the 76-mm. Oto Melara rapid-fire gun were tested on U.S.S. *Talbot* (FFG–4) in 1974 and 1975. The new American SQS–56 sonar, which replaced the earlier Canadian selection, was tested in *Glennon* (DD–840) during those same years.[16] For the land-based sites, a complete propulsion system—twin General Electric LM–2500 gas turbines, Western Gear main propulsion gear transmission unit, drive shaft, and controllable-pitch propeller—was built in the Philadelphia Navy Yard. It went operational in August 1973. A combat system land-based site—which included the Mk.92 built by Sperry Gyro Co., a replica CIC, and associated radars and sensors—was assembled at Islip, New York, and given trial runs for several years. In the meantime, the Navy informed Congress it wanted a multiyear construction plan to let contracts in two blocks: twenty-four ships in FY 1975 and twenty-five ships in FY 1977. (*See Chart 1.*) Options for component equipment were to be obtained in FY 1976 and FY 1977, thus providing vendors with continuity of production, as well as the ability to standardize parts and establish reliable pricing. On 31 October 1973, Congress approved the lead ship contract of $202.2 million for Bath Iron Works, beginning the actual procurement process on schedule.[17]

Chart 1: Original Navy Procurement Plan

FY funded	'73	'74	'75	'76	'77	'78	'79	'80	'81	'82	'83
First block	1	0	7	11	6						
Second block					4	10	11				
Delivery					1	0	9	12	10	12	6

One direct result of the tighter management and fiscal controls over the PF project was a revision in the Navy's overall ship procurement system. Up to this point, the CNO had stated requirements—usually on a single sheet of paper—and the Chief of Naval Material (CNM) translated this list into hardware. During the previous design, cost estimation, and procurement specification processes, communication between CNO and CNM was unstructured and informal. This unstructured approach did not, as Zumwalt noted, "maximize mission effectiveness or minimize costs." Declining fleet assets and escalating costs were forcing the Navy's hand, however, and on 4 January 1974; the CNO approved a new instruction for defining ship operational requirements, maximum costs, and program constraints. The PF program was an example of the sharply increased test and evaluation requirements laid out in the instruction and proved a model for future programs.[18]

Unfortunately, the best management system in any defense procurement program cannot overcome that most dangerous of enemies: an unfavorable opinion in Congress. Although the lead ship was funded in FY 1973, the Senate Armed Services Committee (SASC) voiced concerns with the program during the summer of 1974. The major issue was the reliability of the foreign-developed systems in the PF program, particularly the Dutch fire control system and the Italian 76-mm. gun. The SASC, claiming that the concurrent development of these "untested" systems was of concern, issued a mark-up bill that reduced the number of PFs from seven to three and reduced funding from $436.5 million to $186 million.

The Navy protested these cuts, arguing the U.S.-manufactured versions of fire control system and gun were reliable and that the delay would upset procurement by disrupting multiyear vendor contracting. In the case of the Dutch WM–27 fire control system, the Navy argued it was not "developmental" since it had been delivered to fourteen countries over the past ten years. In addition, the Sperry Gyroscope Co., whose involvement in analog and digital fire control systems went back sixty years, could easily handle the contract. Finally, an American contractor for the Oto Melara had not yet been chosen for financial—not technical—reasons and Italian-

made guns, which were in service in several navies, could be put in as many follow-on ships as required.[19]

More importantly, the initial procurement plan called for sixteen or seventeen ships each to be assigned to three yards: Bath Iron Works and the Todd Shipyards located in Los Angeles and Seattle. The primary objective was to keep costs down, both by taking advantage of economies of scale and by ensuring rapid delivery. With three yards at work, fabrication could begin in late 1976, and the entire program could be completed between early 1979 and early 1983. Dropping the initial block of ships from seven to three, however, would increase costs by stretching out the program and introducing uncertainty in shipyard planning and pricing estimates.[20]

These pleas fell on deaf ears and only three follow-on frigates were authorized in FY 1975. The Navy assigned one to each shipyard and, owing to long-term uncertainty, none of these hulls were laid down in 1976 as planned. On a more positive note, the land-based system evaluations were a success and the lead ship, *Oliver Hazard Perry,* was scheduled for launch on 25 September. Unfortunately, as that year began, the program faced another crisis.

In March 1976, the House Armed Services Sea power Subcommittee, led by Chairman Charles E. Bennett (D–FL), killed the patrol frigate program in its entirety. Instead of the inexpensive ships called for by Zumwalt four years earlier, the subcommittee, with the support of Admiral H.G. Rickover, diverted a significant portion of the shipbuilding account to nuclear-powered warships, calling for an additional Trident missile submarine, another *Nimitz*-class aircraft carrier, and two nuclear-powered strike cruisers. Fortunately for the frigate program, the Senate, in part led by Budget Committee Chairman Edmund S. Muskie (D–ME) who kept an eye out for Bath Iron Works, refused the cut and authorized six more ships that year. Although the program did not suffer any other significant challenges, authorizations did not keep pace with initial plans, and the forty-two remaining ships were authorized over eight years instead of the planned six (*see Chart 2*). The drawn-out contracts led to longer delivery times, stretching the entire construction program from five to eleven years.[21]

Did the program work?

As set by Zumwalt in 1972, there were three overall design goals within the PF program: cost, displacement, and crew size. While the financial constraint did hold down cost growth, the stretching out of the construction program increased planned outlays from $45.7 million to an estimated

Chart 2: Actual U.S. Navy Procurement Plan[22]

FY funded	**'73**	**'74**	**'75**	**'76**	**'77**	**'78**	**'79**	**'80**
Authorized	1	0	3	6	8	8	8	5
Laid down			1	0	3	7	7	7
Delivery					1	0	1	5
FY funded	**'81**	**'82**	**'83**	**'84**	**'85**	**'86**	**'87**	**'89**
Authorized	6	3	2					
Laid down	8	8	5	2	2	0	1	
Delivery	8	9	9	8	5	2	2	1

$68 million each (in constant FY 1973 dollars) for the initial frigates. Cost growth caused by systems enhancement, or "capability creep," was theoretically limited by NavSea's elimination of the characteristics change margin, which left a growth margin of only thirty-nine tons. With the passage of time, however, NavSea decided holding the line on growth was neither possible nor desirable. This led to a steady increase from the original 3,600 tons (full load) to almost 4,100 tons (full load), a 14 percent increase.

The new LAMPS III provided a quantum improvement in ASW capability, and it was authorized starting with the FY 1979 ships (FFG–36 and later), though some components were not finally installed for many years. The LAMPS III system included new data link hardware, the AN/SQR–19 towed array sonar, an improved helicopter recovery system (RAST), and larger hangars to accommodate the bigger SH–60 Seahawk helicopters. Starting with FFG–55, fin stabilizers, more electromagnetic radiation shielding, the Phalanx (CWIS) close-defense system, and a lengthened stern raised both the displacement and the price to almost $85 million (constant FY 1973), a 47 pecent increase in cost.[23]

These increased capabilities broke the ceiling on displacement, as the original goal had been 3,400 tons (full load), and—as much of this weight increase occurred topside—raised the ship's center of gravity. In order to limit the adverse effect on stability, some weight savings were gained through offsetting reductions, but in most cases ballast approaching seventy tons was added deep in the ship. This increase could not continue indefinitely, as too much weight would start to effect speed and endurance, and a strict weight-monitoring program went into effect in 1982. Still, by the time the later flight FFG–7s came into service, NavSea discovered displacements were coming in significantly higher than predicted. This was caused by heavier than expected components, unrealistically low weight allowances for crew members and supplies, and the usual "squirreling" of excess spares and consumables by ship's company.[24]

At the same time, however, Zumwalt's original size limit did help to enforce the original limit on crew size. Originally constructed with only 185 bunks for both crew and helicopter detachment, the designers automated much of the engineering plant and reduced bridge and Combat Information Center (CIC) watch-standing needs. With only twenty-two sailors required on each watch, a significant portion of the crew was freed up for preventative maintenance. By FFG–61, manning levels had stabilized at 208 people, with every position occupied.[25] The combination of modular system components, facilitating easy replacement, and the less-expensive gas turbine machinery kept operating costs low. With an annual operating cost of $7.25 million, the *Oliver Hazard Perry*s compared favorably to the $13 million required by *Spruance*-class destroyers.[26] From this point of view, Zumwalt's priorities were successful in limiting the size and cost of the frigate.

Overall Success

Finally, it is worth asking whether the warship was a success while in service. The design did evolve and related equipment changes had an impact on how the ship was received by the fleet. Over time, as the building yards and the Navy gathered experience, the various modifications noted above improved the class in four separate stages or "flights." The improvements, such as Harpoon missile, AN/SQQ–89 sonar and LAMPS III capability, were backfitted into most of the earlier ships, and CIWS was added to all of them. Ironically, the only ship built from the keel up with all the upgrades was *Ingraham* (FFG–61), the last ship in the class.

As initially conceived, the frigate was a multimission warship, intended to provide extra air, surface, or antisubmarine capability to convoy defense or to amphibious operations. Although built for a specific war-at-sea scenario, the towed array and LAMPS III improvements were very useful and, during the 1980s, the frigates began operating in battle groups. According to reports in the 1980s, the crews liked the living conditions—despite the crowding that came with the newer systems—and the planned maintenance cycle kept the ships in "fairly good condition."[27] The SNAP II software system was first installed in *Sides* (FFG–14) in 1983, finally providing the inventory and maintenance automation assumed in the original design philosophy. Despite initial misgivings, the installation was "several quantum leaps" ahead of tracking maintenance by hand and was quickly accepted.[28] These changes helped make the FFGs an inexpensive improvement over the steam-powered *Knox*-class frigates. For their size and weight, they were extremely nimble and capable ships. Their cost

and capabilities appealed to other organizations as well, with Australia purchasing four frigates built in American yards and, along with Taiwan and Spain, building other FFGs in their own shipyards. Two of the older frigates, *Wadsworth* (FFG–9) and *Clark* (FFG–11), were even transferred to Poland, an ironic but positive conclusion for ships designed to defend against the Warsaw Pact.

This is not to say the frigate did not have detractors, especially in its later years. Some anecdotal comments note the Mk.92 and SM–1 technology was outdated by the 1990s, that maintenance was too difficult since funding was low, and that sailors on cruisers and carriers joked that "they wished they were on a 'fig' so they could get sub pay." Others complaints ranged from thin hull plating to helicopter hangar aesthetics, as FFG–7s have been called the "ugliest warship put afloat by any navy."[29] Despite such criticisms, it is difficult to conclude the frigates were not an excellent return for the investment.

As Philip Pugh noted fifteen years ago, and as budget analysts probably knew long before that, self-sustaining competition in military procurement often leads to exponential cost growth in exchange for small improvements in capability. This cost escalation occurs as performance characteristics improve with each upgrade, i.e. the higher the performance, the higher the unit cost. Navies are constantly squeezed between relatively fixed military budgets—in the U.S. roughly 3 percent of GDP—and more rapidly rising unit costs. This requires continual adjustment of fleet size and type, especially during times, such as the early 1970s, when economic growth and productivity lagged behind increasing costs. In those cases, navies often reduce capability in order to increase the number of platforms available. The PF program is a good example of such a dynamic. By saving money, manpower, and operating costs, the FFGs helped the Navy pass through the economic trough of the 1970s and, with the upgrades available from increased defense spending in the 1980s, have served as a reliable platform through the end of the twentieth century. Moreover without these low-end ships, the U.S. Navy never would have been able to grow to the numbers needed to conduct the last phase of the Cold War, which allowed the service to meet the multifaceted challenges of that period.

NOTES

[1] A more detailed history of the FFG program can be found in *History of the U.S.S. Oliver Hazard Perry (FFG-7) Class Ship Building Program* (Washington, D.C.: Naval Historical Center, 1990).

[2] Malcom Muir, Jr., *Black Shoes and Blue Water: Surface Warfare in the United States Navy, 1945–1975* (Washington, D.C.: Naval Historical Center, 1996), 159–60, 168–72.

[3] *Annual Report of the Secretary of Defense to the President and the Congress, February 1995* (Washington, D.C.: GPO, 1995), Table B–3.

[4] Muir, *Black Shoes and Blue Water*, 195–98. For Fisher and the financial underpinnings of naval reform, see Jon T. Sumida, *In Defence of Naval Supremacy: Finance, Technology, and British Naval Policy, 1889–1914* (Boston: Unwin Hyman, 1989), 18–46; and Nicholas Lambert, *Sir John Fisher's Naval Revolution* (Columbia, S.C.: University of South Carolina Press, 1999), 73–126.

[5] Ibid., 187–89.

[6] U.S. Department of the Navy, Naval Ship Systems Command, *Patrol Frigate Ship Acquisition Plan (U), June 1973*, I-1. In reality, even with the PF program, escort force levels fell from 202 in 1970 to 165 in 1980.

[7] Ibid., III-8; OpNav Memorandum OP-90B3/mjs, Ser 0105P90 of 1 June 1971 (Appendix A–1), and CNP/VCNO Action Sheet #836–71 of 18 October 1971 (Appendix B–1).

[8] "New Ships: FFG–7," *Surface Warfare* (September 1975): 34–35.

[9] Michael R. Bonsignore, "A Look at Our Lamps," *U.S. Naval Institute Proceedings* (December 1971): 27–31.

[10] Muir, *Black Shoes and Blue Water*, 178.

[11] "Interview with Commander Larry Carter, FFG 7 desk, Surface Warfare Division of ACNO (SW), 26 April 1989," Operational Archives, Naval Historical Center, Washington, D.C.

[12] *Patrol Frigate Ship Acquisition Plan*, I-15/16; III-12.

[13] Naval Sea Systems Command, *Building Patrol Frigates for the United States Navy* (Washington, D.C.: Department of the Navy, 1974), 3–4.

[14] *Patrol Frigate Ship Acquisition Plan,* I-108.

[15] *Patrol Frigate Ship Acquisition Plan*, I-19/20.

[16] See relevant Command Histories for *Dale* (CG-19), *Glennon* (DD-840) and *Talbot* (FFG-4), Ships History Branch, Naval Historical Center, Washington, D.C.

[17] Captain John D. Beecher, "FFG-7: The Concept and Design," *U.S. Naval Institute Proceedings* (March 1978): 148–50. For proposed funding plan, see *Patrol Frigate Ship Acquisition Plan*, I-44.

[18] Chief of Naval Operations, Instruction 9010.300, 4 January 1974, subj: Top Level Requirements and Top-Level Specifications for the Development of Naval Ships.

[19] Press Release, Navy Liaison Office to the U.S. Senate, 3 June 1974 (copy in Ships History Branch files, Naval Historical Center, Washington, D.C.).

[20] *Building Patrol Frigates for the United States Navy*, 14.

[21] See George C. Wilson, "The Navy's Future: All at Sea," *The Washington Post,* 14 March 1976.

[22] Table constructed from *Combat Fleets of the World* (Annapolis, Md.: Naval Institute Press, 1993), 835.

[23] Beecher, "FFG-7: The Concept and Design," 149; *Combat Fleets of the World*, 836.

[24] "FFG-7 Class—Mission v Weight," Captain Bruce Woodruff, NavSea PMS399, 5 March 1986, Operational Archives, Naval Historical Center, Washington, D.C.

[25] "Interview with Commander Larry Carter," 12.

[26] For average costs, see *Navy Program Factors Manual*, OpNav 90P–02A, 31 August 1977, summary factors, 2.

[27] "Interview with Commander Larry Carter," 10–14.

[28] "Navy Times interview with Lieutenant Commander Ardin Goss, SNAP II Program Manager, NAVMAT–09B6, 8 September 1983," Ships History Collection, Naval Historical Center, Washington, D.C., 5–8.

[29] See correspondence with various recipients. Contact author for more information.

Moving Target: The U.S. Army Infantry Fighting Vehicle Program in the 1970s

W. Blair Haworth, Jr.

Between the establishment of the Armored Force on the eve of World War II and 1960, the Army developed and fielded four generations of armored personnel carriers. In accordance with wartime and postwar ideas of deployment of infantry in support of tank forces, these vehicles were designed for transport rather than combat, being lightly armored and armed only for self defense. Anticipated conditions of high-intensity armored warfare, possibly in nuclear, biological, and chemical (NBC) conditions, called this concept into question. As early as 1958, an Infantry School study sought to define the characteristics of an infantry fighting vehicle with substantial armament and protection that would allow the armored infantry squad to fight from the vehicle, although no action was taken on the study's recommendations.

In early 1964, the Department of the Army ordered a development effort for mechanized infantry combat vehicles (MICV), to include an interim vehicle, the MICV–65, and an objective vehicle, the MICV–70. The MICV specification demanded a vehicle capable of engaging in combat through organic weapons, as well as the weapons of the carried infantry team, while providing greater ballistic and NBC protection than the current M113 APC; the MICV was nonetheless required to retain the APC's air-portability, amphibious capability, and capacity to accommodate a rifle squad and its equipment in addition to the vehicle crew. The MICV–65 effort produced a test-bed vehicle, the XM701, which largely employed existing components. The XM701 was found unsatisfactory because of its size and automotive performance.

The MICV–70 project, on the other hand, led to a purpose-built vehicle, the XM723 MICV, armed with light cannon and a machine gun in a one-man turret, and provided with vision devices and firing ports for the mechanized

infantry squad it carried. The XM723 had a troubled development history due to difficulty in meeting performance requirements within the specified cost, weight, and dimensions, despite an optimistic outside contractor report that claimed the MICV–70 specification should have been both attainable and cost-effective. In an effort to clarify this situation, in August 1968 Army Chief of Staff General William C. Westmoreland set up the Mechanized Infantry Combat Vehicle Ad Hoc Study Group (Casey Board), which was tasked to examine the MICV concept (but not the doctrine underlying it) and make recommendations to reduce the weight and cost of the vehicle. The board endorsed the MICV concept and made recommendations relaxing protection and endurance criteria, which yielded cost and weight savings of about one-third.

Despite these concessions, the XM723 program struggled to meet its requirements. The operational and fiscal conditions of the Vietnam War and its aftermath lowered the priority of the program, and even as the XM723 prototype was being delivered in December 1972, a variety of industry and field initiatives suggested that much of the MICV–70 requirement (especially as relaxed by the Casey Board) could be met through modifications of the M113, which had been pressed into combat missions in Vietnam. In addition, the combat record of the analogous Soviet BMP infantry combat vehicle with Arab forces in the 1973 war was markedly unsuccessful, casting doubt on the entire concept.

This situation was further complicated by the cancellation of the Army's Armored Reconnaissance Scout Vehicle (ARSV) program in 1974; lacking resources for a new program in the wake of the Vietnam War, the service merged the Scout and MICV programs with the intention of producing mechanized infantry and armored cavalry variants of the XM723. The failure of the ARSV and its subsequent merger into the Mechanized Infantry Combat Vehicle program late in 1975 greatly increased the importance of the latter to the Army. It also introduced an entire new level of complexity into the XM723's development.

Although the Scout and Infantry variants of the MICV were still automotively identical, they were envisioned as having different weapons stations. The infantry version was to continue with the one-man turret as planned—in fact, it was to receive two of them. The planned cannon armament was still in development; therefore, an interim weapons station mounting the M139 20-mm. cannon continued in development.

The Scout vehicle was a different matter. Its reconnaissance mission placed a premium on observation for the commander. The original MICV arrangement, with the commander stationed in the hull behind the driver and beside the turret, was unacceptable. The Scout was thus to have a two-

man turret, so the commander could be stationed at the highest point in the vehicle, with a 360-degree field of view. Also, in addition to the cannon and coaxial machine gun of the MICV, the Scout variant was to mount the tube-launched, optically tracked, wire guided (TOW) heavy antitank missile, as a result of the Army's post-Vietnam reorientation to European warfare, which foresaw a need for antiarmor firepower in forward areas.

Quite aside from the administrative and engineering complexity involved, this situation was insupportable. In a time of fiscal retrenchment and reductions in force, asking Congress for funding to produce a single vehicle with two hulls and three turrets seemed the quickest way to have the project join the MBT–70 and the ARSV. The embarrassment latent in this situation was all the greater given that the Army had dismissed the possibility of an M113-based MICV years before, due partially to the undesirability of a mixed fleet. To address these problems, in August 1976 the Department of the Army appointed Brig. Gen. Richard Larkin, assistant commander of the 4th Infantry Division (Mechanized), to head a task force to examine the MICV program. After three months' deliberations, the Larkin task force recommended that development of both one-man weapons stations be abandoned. Instead, it was recommended that an essentially common vehicle with the same level of protection as the existing vehicle should be procured. This course of action was reinforced by the perception that the commander's limited visibility and separation from vehicle's weapons and sensors had been a major shortcoming of the BMP in 1973.

Combat experience was confirmed by experimental evidence. While the Larkin task force was sitting, human factors tests were carried out in the course of second-phase operational testing. These tests found that the XM723 MICV, which shared the BMP's layout, was equally difficult to command, despite the addition of a light-emitting diode display to help the commander transmit target bearings to the gunner in the turret.[1]

Under the Larkin task force's scheme, the cavalry vehicle would thus mainly differ from that of the infantry in carrying a smaller crew and more ammunition, while omitting the firing port weapons. In both roles, the vehicle was to mount the turret previously associated with the scout version.

In some ways, this innovation was revolutionary. It put the TOW, which had previously been regarded as a company- and battalion-level antitank weapon operated by specialists, at the disposal of each mechanized infantry squad. It thus gave mechanized infantry units a remarkable density of antitank firepower.

In other ways, the addition of TOW was an evolutionary step. Mechanized infantry forces had, after all, traditionally deployed large numbers of antitank weapons, both to provide a positional anchor to support

armored maneuver and to free up tanks that would otherwise be required for their protection in the defense. The proliferation of antitank missiles was thus analogous to deployment of the bazooka, which had been issued to each World War II armored infantry squad, rather than at the company level where it originally resided in other infantry tables of organization and equipment—or the machine gun, which went from being a battalion weapon to a squad weapon over the course of World War I, and from a squad to a fire team and even (as the assault rifle) a personal weapon during World War II.

Whether revolutionary or evolutionary, the addition of TOW to the Cavalry Fighting Vehicle at least had a firm basis in doctrine. In the summer of 1976, just before the Larkin task force began its deliberations, the Army Training and Doctrine Command (TRADOC) under General William DePuy issued a new edition of the Army's key doctrinal manual, *FM 100-5, Operations*. This work marked a radical reorientation of the Army's professional thinking from the problems of peripheral war and counterinsurgency in general, and Vietnam and its aftermath in particular, to those of central war in Europe against the forces of the Warsaw Pact. In particular, at the tactical level he envisioned a defensive screen of "covering forces," well supplied with antitank weapons—armored cavalry units equipped with TOW-armed scout vehicles, for example. These units were to force the attacking formations to stop, deploy, and engage them, thus incurring delays and telegraphing plans. The time and intelligence thus gained would, in turn, allow the armored main battle forces to concentrate, while air and artillery firepower from the rear battle area would be brought to bear as well.

The TOW, then, was seen as an emerging doctrinal necessity for the scout variant. For its infantry counterpart, the addition of the missile was more important politically than doctrinally; a common hull and turret for the two vehicles made for a vital savings in development costs. Furthermore, without it, the MICV, whatever its virtues, represented only an incremental improvement over the M113 and its derivatives. The total cost increment for each vehicle equipped with TBAT–II as opposed to the basic XM723 design was given as $79,000 (Fiscal Year 1976) in congressional testimony. It is worth noting that much of this cost was for the thermal sight, an item deemed necessary in any event both for the scout mission and to match the night-fighting capability of the XM1 main battle tank.[2] For this relatively small monetary outlay, the XM2 gained the new guided missile capability that had made such an impact in the early phases of the Yom Kippur War without requiring the development of a new weapons system. Moreover, it did so by putting the weapons under armor, rendering them resistant

to the suppressive fire used as a counter to antitank missile attacks in 1973. Previous mobile ground mountings for the TOW, on M151 jeeps and atop M113s, had been unprotected. As General Donn Starry, DePuy's successor at TRADOC, stated: "We in TRADOC . . . decided to put the TOW on the MICV because we realized that if we did not put the TOW on the MICV, we would probably never have an MICV."[3] Even without this rather pragmatic rationale, the Army's addition of TOW to the MICV made considerable sense in terms of the service's available resources. Time and fiscal constraints left the Army with the twelve-man XM723 hull and automotive systems on its hands, with its development almost complete. These were sized for a mechanized infantry squad the Army would likely be unable to field, within the constraints of the post-Vietnam volunteer Army. With only the gunner in the turret and the commander/squad leader in the hull, the XM723 was, in any case, configured in a manner both combat experience and experimentation suggested were at best inefficient and at worst untenable. Assuming the necessity for staying with the MICV hull and power train already developed, the TBAT–II design was a useful exercise, in effect taking up the excess volume in the MICV's design while correcting the problematic configuration and addressing the perceived Soviet armor threat. A missile avoiding the mobility penalties inherent in the TOW would have been better and would certainly have made a more clear-cut argument for antitank capability for the new vehicles, but no such weapons system was available.[4]

Preliminary work on the modifications necessary for the TBAT–II configuration having already begun, the redesign, based on the MICV Task Force's detailed recommendations, went ahead quickly. Larkin's group, cognizant of the increased level of complexity and expense this redesign entailed, recommended that the TOW installation be relatively simple, carrying two rounds rather than the four originally considered, in a non-elevating mount, unlike those being studied for specialized M113-based TOW carriers. Similarly, they recognized the probability that the new turret would drive up the vehicle's weight. In view of this problem, the Larkin task force recommended that the MICV's amphibious capability be achieved by use of a water-barrier system. This was a bathtub-like canvas enclosure around the hull to increase waterborne displacement, as pioneered by the *Sherman* DD's of World War II. Use of a water barrier was probably inevitable if amphibious capability was to be achieved, as the MICV's hullborne flotation had become marginal at best.[5]

Perhaps the most significant design impact of the new arrangement was on the squad. The original MICV was sized for the then-current eleven-man infantry rifle squad standard throughout all types of infantry unit,

whether mechanized, regular, airborne, or airmobile. Only six of these men, however, aside from the vehicle crew and squad leader, were placed where they could observe or fight from under armor. Accommodating the larger turret ring and providing stowage for reserve missile rounds effectively eliminated the odd two men. Officially, a trend was emerging to reduce the size of the squad to nine men in view of manpower concerns; furthermore, Army research such as the Infantry Rifle Unit Study of the early 1970s had suggested that improved firepower allowed a squad as small as seven. At any rate, in practical terms, few Army infantry squads at this time were ever at full strength. Even under the relatively improved conditions of the early 1980s, many M113-equipped mechanized infantry platoons could field only eighteen to twenty-five men, making for de facto rifle "squads" of five to seven which concentrated on manning their most potent weapons first.[6]

FMC was quickly awarded a contract to produce the modified vehicles, and the redesign effort continued. In March 1977, the MICV program was renamed "Fighting Vehicle Systems" in recognition of its wider purview. Similarly, in May the departure from the original XM723 MICV concept was recognized by yet another redesignation: the MICV became the XM2 IFV, while the Cavalry vehicle became the XM3 Cavalry Fighting Vehicle (CFV). The redesign progressed apace, as several of the thorniest problems of the original MICV effort were worked out.

All this redesign, while relatively straightforward, took time and raised costs. This, in turn, drew congressional attention. Some legislators, notably Senator Sam Nunn (R–GA) and Senator Gary Hart (D–CO), as well as Hart's defense aide, William S. Lind, questioned the entire rationale for the MICV. They believed the system was already obsolescent in concept, in particular due to its limited protection relative to the XM1. They favored, instead, a heavier infantry fighting vehicle with tank-like levels of protection. The Army had preliminary studies for such a vehicle underway but appears not to have favored such a solution on the grounds of cost and weight, which would have been on the order of the M1 tank.[7]

As a result, hearings were held in March 1977, before the Research and Development Subcommittee of the Senate Armed Services Committee to examine the program. The Army's main witnesses were General DePuy, commander of TRADOC, and the Honorable Edward A. Miller, assistant secretary of the Army for Research and Development. General DePuy opened the testimony with a discussion of the strategic situation in Europe, the applicability of the Active Defense doctrine to that situation, and the significance of the MICV under that doctrine.

Perhaps the most striking characteristic of the Army's testimony in these hearings was the essentially negative character of the defense of the MICV.

General DePuy, who nominally saw the the MICV as fundamental to his new doctrine, still tended to couch his case for the system in terms of sunk costs, justification by foreign practice, and the inadequacy of the M113 for mobile armored combat, rather than any inherent quality of the vehicle itself. For instance:

> Almost every army you look at is ahead of the American Army, as far as taking care of our infantry. The Russians are ahead of us, the Germans are ahead of us, the Dutch are ahead of us, the French are ahead of us, the Yugoslavians are ahead of us. Almost everybody has a better infantry vehicle than the U.S. Army.[8]

British armored warfare theorist Richard Simpkin's lampoon of the Army's attitude—"Well, I guess we have to have this MICV, 'cos everybody else has one so otherwise we'll be disadvantaged"—is an exaggeration, but not by much.[9]

In the wake of these hearings, Congress directed the Army to examine the IFV concept further, with an eye to the costs involved. In October 1977, therefore, yet another Department of the Army task force, this time chaired by Maj. Gen. Pat Crizer, reevaluated the requirement for the IFV and CFV, examining their design and making inquiries into the need for a more survivable vehicle.[10] In addition, Congress directed the General Accounting Office (GAO) to investigate the Fighting Vehicle Systems program, especially with respect to the vehicles' compatibility with the XM1 tank, itself in development at a somewhat more advanced stage—and also the target of intense congressional and press scrutiny.

The GAO presented its findings in a comptroller general's report dated 12 December 1977. It was notably critical of the XM2/3 design. The GAO report asserted that the 1973 Arab-Israeli War had shown the necessity for a properly constituted combined arms team on the modern battlefield. This meant a well-equipped mechanized infantry force. At the same time, the report raised the question of whether the XM2 was in fact the proper equipment.[11] In its investigation, the GAO compared the Army's stated requirements for the tank/IFV team with the actual performance achieved. The civilian investigators pointed out that institutional considerations made coordination of the two vehicle programs difficult:

> To effectively act as a team, the XM-1 and IFV must complement each other. Although the XM-1 and the IFV are to work closely together, two different Army branches are responsible for developing them. The XM-1 tank is under the Army armor branch, which is dedicated to maintaining and operating tanks. The IFV is under the Army infantry branch, which in the past has gone into battle on foot.[12]

GAO thus set out "to determine whether separate development affected the compatibility of the XM–1/IFV as a team and whether recent events affected the Army's . . . justifications for these systems. . . ."[13] Without

stopping to define "compatibility"—an omission common to Army sources as well—the GAO compared the two vehicles and concluded that the IFV was significantly inferior to the XM1 in cross-country mobility and slower in acceleration. Furthermore, the IPV presented a larger silhouette with less armor and more pronounced noise and smoke signatures compared to the turbine-powered XM1.[14] Compounding these problems was an absence of doctrinal publications on tank/IFV teamwork. Although TRADOC had produced a groundbreaking series of field manuals on tank/mechanized infantry tactics, the FM 71-series, these manuals dealt with the M60/M113 team, with a different set of characteristics. The GAO report commented:

> In the case of the IFV, the Army is following a concept of developing a new weapons system and then determining how it will be used. Army officials said that the tactics for the IFV will be refined as soldiers train with the vehicle. In fact, this was one reason the Army wanted to field an interim version of the IFV[15]—a plan it has now abandoned because testing did not substantiate its practicality. We believe that the Army should develop its written plan now, so that it may make vehicle modifications, if warranted, in a timely and less expensive manner.[16]

The GAO's final area of concern was the complexity of the IFV. Aside from concerns about the potential maintenance burden and immaturity of the turret and firing port weapons of the XM2, which were still in development, the investigators were concerned about the role of the IFV gunner, who was responsible for firing and maintaining three different systems: the 25-mm. cannon, the TOW missile, and the 7.62-mm. coaxial machine gun. Acquiring and maintaining the necessary set of skills was seen as a potentially critical problem.[17] It must be pointed out that the investigators did not take into account the relative simplicity of operation, if not of maintenance, of the TOW system. Israeli gunners had reportedly been brought to reasonable proficiency with four hours' practice under emergency conditions during the 1973 war,[18] whereas Egyptian Sagger operators had to train on simulators even at the height of the war, firing twenty to thirty simulated rounds per day simply to maintain proficiency.[19]

Automotive complexity also concerned the authors of the comptroller general's report. The hydromechanical transmission attracted attention as a major source of breakdowns. So did the suspension. These, however, were recognized as developing items, with the potential for improvement. A more fundamental criticism was aimed at the swim-barrier flotation system. The GAO pointed out that the swimming requirement—certainly not "compatible" with the mobility characteristics of the fifty-eight-ton XM1, and not found in the analogous West German Marder—was essentially a badly thought-out aping of the BMP. Swimmability placed a fundamental limit on the XM2's armor protection and added complexity and expense to

the vehicle for marginal return, especially given that the Army estimated that only 3 percent of European waterways required a swim capability to cross.[20]

Despite this plethora of complaints, it is worth noting that the GAO's technical criticisms were not single-mindedly against innovative technology. The report, to cite one example, looked askance at the Army's decision to omit collective NBC protection from both the XM1 and the XM2/3. In particular, it cited advances in Soviet offensive chemical capabilities, together with Soviet efforts to install such protection on tanks and BMPs.

In its final recommendations, the comptroller general's report suggested that the secretary of Defense determine:

> • Whether, considering its advanced state of development, the indicated design changes to make the IFV effective can still be practically made at an acceptable cost.
>
> • Whether a tactical doctrine can be developed that can accommodate the incompatibilities between the IFV and the XM-1 and still provide the effectiveness anticipated from both.
>
> We recommend that, if the design changes and tactical doctrine are unattainable, the secretary direct the Army to find alternatives to the IFV.
>
> We also recommend that the Secretary require the Army to rejustify using individual protective masks and clothing against chemical warfare rather than equipping its new vehicles with protective systems. [21]

Acting largely on this evaluation, the Office of Management and Budget deleted M2/3 funding from the Carter administration's FY 79 budget. A political struggle then ensued to reinstate the program. In February 1979, at hearings before the House Armed Services Commitee on the Fiscal Year 1979 defense appropriation, Brig. Gen. Stan Sheridan, program manager for fighting vehicle systems, defended his program, stating that:

> The Army feels rather strongly there is an urgent requirement for Infantry and Cavalry Fighting Vehicles to fight side by side with the XM1 Tank. It is the Army's position that the current concept and design of that vehicle . . . meets the requirement and provides improved and versatile firepower; mobility compatible with XM1; sufficiently increased protection to allow infantry and cavalry to fight from within the vehicle; and simplified maintenance.[22]

Under questioning from the committee, Sheridan addressed the GAO report, repeatedly emphasizing the advantages of the IFV's enhanced firepower, particularly with respect to the GAO's concern for the increased complexity of the new vehicle. That complexity, he claimed, was the price of increased capability. Toward the end of his testimony, Brig. Gen. Sheridan expressed his frustration with the stop-and-start course of the program: "I don't mean to be facetious but it seems like about every few years we take the plant called IFV, we pull it out, and look at the roots to see if they are healthy . . . ." [23]

In mid–April 1978, the Crizer task force reported to Congress, confirming both the requirement for and design of the IFV and CFV, reporting that a vehicle with increased survivability would involve high investment costs, unacceptable delays in fielding the vehicle, and medium to high technical risk.[24]

While the Crizer task force was completing its investigations for Congress, another one was gearing up to answer the concerns of the Office of the Secretary of Defense (OSD) concern about the program. The IFV/CFV Special Study Group formed at Fort Leavenworth, Kansas, in March 1978, under Brig. Gen. Fred Mehaffey. The Mehaffey group, in conjunction with the Tank-Automotive and Armaments Comand (TACOM) program manager for fighting vehicle systems, was directed to determine the cost-effectiveness of an IFV-based successor for the M113-based Improved TOW Vehicle, and to determine the cost-effectiveness of the IFV and CFV programs against M113 derivatives.[25] The Mehaffey group's recommendations were in the same vein as those of the Crizer task force. It found that the ITV was more cost-effective than the proposed IFV-based TOW vehicle[26] and that M113 derivatives would require extensive reengineering to be even marginally satisfactory, requiring extensive modifications to accept a TBAT–II turret or analogous weapons station, along with a new power plant and suspension. To this end, the Mehaffey group recommended that the Army proceed as planned with the IFV and CFV.[27]

Despite fiscal and political uncertainty, development continued on the XM2 and 3 and in fact in October 1978, Congress reinstated the deleted procurement funds. The previous public law mandate for production delivery to commence by May 1981 was retained.

Operational testing, intended to determine how well the vehicle met user expectations and developmental testing to establish its conformity with the formal requirements occupied most of 1979. These tests, as intended, revealed a number of shortcomings, particularly in the TOW launcher and Integrated Sight Unit. These problems yielded to fixes ranging in scope from the application of Loctite to a motor connector all the way to extensive system redesigns.[28] These remedies, however, cost time and money, which alarmed Congress. The unit cost of the IFV, in constant FY 78 dollars, went from $370,000 to $472,000,[29] a cost that was quickly revised upward to $495,000[30] due to tooling problems at FMC. Taking the inflation rates of the era into account, this made the rollaway cost (i.e., the cost of a completed, fully equipped, M2 or M3) $557,000 in FY 80 dollars, averaged over a projected purchase of 7,000 units.[31] Army representatives maintained that the IFV was still highly cost-effective, however, claiming that an IFV/

CFV-equipped force, while 5 percent to 12 percent more expensive than one equipped with the M113A2, was 80 percent to 120 percent more effective. As with the claim that the IFV was resistant to 92 percent of Soviet weapons (see above), no elaboration for this claim was given.[32]

Meanwhile, the XM2/3 were type-classified Standard on 20 December 1979. FMC delivered the first production vehicle by the May 1981 deadline, and on 20 October 1981, the M2 IFV was officially dedicated in honor of General Omar Bradley in a ceremony at Fort Myer.[33] The newly named Bradley Fighting Vehicle entered production in 1981, and unit service in 1983. At last, the Army had an IFV; it was now necessary to decide what to do with it.

NOTES

[1] Seward Smith, *Human Factors Implications of MICV OT II for Infantry Fighting Vehicle (IFV) Development* (Alexandria, Va.: Department of the Army, Office of the Deputy Chief of Staff for Personnel, U.S. Army Research Institute for the Social and Behavioral Sciences, 1968), 9.

[2] U.S. Congress, Senate, Committee on Armed Services, *Fiscal Year 1978 Authorization for Military Procurement, Research, and Development, and Active Duty, Selected Reserve, and Civilian Personnel Strengths: Hearings Before the Committee on Armed Services, United States Senate, on S. 1210,* 95th Cong., 1st sess., 1977, 5928. Hereafter cited as "SASC 1978."

[3] "Developing Army's Bradley: The Wages of Compromise," *Army* 37 (July 1987): 71.

[4] While commandant of the NATO Defense College, Rome, Bundeswehr Lieutenant General Franz Uhle-Wettler pointed out that a specialized anti-tank self-defense missile would be much more useful on an IFV than the preexisting medium- and long-range missiles fitted; unfortunately, no such weapon (a short-range missile with a quick reaction time) exists despite the acquisition resources put into IFVs by major armies (Franz Uhle-Wettler, "Infantry Versus Tank: Common Sense and High Technology," *NATO's Sixteen Nations* [May–June 1984]: 53).

[5] United States Department of the Army, Tank-Automotive Command, Program Manager, Mechanized Infantry Combat Vehicles, "MICV Systems Message," United States Army Tank-Automotive Command Archives, Warren Mich., "MICV Systems Message #3," Inclosure (*sic*) 1.

[6] Michael S. Hackney, "Understrength Platoon," *Infantry* 72 (November–December 1982): 10. Lieutenant Hackney was a mechanized infantry platoon leader ca. 1980.

[7] Richard M. Ogorkiewicz, "Infantry Armored Vehicles: Origins and Future Trends," *International Defense Review* (May 1990): 512. One of the most thorough published rationales for the heavy infantry fighting vehicle may be found in Richard Simpkin, *Mechanized Infantry* (London: Brassey's, 1980), chapter 5. Grossly compressed, Simpkin's thesis is that the main battle tank had (and has) grown so specialized as an anti-tank system itself and that the threat from other anti-tank weapons had grown so that there were many tactical situations in which IFVs, with their handier armament and dismountable troops, would have to lead, and that in any event, manpower and morale considerations in the NATO scenario called for higher levels of protection. Simpkin counters the cost and weight objections normally leveled at this approach by showing that for large fleet sizes, commonality between MBT and IFV components could realize

economies of scale, and that the potential for hiving off secondary functions from the MBT to a complementary IFV, capable of closer cooperation than the lighter vehicles fielded so far, could drive weight down. In this book, as in several of his others, Simpkin emphasizes that for the NATO powers, the critical resource was manpower rather than money or materiel. Certainly the United States was a prime historical example of this thesis; the nation had run perilously short of riflemen in its last three wars, but never short of funds.

[8] SASC 1978, 5927. Note that the Dutch vehicle alluded to here is the YPR–765, a license-built version of the private-venture AIFV FMC had derived from the M113.

[9] Simpkin, *Mechanized Infantry*, 29.

[10] United States Department of the Army, Tank-Automotive Command, Program Manager, Mechanized Infantry Combat Vehicles, "MICV Systems Messages," United States Army Tank-Automotive Command Archives, Warren, Mich., "PM Message 7," 1. Hereafter cited as "PM Message 7."

[11] U.S. Congress, General Accounting Office, Comptroller General, *The Army's Proposed Close Combat Vehicle Team* (Washington, D.C.: GAO, 1977), i; hereafter cited as "GAO 1977."

[12] GAO 1977, 1.

[13] GAO 1977, 3.

[14] GAO 1977, 4.

[15] The XM723 MICV with M139 20-mm. cannon.

[16] GAO 1977 11. Cf. I. B. Holley, Jr., *Ideas and Weapons* (New Haven, Conn.: Yale, 1953); the tendency for U.S. Army procurement bureaucracies to make doctrine fit its desired weapons dates back at least as far as World War I.

[17] GAO 1977, 15.

[18] Edgar O'Ballance, *No Victor, No Vanquished: The Yom Kippur War* (San Rafael, Calif.: Presidio, 1978), 162.

[19] David C. Isby, *Weapons and Tactics of the Soviet Army* (London: Jane's, 1981), 145.

[20] GAO 1977, 20.

[21] GAO 1977, 27.

[22] U.S. Congress. House Committee on Armed Services, *Hearings on Military Posture and H.R. 10929: Department of Defense Authorization for Appropriations for Fiscal Year 1979*, H.R. 10929, 95th Cong. 2d sess., 1978, 171.

[23] Ibid., 209.

[24] "PM Message 7," 1.

[25] Daniel J. Kaufman, "Organizations, Technology, and Weapons

Acquisition: The Development of the Infantry Fighting Vehicle" (Ph.D. diss., Massachusetts Institute of Technology, 1983), 409.

[26] This was a considerable irony given the Army's rejection of the XM765 and other M113 product improvements in the 1960s due to the cost impact of a two-vehicle fleet for the infantry.

[27] Kaufman, "Organizations, Technology, and Weapons Acquisition," 414.

[28] U.S. Congress, House, Committee on Appropriations, Subcommittee on the Department of Defense, *Department of Defense Appropriations for 1980*, part 7, 96th Cong., 1st sess., 1979, 132–36; hereafter cited as Appropriations 1980.

[29] Ibid., 109.

[30] U.S. Congress, House, Committee on Armed Services, *Hearings on Military Posture and H.R. 6495 [H.R. 6974]: Department of Defense Authorization for Appropriations for Fiscal Year 1981*, 96th Cong., 2d sess., 1980, 857.

[31] U.S. Congress, Senate, Committee on Armed Services, *Department of Defense Authorization for Appropriations for Fiscal Year 1981*, 96th Cong., 2d sess., 1980, 2333.

[32] Ibid., 2335.

[33] United States Army, Tank-Automotive Command, *U.S. Army Tank-Automotive Command Annual Historical Review, 1 October 1981–30 September 1982*, Joseph L. Avesian, Joseph Mihalak, Ann M. Bos, comps. (Warren, Mich.: United States Army Tank-Automotive Command, 1983), 225.

PART IV

Acquisition in the 1980s

An Overview of Acquisition, 1981–1990

Andrew J. Butrica

The decade of the 1980s was one of extraordinary changes that had a direct and dramatic impact on defense acquisition. On 20 January 1981, as President Ronald Reagan took the oath of office, Iran held fifty-three Americans hostage. Although at peace, the United States was on the verge of the largest military buildup in peacetime history. The Cold War buildup responded to the perception that the United States had allowed its forces to dwindle while the Soviet Union continued to boost its armed forces. Ten years later, on 20 January 1991, the United States and its allies were at war with Iraq. The Cold War was over. The Berlin Wall had been torn down in November 1989, and soon, on 8 December 1991, the creation of the Commonwealth of Independent States (CIS) heralded the start of a new post-Cold War era. Even before the startling end of the Cold War, Secretary of Defense Frank Carlucci, in a February 1988 report to Congress, characterized the 1980s as "a momentous decade."[1]

Two technologies new to the 1980s had a direct and lasting impact on acquisition. In 1981, IBM introduced the 5150 personal computer (PC) powered by an Intel 8088 processor and Microsoft's Disk Operating System (MS-DOS).[2] The other technology was the space shuttle, which began operation on 4 July 1982. No other president since John F. Kennedy undertook as many large-scale space programs as Ronald Reagan. The period saw the formation of a unified Space Command, the launching of the Strategic Defense Initiative, and a national policy mandating that the Defense Department (DoD) purchase launch and other space goods and services from the private sector.

This paper will focus on the evolution of defense acquisition reform during the 1980s. Throughout this tumultuous decade of political, economic, and technological change, the drive for acquisition reform was constant. The Reagan administration concentrated on cutting the cost of acquiring weapons and on streamlining the acquisition process. Some reforms focused

on fraud, waste, abuse, and overpriced spare parts, while others proposed fresh organizational approaches to the acquisition process, and still other reforms hoped to streamline it. This paper also considers the role of Congress in general and the Military Reform Caucus specifically.

In the 1980s, congressional management and control of the defense acquisition process reached an all-time high. Congress's assertive role in instigating and shaping Defense Department reform was complex. Members of the Military Reform Caucus often disagreed among themselves and with their colleagues on the House and Senate armed services committees, not to mention the ongoing discord between Congress and the Defense Department.

This paper treats the evolution of defense acquisition reform in three parts. The first delineates the initial efforts of the Reagan administration. The second focuses on Congress and the Military Reform Caucus. The third examines the recommendations of the Packard Commission, the Reagan administration's response to the reform movement. A concluding section assesses the state of acquisition reform in 1989, as seen through various official reports.

The Carlucci Initiatives

The measures initially taken by the Defense Department to reform the weapons acquisition process grew out of Ronald Reagan's presidential campaign. Reagan accused the federal government of having "overspent, overestimated, and overregulated." He proposed lowering individual and corporate income taxes and shrinking the size of the federal government and budget. "We are being punished," he contended, "for working, for saving, for investing, for growing, by a thoughtless government." In addition, he proposed to curb the regulatory activity of the federal government, because those regulations had reduced productivity, caused economic inefficiency, and worsened inflation. Finally, Reagan vowed that his "first priority would be to embark on a program of rebuilding American military strength." In order to finance this buildup, he proposed, "redirecting the misspent resources presently being consumed by a huge governmental bureaucracy."[3]

The first step toward "redirecting the misspent resources" was the Defense Acquisition Improvement Program (DAIP), better known as the Carlucci Initiatives after Deputy Defense Secretary Frank Carlucci. In actuality, Vincent Puritano, Carlucci's assistant, was its architect. The program's essential goal was to cut costs, while shortening the acquisition process and improving force readiness. Puritano conducted the acquisition improvement study in parallel with a review of the Planning,

Programming, and Budgeting System (PPBS), with an eye toward linking the two processes. Secretary of Defense Caspar Weinberger found the PPBS "congested with paperwork" and in need of streamlining "to allow senior defense management to concentrate on such major problems as cost control."[4] Through the PPBS, the Defense Department developed its five-year plan that culminated in the presentation of the president's defense budget to the Congress. "The results of these two assessments would impact on each other," Puritano explained, "since budgeting and weapons acquisition are intertwined—even though they have not always been adequately treated as such—and because there are inherent problems in coordinating two processes."[5]

The Defense Acquisition Improvement Program consisted of thirty-two initiatives. In addition to coordinating acquisition and PPBS decisions, the stated objectives of the Carlucci Initiatives were: 1) to reduce costs by "looking for substantial and real savings in the acquisition of major weapons systems"; 2) to improve the acquisition process by making it "more efficient and more effective"; 3) to increase program stability; and 4) to require that "appropriate long-range business strategies and planning tools" be instituted "to reduce unit costs" and to increase the "quality while decreasing the delivery time of military hardware and civilian services."[6]

Puritano organized representatives from the services, Office of Secretary of Defense staff, the Defense Systems Management College (DSMC), and the Logistics Commands into five teams, each of which studied a separate acquisition area: 1) cost reduction; 2) shortening acquisition time; 3) improving weapon support and readiness; 4) improving the acquisition review process; and 5) multiyear procurement.[7] Not surprisingly, then, among the key recommended initiatives were multiyear procurement, increased program stability, economic production rates, and fewer defense directives. The program also recommended retaining the under secretary of Defense for Research and Engineering as the defense acquisition executive.

Within less than a year, the Defense Department integrated the Carlucci Initiatives into the acquisition process as part of Directive 5000.1, issued on 29 March 1982.[8] Implementation of acquisition improvement became an important objective of the newly formed Council on Integrity and Management Improvement, headed by Frank Carlucci.[9] A June 1983 Defense Department review of the Acquisition Improvement Program reported that thirteen of the thirty-two initiatives had been incorporated into the acquisition process. Their implementation streamlined the acquisition process by reducing the number of required decision milestones, the amount of documentation, and the number of programs reviewed by high-level management. While reporting progress on another nine initiatives, the report

warned that further action was required to ensure proper implementation. Moreover, other initiatives requiring the revision of statutory thresholds and increasing funding flexibility could not be implemented without the approval of Congress.[10]

In addition to the Carlucci Initiatives, aimed at the weapons acquisition process, the Defense Department focused on fraud, waste, and abuse in procurement. Only later would these become the subjects of media attention and congressional investigations. Among the measures taken was a publicity campaign to revitalize the Defense Hotline and, in April 1981, the creation of the Office of Assistant to the Secretary of Defense for Review and Oversight. This office coordinated the efforts of the Defense Department's auditors, inspectors, and investigators, in an effort to eliminate waste and to prevent and detect fraud and abuse. Subsequently, the Office of Defense Inspector General, created in September 1982 by the Department of Defense Authorization Act of 1982 (Public Law 97–252), took over the functions of the assistant to the secretary of Defense for Review and Oversight.[11]

Reform 88

Not all early Reagan administration acquisition reforms were confined to the Defense Department. Two government-wide reform projects attempted to have a direct impact on defense acquisition: Reform 88 and the Grace Commission. Started in May 1982 (though not announced until 22 September 1982), Reform 88 was a six-year program, directed at the highest level, to make the federal government more efficient. The Cabinet Council on Management and Administration, a select group of departmental cabinet officers, managed the program. Edwin Meese III, counselor to President Reagan, was chairman *pro tempore*, while Joseph Wright, deputy director of the Office of Management and Budget (OMB), directed day-to-day activities. The President's Task Force on Management Reform, under the direction of Martha O. Hesse (OMB), was responsible for implementing the management reforms that emerged from Reform 88.[12]

Reform 88 was an archetypical application of Reagan-era political thinking about making government operate more like a business. It started as a set of fifteen (later expanded to eighteen) projects intended "to streamline the operations of the federal government so that it functions in a more business-like manner." It also aspired to make government more efficient by introducing new advanced technologies. Reform 88 proposed extensive applications of computers and other electronic technologies to improve an assortment of government financial, budgetary, and accounting operations, such as tracking the federal budget, submitting data to OMB

electronically, electronic controls over cash flow, including electronic funds transfers and automated lockboxes, and standardization and consolidation of pay and personnel systems into a single computer-driven system.[13]

The chief Reform 88 change to the acquisition process was the consolidation of the three federal procurement systems (the Defense Department, the National Aeronautics and Space Administration, and the General Services Administration) into a single system, the Federal Acquisition Regulation (FAR), thereby making it easier for businesses to deal with the federal government. The new acquisition regulation went into effect on April 1, 1984. It claimed to have cut the number of separate agency regulations by more than 60 percent.[14]

Nonetheless, the reduction was not so obvious. Whereas the former Defense Acquisition Regulation (DAR) had had twenty-six sections plus appendices A through R (plus manuals and supplements), the new acquisition regulation had eight subchapters, which included a total of fifty-three parts. The old acquisition regulation had a single-column format, while the new one was printed in two columns, cutting the number of pages in half with a single formatting decision. The new acquisition regulation required only three to four three-inch binders, compared to seven similar binders. However, because many of the defense procedures were unique to that agency, the unified acquisition regulation did not include them, and they had to appear in a lengthy supplement.[15] The simplification of acquisition regulations still had a distance to go.

The Grace Commission

The last project added to the original fifteen Reform 88 projects was implementation of the Grace Commission recommendations.[16] The Grace Commission was unusual among government studies in its extensive use of *pro bono* time donated by big business executives. Formally known as the President's Private Sector Survey on Cost Control in the Federal Government, the Grace Commission came into existence through an executive order, dated 30 June 1982, that directed an advisory committee to "conduct a private sector survey on cost control in the Federal Government" and to "advise the President and the Secretary of Commerce, and other Executive agency heads with respect to improving management and reducing costs." Specifically, the study looked for "opportunities for increased efficiency and reduced costs" that could be achieved "by Executive action or legislation," as well as improvements in managerial accountability and administrative control, short-term and long-term managerial improvements, and other specific areas where further study might achieve savings.[17]

The members of the President's Private Sector Survey on Cost Control in the Federal Government were "appointed by the president from among citizens in private life." All served without compensation, although the secretary of Commerce provided staff support through a nonprofit organization (the Foundation for the President's Private Sector Survey on Cost Control). J. Peter Grace, the president of W. R. Grace & Co., led the commission's executive committee, which formed thirty-six task forces, each co-chaired by two or more members of the executive committee, to undertake a series of preliminary reports. Twenty-two task forces studied specific departments and agencies, including the Air Force, the Army, the Navy, and the Office of Secretary of Defense (OSD), while fourteen studied functions cutting across government, such as personnel, data processing, and procurement. Thus, at least half a dozen task forces and their reports evaluated defense acquisition. The executive committee summarized these findings in a final summary report presented to President Reagan in 1984.[18]

The Task Force on the Office of the Secretary of Defense typified the private sector composition of the Grace Commission. Its four co-chairs were Robert A. Beck, Chief Executive Officer (CEO), Prudential Insurance; Carter L. Burgess, Chair, Foreign Policy Association; James E. Burke, CEO, Johnson and Johnson; and Carl D. Covitz, President, Landmark Communities, Ltd. Virtually all of the OSD task force members were from corporations not typically associated with the military-industrial complex. Prudential and Johnson & Johnson, as well as its Ethicon and Ortho Pharmaceutical subsidiaries contributed the largest number of task force members with six each, followed by the law firm of McKenna, Connor & Cuneo; the accounting firms of Touche Ross & Co. and Coopers & Lybrand; and Xerox, which contributed two members each. American Cyanamid Co., American Express, Campbell Soup, Champion International (paper products), Chesapeake & Potomac Telephone Co., Eaton Corporation, Ford Aerospace, GTE, Kenneth, Leventhal & Co., Lincoln National Life, Pepsico, PPG Industries, Proctor & Gamble, TRW, and U.S. Steel (now USX) each provided one commissioner.[19]

The forty-five members of the OSD Task Force "devoted about 160 person-months of *pro bono* work" to the effort and claimed that, if implemented, their recommendations would save $44.684 billion over the first three years.[20] The staff cautioned that they "had the formidable task of bringing their expertise to bear on largely unfamiliar and complex federal operations in the short span of a few months" in an "unprecedented and wide-ranging survey that was performed in a politically charged atmosphere." The OSD task force analyzed opportunities for cost savings and management efficiency in six areas: logistics, weapons acquisition,

retirement provisions, health programs, personnel and compensation, and financial controls. Almost 40 percent of the recommended savings, they determined, would derive just from improved management of the weapons acquisition process.[21]

The OSD Task Force warned that not only was total defense spending escalating, but procurement, the largest component of the fiscal 1983 budget, was the fastest growing part of the defense budget. From fiscal 1974 to fiscal 1983, personnel costs increased 111 percent, operations and maintenance grew by 175 percent, and research, development, testing, and evaluation rose 202 percent, while procurement skyrocketed 369 percent. "Clearly," noted the OSD Task Force, procurement "is an area in need of constant scrutiny for management efficiencies. The huge out-year costs of weapons now being developed will exacerbate this trend."[22]

The OSD Task Force found two fundamental causes blocking efficient management of the acquisition process. The first was the lack of cooperation between the services and the OSD. The Task Force wrote, "The military services have never really bought into the need for central management by the Secretary of Defense. DoD has been in place for thirty-five years, but the services still resist its authority. . . . While no intellectual arguments to this effect were presented to the OSD Task Force, it is evident that the emotional undercurrent exerts a constant tug." The second impediment was Congress. "Congress continually constricts DoD's management prerogatives. Weapons choices, base deployment, and other major management decision cannot be made in isolation from home district political pressures from throughout the country. This creates an environment which favors expansion of programs; the management efficiencies of contraction or consolidation are seldom attainable."[23]

The OSD Task Force made nine recommendations to improve the weapons acquisition process. First and foremost was the consolidation of "the management of the acquisition process within the Office of the Secretary of Defense" under a single senior acquisition executive, the under secretary of Defense for Acquisition, separated organizationally and functionally from the existing office of under secretary of Defense for Research and Engineering, which acted as the defense acquisition executive. A second key recommendation was the establishment of "a stable five-year spending plan for the acquisition of weapons systems at economical production rates."[24] Weapons programs become unstable when any factor, except inflation, causes actual program costs to exceed original estimated costs. Common causes of instability include poor initial cost estimates, stretched and delayed production schedules, engineering changes, and poor contractor performance.

Other recommendations included consolidating all defense contract administration under the direction and control of the senior acquisition executive, instead of the Defense Contract Administration Service (DCAS) and the nine separate service organizations (three Army, four Navy, and two Air Force). Another recommendation, simplification of "the complex regulatory system" governing weapons acquisition, anticipated completion of the new federal acquisition regulation in 1984. Additional recommendations touched on how contractors recovered so-called independent research and development costs; improved integration of defense research data into the weapons acquisition process and elimination of duplicate staff and research efforts; use of common hardware components, subsystems, equipment, and other parts by all services; decreased use of military standards and specifications; more accurate procedures for estimating weapons costs; requiring contractors to absorb a greater share of cost overruns; and limiting the number of new weapons programs started each year.[25]

Finally, the OSD Task Force suggested reorganizing the Office of Secretary of Defense by creating a Defense Executive Office that mirrored corporate organizational structures. "Many large private-sector organizations, recognizing that the burden of coordinating a large complex enterprise is beyond the capability of one or two people, have created Offices of the Chief Executive." The office would consist of the secretary of Defense, the deputy secretary of Defense, the three service secretaries, and the chairman of the Joint Chiefs of Staff. This reorganization would represent individual service views better within the Office of Secretary of Defense, would "establish a base from which to achieve better unified decisions and actions among the services, and [would] relieve the span of control problem of the secretary of Defense."[26]

The OSD Task Force also suggested reorganizing the Joint Chiefs of Staff, but held back making any specific recommendations because the organization of the Joint Chiefs of Staff was "beyond the scope of this Task Force's charter. It should be pointed out, however, that many respected military and civilian leaders believe that it is timely to consider options for JCS reform."[27] In a few years, that reorganization became the focus of the Goldwater-Nichols Department of Defense Reorganization Act of 1986 (Public Law 99–433).[28]

The Military Reform Caucus

For many critics of the Defense Department (and Congress), the Grace Commission reports highlighted the waste and pork-barrel corruption of the government.[29] Many of the reforms proposed by the Reagan administration

required congressional approval. As the OSD task force had noted, "more than 80 percent of the savings dollars can only be achieved if there is congressional concurrence."[30] Friction between the Defense Department and Congress was a normal part of the process established in the Constitution that set the executive and legislative branches against each other. The Defense Department could propose, but Congress ultimately held the power to determine funding. At times during the turbulent Reagan years, disputes between the two branches went before the third branch, the Supreme Court, for resolution.

Central to the defense acquisition reforms initiated by Congress was the Military Reform Caucus, founded in 1981 by Sen. Gary Hart (D–CO). The caucus was a bicameral bipartisan group that embraced all divisions of the political spectrum, from liberals to conservatives. Initially, it served primarily as an educational forum, and its meetings were oriented more toward discussion than action. Caucus members emphasized conventional over nuclear weapons, simpler and more numerous weapons over advanced technology, increased spending on defense areas other than procurement, and maneuver warfare.[31]

During 1981 and 1982, membership in the Military Reform Caucus reached fifty and grew to eighty over the following two years, as caucus leadership passed from the bipartisan team of Senator Hart and Rep. G. William Whitehurst (R–VA) to two Republicans, Representative Jim Courter of New Jersey and Senator Nancy Kassebaum of Kansas. At the same time, the caucus's focus also changed, with attacks on specific defense systems such as the M2 Bradley Infantry Fighting Vehicle, the Abrams M1 tank, the Sergeant York (DIVAD) Air Defense gun, and the Maverick antitank missile.[32] Attacks on individual weapons, however, were time consuming and aimed at the end of the acquisition process. Reform needed to correct things at the start, before problems appeared. Procedural reform also avoided dividing the Military Reform Caucus over specific programs and spending in their home states and districts.

At the same time, the caucus also shifted its attention to the mounting spare parts scandal. By attaching this issue to its agenda, the Military Reform Caucus drove defense acquisition legislative activity to an all-time high. Caucus membership swelled to more than 130 by 1986, including more than one hundred representatives and nearly thirty senators. Senators Charles Grassley (R–IA) and David Pryor (D–AR) and Representatives Denny Smith (R–OR) and Mel Levine (D–CA) provided bipartisan bicameral leadership during the height of the reform movement, 1985 and 1986.[33]

The spare parts scandal that propelled defense acquisition reform began not in Congress, but in the media and among public interest groups, chief of

which was the Project on Military Procurement, founded in 1981 by Dina Rasor, ABC News Washington bureau editorial assistant. The goals of her group, according to its literature, were "to reform the Pentagon procurement system by educating the public and the Congress of the ongoing waste, fraud and abuse through the press; to provide an effective and reliable defense while saving the American taxpayer as much money as possible; and to assist in any way, whistleblowers in the military establishment who wish to expose those abuses." Initially, like the Military Reform Caucus, the project attacked the M-1 Abrams battle tank and other specific weapons programs.[34]

The exposure of a toilet seat costing $700 and a $435 claw hammer provided the reform movement its icons, and more importantly the kind of facile and tangible publicity angle needed to move public opinion. The spare parts scandal started in the summer of 1982 with a memorandum written by an Air Force official criticizing the engine manufacturers Pratt and Whitney for exorbitant price increases. When the Project on Military Procurement released the memorandum to the press, a flood of stories followed along with numerous requests to the project for more spare parts stories.[35] Additional revelations emerged until the list of spare parts with astronomical price tags had grown quite lengthy, and still more examples were not hard to come by. House and Senate investigations soon followed. Rep. Charles Schumer (D–NY) succinctly summed up the situation: "What welfare mothers did for social spending in the 1970s, $6,000 coffee pots are doing for defense spending in the 1980s."[36]

The Ten Commandments

Defense Secretary Caspar Weinberger responded to the spare parts scandal with a number of schemes. In August 1983, he announced a ten-point program, commonly known as Weinberger's Ten Commandments, to fight price abuse. The program included offering incentives to increase competitive bidding and to reward employees who pursued cost savings, as well as taking "stern disciplinary action, including reprimand, demotion and dismissal, against employees who are negligent in implementing Defense Department procedures." The Ten Commandments were less harsh on contractors, however. They advised "alert[ing] defense contractors to the seriousness of the problem and ask[ing] them to take disciplinary action when necessary and reward[ing] employees when appropriate." The tenth directive reminded defense employees, "The many corporations not involved in spare parts overcharging should not be maligned because of the failures of a few."[37]

A somewhat different set of ten directives appeared in the version presented to Congress. For example, the tenth directive read: "Secretary's Personal Resolve to Straighten Up the Spare Parts Situation," and the directive to "alert contractors to the seriousness of the problem" failed to mention taking disciplinary action, but added simply: "Our Strong Resolve to Control Prices." Weinberger's position before Congress was that the reported cases of the Defense Department paying "exorbitant prices" for spare parts was not the norm. He admitted that some serious problems exist, but he added, "it is noteworthy that our own management procedures have uncovered this problem and are being applied to correcting it."[38]

Believing that spare parts pricing was just one facet of the problem, Weinberger promoted the use of standard parts during engineering design, development, production, or modification of equipment and major weapon systems, expanded training for spare-parts procurement personnel, and accelerated plans to acquire computer software to assist in controlling spare parts.[39] These and more than 500 more individual initiatives, including increasing competition, exercising customer leverage, and improving price surveillance and control, formed the Spares Management Improvement Program. To oversee the program, Weinberger established a new position, deputy assistant secretary of Defense for Spares Program Management. "This marks the first time," he told Congress, "we have had a single office with responsibility for all aspects of spare parts management."[40]

The 1985–1986 Reform Wave

As the Defense Department instituted changes to address the spare parts scandal, Congress considered a tsunami of acquisition reform legislation, especially in 1985 and 1986. So overwhelming was the deluge of proposed acquisition reforms, that in 1985 the Senate created the Armed Services Defense Acquisition Policy subcommittee chaired by Dan Quayle. Congress added a substantial number of reform bills to the fiscal 1986 and 1987 defense authorization bills. Aggregated, they became Title IX of the 1986 Defense Authorization Act, more commonly referred to as the Defense Procurement Improvement Act of 1985, and Title IV of the Defense Authorization Act of 1987, known as the Defense Acquisition Improvement Act of 1986.[41]

Key to understanding the large number of reform bills was not just the ongoing spare parts scandal and attacks on specific weapons systems but also the passage of the Gramm-Rudman Deficit Reduction Act of 1984. Gramm-Rudman aspired to control the rapidly rising deficits that had been so integral to the largest military buildup in peacetime history. Under

Gramm-Rudman, not just deficits but defense spending, too, would have to stop growing.

While it is beyond the scope of this paper to address the hundreds of reform measures that Congress considered, even just for the years 1985 and 1986, a look at a few key victories gives an idea of the extent of reform legislation. An early major victory of 1983 addressed the need for an independent operational testing and evaluation office in the Defense Department. Testing was at the heart of the long-standing aphorism "fly before you buy." Reformers insisted that rigorous testing of any weapon, preferably under battlefield conditions, should precede any procurement decision.

Congress passed the Office of Operational Testing and Evaluation Law as an amendment to the Fiscal Year 1984 Defense Authorization Act, which became part of the Department of Defense Authorization Act of 1984 (Public Law 98–94). Its intent was to assure that weapons would undergo thorough and realistic testing prior to any procurement decision. The law, however, was not implemented for eighteen months. The Defense Department did not request funding for the office during the next fiscal year. In 1985, two years later, instead of the candidate favored by the Military Reform Caucus, President Reagan nominated a McDonnell Douglas test pilot whom the caucus opposed. Thus, not only did the White House delay implementation of the law, but it staffed the office with someone unacceptable to its principal advocates.[42]

Although the Military Reform Caucus strongly advocated "fly before you buy," a principal reformer axiom was expressed by the movement's tongue-in-cheek motto, "more bang for the buck." The fundamental goal was efficiency, and the greatest promoter of efficiency, from the reformers' perspective, was free-market competition. Hence, much reform legislation aspired to increase private competition for defense dollars. The first and foremost piece of legislation fostering greater competition was the Competition in Contracting Act (CICA) of 1984, "widely regarded as the first major piece of procurement reform legislation passed by the Congress in over forty years."[43] The bill passed as part of the Gramm-Rudman Deficit Reduction Act of 1984. Although the act was directed at all federal procurement, the problems posed by the Pentagon's disproportionate share of federal procurement provided the major impetus for the legislation. The goal of the legislation was to promote full and open competition in federal procurement procedures through a number of procedures and requirements.[44] It required all federal agencies to open bidding on contracts to all qualified and interested firms and enforced this requirement.

In 1985, as part of the legislative work on the fiscal 1986 defense authorization bill, reformers championed a long list of reform measures.

The Military Reform Caucus sponsored all of them. Heading the reform agenda were more stringent requirements for competitive contracting, specifically "dual sourcing" and "creeping capitalism." The dual-sourcing amendment required the Pentagon, except under certain circumstances, to seek multiple contractors for both the development and production stages of procurement. Under creeping capitalism, the portion of competitive contracts was to increase by 5 percent each year until the total percentage reached 70 percent. Moreover, the Defense Department would renegotiate contracts on a yearly basis.[45]

The Boxer-Bennett amendment confronted the so-called revolving door problem of personnel transfers from the Pentagon to defense industry and vice versa. In particular, the steady flow of Defense Department employees from government jobs to employment with defense contractors blurred the distinction between public responsibility and private interest. A significant number of Pentagon officials, moreover, left government to work for the very contractor, and even the very same program, over which they had had supervisory and decision-making responsibility. Many thought that this state of affairs also contributed to waste and fraud. The Boxer-Bennett amendment called for strictly supervised limitations on revolving-door employment. It prohibited Pentagon employees from working for contractors over whom they had had significant responsibility for two years after leaving government employment. The legislation also sought to enhance and enforce reporting procedures and penalties for violations.[46]

Under the rubric of "allowable costs," yet another amendment forbid the Defense Department to reimburse costs incurred by contractors for such things as lobbying, legal fees, advertising, entertainment expenses, and other amenities that often found their way into bills that the department would pay. Another compelled the Defense Department to utilize "should-cost studies." These would require contractors to submit data on how their projected costs of production compared with similar operations performed in civilian production. Other proposed legislation required warranties on Pentagon purchases.[47]

The Packard Commission

The wave of acquisition reforms legislated as part of the fiscal 1986 and 1987 defense authorization bills, as well as the growing number of studies condemning defense acquisition and procurement practices, combined with the need to limit the growth of defense spending driven by Gramm-Rudman, and put pressure on the White House to take a stand on defense reform. Reagan responded by convening the President's Blue Ribbon Commission

on Defense Management, better known as the Packard Commission, because of its chair, David Packard, chairman of Hewlett-Packard, a major defense contractor. The commission consisted of Packard, fifteen commissioners, and a staff of thirty-eight divided into sixteen professional and technical staff, two senior consultants, two public affairs specialists, and thirteen administrative staff. The two senior consultants were well known names in defense acquisition: Vincent Puritano, former assistant to Deputy Defense Secretary Frank Carlucci; and Jacques Gansler, future under secretary of Defense for Acquisition and Technology.

Most (eight out of fifteen) of the Packard commissioners were officials formerly with the Office of Secretary of Defense (Frank Carlucci, Dr. William Perry), the services (Lieutenant General Brent Scowcroft, Admiral James Holloway III, General Paul Gorman, General Robert Barrow, R. James Woolsey), or the Reagan cabinet (William P. Clark). The others included a past secretary of Housing and Urban Development (Carla Hills), former legislators (Nicholas Brady, Barber Conable, Jr.), and retired corporate executives (Charles Pilliod, Jr., Louis Cabot), as well as the retired dean of the Stanford Business School (Ernest Arbuckle) and economist Herbert Stein.[48] Clearly not represented were the voices of defense acquisition reform such as the Military Reform Caucus or the Project on Military Procurement. Because a major aim of the Packard Commission was to evaluate defense acquisition, the Acquisition Task Force formed under the direction of Dr. Perry. Its members included Packard, Cabot, Pilliod, Woolsey, and Arbuckle, who passed away while working on the effort.[49]

The Packard Commission released the results of its study in three separate reports published between February and June 1986. The Commission's goal was to study "defense management and organization in its entirety," including "the budget process, the procurement system, legislative oversight, and the organizational and operational arrangements, both formal and informal, among the Office of the Secretary of Defense, the Organization of the Joint Chiefs of Staff, the Unified and Specified Command system, the Military Departments, and the Congress." The four major areas of study were national security planning and budgeting, military organization and command, acquisition organization and procedures, and government-industry accountability.[50]

The Packard Commission blamed Congress for many acquisition woes beginning with the April 1986 *Interim Report*. "Today, there is no rational system whereby the Executive Branch and the Congress reach coherent and enduring agreement on national military strategy, the forces to carry it out, and the funding that should be provided. . . . The absence of such a system contributes substantially to the instability and uncertainty that plague

our defense program. These cause imbalances in our military forces and capabilities, and increase the costs of procuring military equipment."[51]

The Packard Commission recommended that defense acquisition should be run in the same manner as a successful commercial venture. This recommendation was not surprising in light of the Reagan administration's often-stated goal of making government operate in a more business-like manner. The commission delineated the characteristics of a successful business operation: "Short, unambiguous lines of communication among levels of management, small staffs of highly competent professional personnel, an emphasis on innovation and productivity, smart buying practices, and, most importantly, a stable environment of planning and funding." The commission found that federal law governing procurement had become "overwhelmingly complex" and that "responsibility for acquisition policy has become fragmented. There is today no single senior official in the Office of the Secretary of Defense working full time to provide overall supervision of the acquisition system." The result was that "policy responsibility has tended to devolve to the services, where at times it has been exercised without the necessary coordination or uniformity."[52]

The Packard Commission did not wait for its final report to begin making recommendations. The April 1986 *Interim Report* furnished its first set of reform proposals. The first was one already made by the Grace Commission: Create a new position, under secretary of Defense for Acquisition. The Packard Commission went farther, though. It recommended that the Army, Navy, and Air Force each should establish a service acquisition executive position "filled by a top-level civilian presidential appointee." The service acquisition executives in turn would appoint program executive officers (PEO), "each of whom would be responsible for a reasonable and defined number of acquisition programs. Program managers for these programs would be responsible directly to their respective PEO and report *only* to him on program matters."[53]

The Packard *Interim Report* also recommended simplifying and streamlining all federal statutes governing procurement into a single government-wide procurement statute; fully institutionalizing "baselining" for major weapon systems at the initiation of full-scale engineering development; expanding the use of multiyear procurement for high-priority systems; increasing "commercial-style" competition, "relying on inherent market forces instead of governmental intervention"; making greater use of components, systems, and services available "off the shelf"; giving a high priority to building and testing prototype systems and subsystems before proceeding with full-scale development; beginning operational testing early in advanced development and continuing through full-scale

development, using prototype hardware; enhancing the quality of acquisition personnel; and establishing "business-related education and experience criteria for civilian contracting personnel . . . [to] provide a basis for the professionalization of their career paths." The report also suggested having the under secretary of defense (acquisition) and the vice chairman of the Joint Chiefs of Staff co-chair the Joint Requirements Management Board (JRMB). The board would "play an active and important role in all joint programs and in appropriate service programs by defining weapons requirements, selecting programs for development, and providing thereby an early trade-off between cost and performance."[54]

The second Packard Commission report, issued in April 1986, provided, as its title proclaimed, *A Formula for Action*. The report again offered "an acquisition model to emulate," namely, that of "successful programs from private industry," as exemplified by the IBM 360 computer, the Boeing 767, the AT&T telephone switch, and the Hughes communication satellite. The "formula for action" was largely a repackaging of the recommendations set forth in the *Interim Report*. The major change was a greater emphasis on the quality of acquisition personnel. On one hand, the report advised, the Defense Department should "substantially reduce the number of acquisition personnel." Establishing "short, unambiguous lines of authority" from the Defense secretary down to the program managers would "streamline the acquisition process and cut through bureaucratic red tape. This should allow for a substantial reduction in the total number of personnel in the defense acquisition system, to levels that more nearly compare with commercial acquisition counterparts."[55]

On the other hand, the Defense Department needed to "attract and retain the caliber of people necessary for a quality acquisition program." "Compared to its industry counterparts," the defense acquisition workforce was "undertrained, underpaid, and inexperienced. Whatever other changes may be made, it is vitally important to enhance the quality of the defense acquisition work force—both by attracting qualified new personnel and by improving the training and motivation of current personnel." The Packard Commission "strongly" supported the measures undertaken by the Army, Navy, and Air Force to establish "a well-defined acquisition career program for its officers."[56]

It also supported measures already passed by congressional reformers. In 1984, for example, Congress established a minimum four-year tenure for program management assignments. The 1986 Defense Authorization Act prescribed requisite qualifications and training, including at least eight years of acquisition-related experience and appropriate instruction at the Defense Systems Management College (or equivalent training). The

Packard Commission supported these changes and recommended a number of specific changes in civil service regulations regarding the employment of professionals and specialists.[57]

The final Packard Commission report, *A Quest for Excellence*, appeared in June 1986. It again echoed the recommendations of the two previous reports.[58] The title reflected the rising currency of "excellence" and "quality" among U.S. corporate executives who had read, or had been motivated by, such books as *In Search of Excellence* that preached the gospel of Total Quality Management (TQM) in one form or another.[59] The Packard Commission embraced the TQM gospel as a solution to the Defense Department's acquisition woes. "During the last decade or so a new theory of management has evolved," *Quest for Excellence* explained. "These new management practices have resulted in much higher productivity and much higher quality in the products being produced." With the application of Total Quality Management, "productivity and quality become hallmarks of defense acquisition."[60] The concept, however, was not new to the Defense Department or to defense program managers, as a scan of *Program Manager*, a periodical published by the Defense Systems Management College for program managers, reveals.[61]

Implementation and Assessment

Implementation of the Packard Commission's recommendations began shortly after the release of the February 1986 *Interim Report*, with the issuance of National Security Defense Directive 219, "Implementation of the Recommendations of the President's Commission on Defense Management," on 1 April 1986. Implementation, however, appears to have been confined to creating reports. Moreover, Congress, not the defense directive, created the office of under secretary of Defense for Acquisition through the Defense Acquisition Improvement Act of 1986 (PL 99–661). The defense directive assumed the establishment of the office and directed the secretary to issue a directive "outlining the roles, functions, and responsibilities of the Under Secretary of Defense for Acquisition." The key action that the directive mandated was the preparation of additional directives establishing the service acquisition executives. These, in turn, would appoint the program executive officers.

The goal of the office of under secretary of Defense for Acquisition, according to James Woolsey, a member of the Packard Commission's Acquisition Task Force, was to achieve a fundamental or "cultural change" in the way the Pentagon purchased equipment.[62] Instead, the office quickly came to suffer from its own form of the "revolving door" problem.

Almost immediately after passage of the legislation creating the office, President Reagan submitted the name of Richard Godwin, a Bechtel executive and long-time associate of Weinberger. The appointment of someone with "a solid industrial background" was in accordance with the recommendation of the Packard Commission.[63] Godwin assumed his post on 30 September 1986, and resigned one year later, on 30 September 1987. His resignation reflected the Defense Department's reluctance, according to Woolsey, "to move ahead vigorously with implementation of the Packard recommendations." The institution simply "was not prepared to change the status quo." Indeed, he observed, "everybody agreed that these changes were desirable so long as we did not make any change."[64]

Godwin's successor, Robert Costello, a former General Motors Corporation executive, served somewhat longer—a year and five months, from 18 December 1987 to 12 May 1989. By August 1989, when Ford Motor Company Vice President John Betti became the third under secretary for Acquisition in three years, the success of the Packard Commission recommendations and earlier Defense Department reform efforts was less and less clear. For example, a 1989 Senate investigation found that the Defense Department had not increased significantly its use of off-the-shelf or commercial items despite a long history of directives (such as the Carlucci Initiatives) and legislation, including an amendment to the 1987 Defense Authorization Act.[65]

Even earlier, a series of three 1986 Government Accounting Office (GAO) reports criticized the Defense Acquisition Improvement Program. While one report found that the Defense Department had improved its cost and schedule estimating capabilities, it noted that: "DoD has made little progress in stabilizing weapons acquisition programs. DoD still needs to budget more realistically, limit the number of new programs, and eliminate marginal programs." Of the thirty-two Carlucci Initiatives, the Defense Department had implemented fully only ten. "The expected benefits have been fully achieved on four initiatives and partially achieved on the remaining six," the GAO reported. The four initiatives were the reduction of milestones, the establishment of an acquisition council, the creation of a defense acquisition executive, and setting new thresholds for milestone reviews. The GAO also criticized the Defense Department's lack of commitment: "We believe that the initial sense of commitment to the improvement program has dissipated. A strong DoD commitment is particularly crucial to achieving results because the problems being addressed are long-standing and not amenable to ready solutions. . . . We found that, however, the DoD has not carried through with its action plans on most of the program's initiatives, and is not monitoring actions to ensure that results are being achieved."[66]

The GAO report that focused on the views of government and contractor program managers found that, overall, "the Acquisition Improvement Program has made little or no difference in the acquisition process." Although the program had aimed at empowering program managers, about half of the government managers and nearly three-fourths of the industry managers indicated that the government manager's authority was "only marginally adequate to inadequate."[67]

On top of these and other studies of the Reagan administration's efforts to reform the defense acquisition process, not to mention the loss of White House credibility that resulted from the Iran-Contra scandal, came Operation ILL WIND. Ill Wind investigated and revealed extortion, bribery, and kickbacks involving contractors, consultants, and the Defense Department (mostly Navy) officials.[68] The Justice Department investigation involved search warrants and more than 250 subpoenas for documents and evidence on the activities of more than fifty private consultants and more than a dozen defense companies and industry executives, as well as Pentagon officials. Some of the convictions that resulted from the investigation included those of a high-ranking department official for selling his influence for bribes and leaking government information to defense firms bidding on weapons contracts; a consultant for arranging bribery payments to two Defense Department officials; and a large corporation for bribing government officials and conspiring to defraud the government.[69]

With the election of George H. Bush in 1988 came a chance to start military reform with a clean slate. However, his selection of Sen. John Tower, an unrelenting opponent of acquisition reform on the Senate Armed Services Committee, for Defense secretary, and his choice of vice president, Sen. Dan Quayle, who also fought acquisition reform legislation, did not foreshadow a strong reform effort. Nonetheless, President Bush ordered Defense Secretary Dick Cheney to report on implementation of the Packard recommendations as part of a national security review. Cheney concluded on an optimistic note: "While some progress unquestionable has been made since 1986, there is no basis for complacency. On the contrary, redoubled efforts will be required in order to realize improvements to the degree contemplated by the Packard Commission and the Goldwater-Nichols Act. But the progress to date does give cause for hope that the necessary consensus and commitment can be sustained in the coming years."[70]

In hindsight, the perspective of 1989 necessarily was shortsighted, because the future is unforeseeable. History was on the precipice of dramatic events that would create a new world order, to borrow President Bush's expression. Those evaluating the status of defense acquisition reform in 1989 were not aware that the Cold War was about to end. Nor

did they know that the United States and its allies soon would be involved in Operation DESERT STORM. Yet, despite all the changes, the drive to reduce federal spending and to reform the acquisition process would remain constants well into their unforeseeable future.

NOTES

[1] Frank C. Carlucci, *Report of the Secretary of Defense Frank C. Carlucci to the Congress on the Amended FY 1988/FY 1989 Biennial Budget* (Washington, D.C.: GPO, 18 February 1988), 3.

[2] Paul E. Ceruzzi, *A History of Modern Computing* (Cambridge: MIT Press, 1998), 268–73.

[3] American Enterprise Institute for Public Policy Research, *The Candidates 1980: Where They Stand* (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1980), 66–72.

[4] Caspar Weinberger, *Report of the Secretary of Defense to the Congress* (Washington, D.C.: GPO, 1 February 1984), 100, hereafter cited as Weinberger, 1984.

[5] Vincent Puritano, "Getting Ourselves Together on Systems Acquisition," *Defense '81* (October 1981): 9.

[6] Carlucci, Memorandum, "Improving the Defense Acquisition System and Reducing System Costs," March 2, 1981, 59–60, in Puritano and Paul J. Berenson, *Improving the Defense Acquisition System and Reducing System Costs* (Washington, D.C.: Office of the Secretary of Defense, 30 March 1981).

[7] Puritano and Berenson, *Improving the Defense Acquisition System*, 2, 72. The names of the members of the five teams are on 72.

[8] Joe Ferrara, "DoD's 5000 Documents: Evolution and Change in Defense Acquisition Policy," *Acquisition Review* (Fall 1996): 118–19.

[9] Weinberger, *Annual Report to the Congress, Fiscal Year 1983* (Washington, D.C.: GPO, 8 February 1982), III-138.

[10] Weinberger, 1984, 100–101.

[11] Weinberger, *Report of the Secretary of Defense to the Congress* (Washington, D.C.: GPO, 1 February 1983), 79–80.

[12] David D. Acker, "'Reform 88': A Six-Year Program To Reduce Cost with a Target of 1988," *Program Manager* 13 (January–February 1984): 41; [Acker], "A Program to Improve Administration and Management in the Federal Government," *Program Manager* 12 (January–February 1983): 10. A search of several library catalogs has failed to reveal any reports on the results of Reform 88 either under the authorship of Martha Hesse, the Cabinet Council on Management and Administration, or the President's Task Force on Management Reform.

[13] Acker, "'Reform 88': A Program to Improve Government Operations," *Program Manager* 12 (March–April 1983): 44; Acker, "'Reform 88': A Six-Year Program To Reduce Cost with a Target of 1988," 39–40.

[14] Lieutenant Colonel Alan W. Beck, "FAR Is Near! New Federal Acquisition Regulations for 1984," *Program Manager* 12 (September–October 1983): 26; Acker, "'Reform 88': A Six-Year Program To Reduce Cost with a Target of 1988," 40.

[15] Beck, "FAR Is Near!" 26.

[16] Acker, "'Reform 88': A Six-Year Program To Reduce Cost with a Target of 1988," 40.

[17] Executive Order 12369, "President's Private Sector Survey on Cost Control in the Federal Government," 30 June 1982.

[18] Preface, in *President's Private Sector Survey on Cost Control: Task Force Report on the Office of the Secretary of Defense* (Washington, D.C.: GPO, 1983), hereafter cited as *OSD Task Force Report*. Vol. 1–2, bound together, formed the final summary report presented to President Reagan. The two-volume final summary appears to have been published as J. Peter Grace, *War and Waste: President's Private Sector Survey on Cost Control* (New York: Macmillan, 1984). Executive summaries for all task force reports appear on pages 407–531. Also relevant is Grace, *Burning Money: The Waste of Your Tax Dollars* (New York: Macmillan, 1984).

[19] OSD task force members are listed in *OSD Task Force Report*, 345–49.

[20] *OSD Task Force Report*, 338; Letter, OSD Task Force co-chairs to J. Peter Grace, in ibid.

[21] *OSD Task Force Report*, vi, ii.

[22] Ibid., iii.

[23] Ibid., ii, 3.

[24] Ibid., vi, 37, 198.

[25] Ibid., 146–47, 150, 156, 165, 171, 178, 189.

[26] Ibid., vi, 37–38.

[27] Ibid., 38.

[28] On Goldwater-Nichols, see Dennis J. Quinn, *The Goldwater-Nichols DoD Reorganization Act: A Ten-Year Retrospective* (Washington, D.C.: National Defense University, 1999). I have omitted any discussion of Goldwater-Nichols from this paper, as it essentially impacted acquisition only indirectly, that is, through the requirements process.

[29] In Randall Fitzgerald and Gerald Lipson, *Porkbarrel: The Unexpurgated Grace Commission Story of Congressional Profligacy* (Washington, D.C.: Cato Institute, 1984), the authors used the Grace Commission reports to attack Congress for interfering with the Executive Branch. A more balanced, albeit limited, study of the Grace Commission, is Charles H. Levine, ed. *The Unfinished Agenda for Civil Service Reform:*

Implications of the Grace Commission Report (Washington, D.C.: Brookings Institution, 1985).

[30] *OSD Task Force Report*, vi.

[31] Gary Hart with William S. Lind, *America Can Win: The Case for Military Reform* (Bethesda: Adler & Adler, 1986), ix–xi, 9–11. On maneuver warfare, see William S. Lind, ed., *Maneuver Warfare Handbook* (Boulder, Colo.: Westview Press, 1985); and Richard D. Hooker, Jr., ed., *Maneuver Warfare: An Anthology* (Novatio, Calif.: Presidio Press, 1993).

[32] Daniel Wirls, *Buildup: The Politics of Defense in the Reagan Era* (Ithaca: Cornell University Press, 1992), 171, 177. See Dina Rasor, *More Bucks, Less Bang: How the Pentagon Buys Ineffective Weapons* (Washington, D.C.: Fund for Constitutional Government, 1983), for attacks on specific weapons systems. I have relied extensively on Wirls for the Military Reform Caucus as it is the only source to treat it in any systematic fashion.

[33] Wirls, *Buildup*, 171.

[34] Ibid., 95–97; A. Ernest Fitzgerald, *The Pentagonists: An Insider's View of Waste, Mismanagement, and Fraud in Defense Spending* (Boston: Houghton Mifflin: 1989), 150–54. For background on the founding of the Project on Military Procurement, see ibid., 130–32. Also useful is Dina Rasor, *The Pentagon Underground* (New York: Times Books, 1985).

[35] Donna Martin, *Defense Procurement Information Papers: Campaign '84* (Washington, D.C.: Project on Military Procurement, 1984), 23–26; Wirls, *Buildup*, 98.

[36] Quoted in "House Accord May Clear Way For Vote on Defense Measure," *Congressional Quarterly Weekly Report*, 14 September 1985, 1799.

[37] "SECDEF Weinberger's 10-Point Program to Fight Price Abuse," *Program Manager* 13 (July–August 1984): 30.

[38] Weinberger, 1984, 104.

[39] Ibid., 105; Weinberger, *Report of the Secretary of Defense to the Congress* (Washington, D.C.: GPO, 4 February 1985), 87–90.

[40] Weinberger, *Report of the Secretary of Defense to the Congress* (Washington, D.C.: GPO, 5 February 1986), 107.

[41] Wirls, *Buildup*, 182, 184.

[42] Martin, *Defense Procurement Information Papers*, 95–99. On the Defense Department's reluctance to implement the legislation, see Michael R. Gordon, "Help Wanted in Weapons Testing Office But Pentagon Slow To Fill Top Job," *National Journal* 14 October 1984, 1914–17.

[43] Wirls, *Buildup*, 177.

[44] See Andrew Mayer, *The Competition in Contracting Act*, Congressional Research Service, Report No. 85-115F, 14 May 1985; and

Curtis L. Coy, "The Competition in Contracting Act of 1984" (M.A. thesis, Naval Postgraduate School, June 1986).

[45] Wirls, *Buildup*, 179.

[46] Ibid., 180; Martin, *Defense Procurement Information Papers*, 79–90.

[47] Wirls, *Buildup*, 180; Martin, *Defense Procurement Information Papers*, 31–36, 79–90.

[48] President's Blue Ribbon Commission on Defense Management, *An Interim Report to the President* (Washington, D.C.: The Commission, 28 February 1986), 25–26; hereafter cited as *Interim Report.*

[49] President's Blue Ribbon Commission on Defense Management, *A Formula for Action* (April 1986), 1; President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence* (June 1986), 41; hereafter cited as *Formula* and *Quest*, respectively.

[50] *Interim Report*, 1, 3.

[51] Ibid., 5.

[52] Ibid., 13–14.

[53] Ibid., 16.

[54] Ibid., 16–18.

[55] *Formula*, 11, 17–18.

[56] Ibid., 27–28.

[57] Ibid., 28–30.

[58] The chief additional recommendations related to rights to technical data and industrial mobilization. *Quest*, 41, 64–65, 70–71.

[59] See, for example, Thomas J. Peters and Robert H. Waterman, Jr., *In Search of Excellence: Lessons from America's Best-Run Companies* (New York: Harper & Row, 1982).

[60] *Quest*, 41–42.

[61] Some examples are: Lieutenant Colonel Daniel G. Robinson, "Quality Circles: Are They Good for the American System?" *Program Manager* 11 (January–February 1982): 9–12; and Patricia A. Kelley, "Searching for Excellence in the Program Office," *Program Manager* 13 (July–August 1984): 20–25.

[62] U.S. House, Committee on Armed Services, *Report on the Duties and Authority of the Under Secretary of Defense (Acquisition)*, 100th Cong., 1st sess., 16 November 1987, 3.

[63] *Interim Report*, 16.

[64] *Report on the Duties and Authority of the Under Secretary of Defense (Acquisition)*, 1, 35.

[65] U.S. Senate, Committee on Governmental Affairs, Subcommittee on Oversight of Government Management, *DoD's Inadequate Use of Off-the-Shelf Items*, 101st Cong., 1st sess., 30 October 1989.

[66] United States General Accounting Office, *Acquisition: DoD's Defense Acquisition Improvement Program: A Status Report*, GAO/NSIAD-86-148 (Washington, D.C.: GPO, July 1986), 1, 2, 13; GAO, *Acquisition: Status of the Defense Acquisition Improvement Program's 33 Initiatives*, GAO/NSIAD-86-178BR (Washington, D.C.: GPO, September 1986), 2.

[67] GAO, *Acquisition: DoD's Acquisition Improvement Program: Program Manager's Views*, GAO/NSIAD-86-193FS (Washington, D.C.: GPO, September 1986), 1.

[68] Andy Pasztor, *When the Pentagon Was for Sale: Inside America's Biggest Defense Scandal* (New York: Scribner, 1995), discusses Operation Ill Wind in detail, from the perspective of a journalist who covered the investigation. See, also, chapter 16, "Operation Ill Wind," in Fitzgerald, *Pentagonists*.

[69] GAO, *High-Risk Series: Defense Weapons Systems Acquisition*, Report GAO/HR-93-7 (Washington, D.C.: GPO, December 1992), 11.

[70] Dick Cheney, *Defense Management: Report to the President* (Washington, D.C.: Department of Defense, July 1989), I, 1.

The Strategic Defense Initiative and Acquisition Reform: The Case of Brilliant Pebbles

Donald R. Baucom

The military-industrial complex does not appear to be a rogue elephant crashing through the jungle in whatever direction it pleases. Instead, it appears that this behemoth must be kicked and prodded onto another path. And, once there, it may come crashing back to the path with which it is more familiar.

Erik Pratt,
Selling Strategic Defense, 1990.[1]

Introduction

In *Selling Strategic Defense*, Professor Erik Pratt tells us that the so-called military-industrial complex is similar to a dull beast plodding along in well-worn ruts. Only by kicking and prodding it can we force it onto a new course; and even if we succeed in changing its path, we must be constantly on guard lest the indolent creature return to its old ways. The case of the Brilliant Pebbles program suggests that something very similar might be said about the defense acquisition process.

Brilliant Pebbles, or BP, was a concept for a space-based, antimissile interceptor that was part of the Strategic Defense Initiative (SDI) launched by President Ronald Reagan on 23 March 1983. Compared to traditional military space acquisitions, BP was a radically different program. Instead of being built with components designed to rigorous military specifications for space-qualified systems, it was to be fashioned largely from off-the-shelf, commercial quality components similar to those found in camcorders and desktop computers. Furthermore, in an effort to foster a spirit of partnership that would encourage innovation, program managers relied upon contractual arrangements that were more cooperative than legalistic.

The man most responsible for developing this revolutionary acquisition strategy was Lt. General George L. Monahan, Jr., U.S. Air Force, director of the Strategic Defense Initiative Organization (SDIO), which had been chartered in April 1984 to manage the SDI program. Although his plan to eschew military specifications was firmly rooted in acquisition reform efforts of the 1980s, it met with a tepid response from the Department of Defense (DoD) acquisition staff. Furthermore, as Monahan and his successor continued pushing an innovative acquisition strategy that would also have been largely free of the constraints of DoD oversight, the defense acquisition staff steadily asserted its authority over the entire SDI program through measures that could be justified using the same reform literature that had inspired the Brilliant Pebbles acquisition strategy.

This odd turn of events flowed from the schizoid character of acquisition reform reports. On the one hand, those preparing the reports seemed inspired by the direct lines of authority and freewheeling environment that had prevailed in successful developmental organizations like Kelly Johnson's legendary Skunk Works.[2] On the other, they were committed to following sound, standard practices that could only be propagated and implemented by a strong, centralized acquisition authority. The conflict between these two poles is a strong underlying theme in the following story of SDIO's efforts to acquire the Brilliant Pebbles interceptor.

The Advent of Brilliant Pebbles

The first director of the SDI Organization was Air Force Lt. Gen. James A. Abrahamson. Under his leadership, the SDI program was focused almost exclusively on research and development for its first two and a half years.

By the end of 1986, progress in the program had convinced the secretary of Defense and President Reagan that SDI had advanced sufficiently to warrant taking the first step toward the deployment of missile defenses: they directed SDIO to submit a missile defense system concept for review by the Defense Acquisition Board (DAB). This concept was known as the Strategic Defense System (SDS) Phase I Architecture and was designed to meet the missile defense requirements established by a 23 June 1987 memorandum from the Joint Chiefs of Staff.

During June and July 1987, the DAB reviewed the SDS Phase I Architecture and recommended that its six component systems be authorized to proceed into the demonstration and validation phase. These six original elements were the boost surveillance and tracking system, the space-based interceptor (SBI), the battle management/command and control and communications system, the space-based surveillance and tracking system,

the ground-based surveillance and tracking system, and the exoatmospheric reentry vehicle interceptor system. When combined in accordance with the architectural concept, these elements would form a multi-tiered defense that could attack Soviet missiles and warheads throughout their flight. On 18 September 1987, Secretary of Defense Caspar Weinberger approved the DAB's recommendations.[3]

It was soon apparent that the original Phase I Architecture had two major deficiencies: It was too costly, and its space-based elements were vulnerable to attack by Soviet antisatellite systems (ASATs). The focus of vulnerability was the space-based interceptor, which was to be, in essence, an orbital garage housing a number of interceptor missiles. If a single Soviet ASAT could destroy an SBI, it would achieve a highly advantageous kill ratio by destroying multiple interceptors with one shot.

A possible answer to these problems had begun to emerge several months before the 1987 DAB review. In November 1986, Edward Teller and his protege Dr. Lowell H. Wood, Jr., a scientist at Lawrence Livermore National Laboratory, had breakfast in Cambridge, Massachusetts, with Dr. Gregory H. Canavan of the Los Alamos National Laboratory. During the course of their conversation, Canavan suggested that the problems of vulnerability and cost associated with space-based missile defense systems might be overcome by developing small, autonomous interceptors whose sensors and powerful miniature computers would allow them to operate with little or no support from other satellites. Inspired by Canavan's suggestion, Wood developed the concept for Brilliant Pebbles.[4]

Wood briefed General Abrahamson on an early version of BP on 24 February 1987. This was a "stand-alone, 'un-garaged' interceptor" that weighed ten to twenty-five kilograms. This small size, Wood thought, would allow the interceptors to be placed in low earth orbit by a "laser propulsion system."[5] In October, the full-blown BP concept was briefed to Abrahamson.[6]

By the time of his retirement from the Air Force at the end of January 1989, Abrahamson had become a strong supporter of the Brilliant Pebbles concept. In his final report on the SDI program, General Abrahamson stated: "This concept should be tested within the next two years and, if aggressively pursued, could be ready for initial deployment within five years."[7]

On 9 February 1989, a few days after Abrahamson's retirement, President George Herbert Walker Bush delivered his State of the Union address. Here, he told Congress that he was

> charging the Department of Defense with the task of developing a plan to improve the defense procurement process and management of the Pentagon, one which will fully implement the Packard commission report. Many of these changes can only be made with the participation of the Congress, and so, I ask for your help. We need

fewer regulations. We need less bureaucracy. We need multiyear procurement and two-year budgeting. And frankly—and don't take this wrong—we need less congressional micromanagement of our nation's military policy.[8]

Acquisition Reform: Mixed Signals

The recommendations of the Packard Commission of which Bush spoke were contained in the commission's final report, *Quest for Excellence* (June 1986), which had concluded that the defense acquisition process was fundamentally broken.

All of our analysis leads us unequivocally to the conclusions that the defense acquisition system has basic problems that must be corrected. These problems are deeply entrenched and have developed over several decades from an increasingly bureaucratic and overregulated process. As a result, all too many of our weapons systems cost too much, take too long to develop, and, by the time they are fielded, incorporate obsolete technology.

Such a situation could not be resolved through the application of a few management Band-aids, but rather required fundamental, institutional change, including the application of the concepts that collectively came to be known as Total Quality Management (TQM).[9]

In spite of its clarion call for acquisition reform, the Packard report displays a degree of ambivalence in its recommendations. While lauding the decentralization of authority that was a hallmark of TQM, the report also called for establishing the position of under secretary of Defense for Acquisition. This official was to set acquisition policy and oversee the acquisition process. Furthermore, while the report advocates streamlining the acquisition process, this would have entailed essentially recognizing three separate service acquisition fiefdoms in which program managers (PMs) reported through program executive officers (PEOs) to service acquisition executives, who in turn answered to the defense acquisition executive.[10] Such short lines of communication might promise the PM quick access to top acquisition decision makers, but would also invite top-level meddling in program management. It was recommendations such as these that the Bush administration was now expecting the Defense Department to implement fully.

To guide DoD in its implementation efforts, on 25 February 1989, President Bush issued National Security Review 11, which directed the secretary of Defense to review existing management practices and make recommendations to improve the Pentagon's ability to implement the reform proposals contained in the Packard Commission report. This was to entail an examination of DoD's personnel and organizational structures, defense

planning, acquisition practices and procedures, and government-industry accountability. Where acquisition was concerned, NSR–11 directed the responsible defense authorities to:

• Define the appropriate role of the under secretary of Defense for Acquisition.

• Streamline the acquisition management chain.

• Examine "the number of layers, multiplicity of reviews, and specific advocates who intervene in the acquisition process and limit the ability of the program manager to function efficiently."

• Seek "ways to return authority and responsibility to the designated managers."

• "Identify improvements in the process for defining military needs."

• Consider "civilian participation in the process of defining requirements and system specifications."

• "Look for ways to make off-the-shelf systems and subsystems the first choice of program managers."

• Work "to streamline the use of detailed military specifications."

Recommendations based on this review were to be submitted to the president by 10 May 1989.[11]

In response to NSR–11, Secretary of Defense Dick Cheney instituted the Defense Management Review (DMR), the results of which he reported to the president on 12 June 1989. The DMR's principal recommendations were presented in the three main sections of the Cheney report. The Management Framework section stated that the Pentagon's acquisition management structure was basically sound and delineated the responsibilities of DoD's major officials and agencies with regard to the acquisition process. The DMR noted that the under secretary of Defense for Acquisition (USD(A)) must be responsible for policy, administration, oversight and supervision of acquisition matters, exercising his authority primarily through the Defense Acquisition Board.[12]

Yet, where the DAB was concerned, the reviewers seemed to be of two minds. On the one hand, the report called for the DAB to be streamlined by reducing its membership and curtailing the number of people serving on its standing and ad hoc committees. On the other, the report noted that the DAB should "rigorously oversee major systems acquisition, to ensure that the acquisition process is managed in a manner consistent with DoD policy." This policy was to "define minimum required accomplishments, and permit additional program-specific exit criteria to be established by the USD(A), at each Milestone in a system's life." Overall, DAB reviews were to be the critical means through which the USD(A) controlled the acquisition process. In the words of the DMR report: "The paramount objective of the

USD(A) will be to discipline the acquisition system through review of major programs by the DAB."[13]

To assist the USD(A) with his daunting management oversight tasks, the DMR report proposed strengthening his hand by making him "a key advisor to the secretary and deputy secretary on resource decisions affecting acquisition program baselines, including the cost, schedule and performance of all major systems." It also called for the Joint Requirements Oversight Council to "assume a broader role in the threshold articulation of military needs and the validation of performance goals and baselines for all DAB programs at their successive milestones."[14]

The DMR's more specific recommendations for fully implementing the acquisition management reforms advocated by the Packard Commission were contained in the "Defense Acquisition" section of the Cheney report, which detailed the characteristics of successful acquisition management as described in the Packard report. These were:

• "Clear Command Channels," which referred to the "clear alignment of responsibility and authority, preserved and promoted through short, unambiguous chains of command to the most senior decision makers."

• "Program Stability," which concerned funding and management, was to be achieved through the establishment of baseline figures for "cost, schedule, and performance."

• "Limited Reporting Requirements," which would be achieved by adhering to "the principle of 'management by exception'" that focused on "deviations from the agreed baseline."

• "Small, High Quality Staffs."

• "Communications with Users" to assure adequate understanding of their requirements so that cost, schedule, and performance can be appropriately balanced.

• "Better System Development" to ensure that problems are discovered and corrected before production begins. This should include "investing in a strong technology base that emphasizes lower-cost approaches to building capable weapon systems, greater reliance on commercial products, and increased use of commercial-style competition."[15]

Under the concepts advanced by the DMR, clear command channels were to be achieved by establishing lines of authority and responsibility that flowed down from the USD(A) through "experienced, full-time" service acquisition executives (SAEs), who administered service programs "within policy guidance from the USD(A)." From the SAE, authority and responsibility flowed down through program executive officers (PEOs), who were key middle managers responsible to the SAEs for defined and limited groups of major programs, to individual program managers, who

were "vested with broad responsibility for and commensurate authority over major programs." The goal was to "confine management accountability within this greatly streamlined chain of command, which was intended to capture all cost, schedule and performance features of all major programs."[16]

The authority of the SAE was enhanced by giving him a voice in the selection of the PEOs. The SAE was also responsible for evaluating the PEO's performance. The PEO and SAE were then responsible for selecting PMs and evaluating their performance.[17]

The OSD-service acquisition structure outlined above promised to streamline and strengthen the management of major systems acquisition within the military departments by fixing responsibility and defining authorities more clearly so as to sharpen accountability. At the same time, it "should help relieve PMs of requirements for repetitive reviews by and reports to service command layers" and help eliminate "duplicative or unnecessary functions and management layers." The elimination of these unnecessary reviews and functions should facilitate substantial reductions in overall staffing, which was a facet of what the Packard Commission meant by streamlining. Furthermore, the Cheney report expected "streamlining of substantial magnitude" to result from the application of Packard Commission reforms to service acquisition processes.[18]

Another expected outcome of acquisition reform was reduced reporting requirements. The Packard Commission, as well as several earlier reviews of the defense acquisition process, had found that "the system is encumbered by overly detailed, confusing, and sometimes contradictory laws, regulations directives, instructions, policy memoranda, and other guidance." As a result,

> little room now remains for individual judgment and creativity of the sort on which the most successful industrial management increasingly relies to achieve higher levels of productivity and lower costs. Much of this stifling burden is a consequence of legislative enactments, and urgently requires attention by Congress. Much also has been administratively imposed and requires prompt corrective action by DoD.[19]

To reduce the administrative burden that DoD had imposed on its own acquisition activities, Secretary Cheney directed the establishment of a "joint OSD-services task force to conduct a zero-based review" of acquisition guidance from the Defense Department and the military services. Chartered by the USD(A), this task force was to have a

> strong presumption against retention or duplication of guidance, absent a clear and compelling need. The burden of establishing such a need will be placed on the proponent of the guidance in question. Special scrutiny will be given to guidance that imposes or occasions unnecessary costs in the acquisition process; that inhibits the implementation of sound procurement policies such as "best value" competitive

practices and the buying of commercially-available products; that more narrowly confines the discretion of working levels than is required by law or sound management control; and that imposes unnecessary reports and review on program offices and contractors.[20]

The Cheney report went on to say that an integral part of the "concept of limited reporting and review requirements is the principle of management by exception—i.e., intervention by senior management only at milestone intervals, in response to a PM's request, or in the event that a program encounters substantial problems in meeting its baseline."[21]

Cheney's submission of the DMR report to President Bush came as SDIO was exploring the viability of the Brilliant Pebbles interceptor concept. This timing assured that the DMR's recommendations would loom large in the mind of the agency's new director when he began to shape the BP acquisition strategy.

Monahan's Initiative: Brilliant Pebbles and Acquisition Reform

Like his predecessor, James Abrahamson, the second SDIO Director, George L. Monahan, Jr., was an Air Force lieutenant general. Born in Minneapolis, Minnesota, in 1933, he graduated from West Point in 1955 and later earned a master's degree in electrical engineering from the University of New Hampshire. A fighter pilot with more than 3,500 flying hours, he flew 122 combat missions in Vietnam, including seventy-five missions over North Vietnam. As a senior officer he had served in several important posts, including system program director for the F–16 multinational fighter program, vice commander of the Air Force Systems Command, and principal deputy assistant secretary of the Air Force for Acquisition.[22]

During Monahan's first year as SDIO director, analyses indicated that Brilliant Pebbles could resolve the cost and vulnerability problems of the Phase I architecture. Small and dispersed throughout large areas of space, the Pebbles would be difficult targets for Soviet ASATs. Even if an ASAT struck a Pebble, it would destroy only a single interceptor, a simple one-for-one exchange ratio.

Regarding cost reductions, since BP interceptors were self-contained, they did not require the support of the large, vulnerable, and expensive garage that was a hallmark of the space-based interceptor. Further cost reductions were to be achieved by mass-producing the Pebbles and eliminating one and perhaps both of the original architecture's two space-based sensors.

Once it was clear that Brilliant Pebbles should be integrated into the architecture, the next step was to develop an appropriate acquisition strategy.

Here, SDIO was fortunate to have at its helm an officer with General Monahan's knowledge of the acquisition process. He had worked in the acquisition field since 1972 and was well versed in its esoterica. Furthermore, Monahan had ample incentive to push for a streamlined acquisition process as called for by the Packard Commission and the DMR, for managing the acquisition of the SDS Phase I Architecture with its original six major defense acquisition programs (MDAPS) had become a heavy burden for SDIO. Since Brilliant Pebbles was rapidly becoming the key element in one of DoD's most critical programs, Monahan might have sufficient leverage to convince the Defense Department to make the BP program a flagship program for acquisition reform. But before he could ask for more authority and autonomy from DoD, the general had to shore up his organization.

The SDI organization that Monahan took over was geared primarily for managing an R&D program, rather than for acquisition management. As a result, the general immediately began securing the expertise needed to manage the various architectural elements through the acquisition process. He also established a program control office and pursued the system engineering expertise required to support the overall SDI architecture and its major components.[23]

By the fall of 1989, the results of the various studies of Brilliant Pebbles were leaking out, making it increasingly apparent to Monahan that he would soon have to secure DAB approval for significant changes to the SDS architecture. On 20 September 1989, as SDIO's Space-Based Architecture Study was nearing completion, General Monahan advised USD(A) John Betti that he would be prepared to present the study's recommendation on the architecture to the Defense Acquisition Board that was scheduled for 12 December 1989.[24] During the first week of October, Betti agreed to this review, but set the date for 11 December. At the same time, he advised Monahan to be prepared for another DAB review in the spring of 1990, at which time SDIO would be expected to present the "Baseline for the Phase I Strategic Defense System."[25]

The results of the Space-Based Architecture study were briefed on 27 November 1989 to OSD's Strategic Systems Committee (SSC). About a week later, Dr. George R. Schneiter, chairman of the SSC, advised Betti that the BP concept seemed "to be an attractive alternative for the space-based interceptor." Schneiter noted that SDIO had recommended "pursuing Brilliant Pebbles, retaining a down-scoped effort on other SBI concepts for one to two years, and revising the Space Surveillance and Tracking system." He then stated that his committee agreed with "SDIO's general acquisition approach for the space-based elements." However, the SSC recommended that SDIO complete "additional architectural trade studies to further refine

the ground- and space-layers" of the architecture. Finally, the SSC agreed to continue planning for the 11 December DAB review, which was to review the SDI program in the context of the funding guidance of National Security Directive 14. Should the funding profile advanced in this directive be altered significantly prior to 11 December, Schneiter wrote, the DAB review should be slipped to January 1990 to allow SDIO time to prepare a modified plan for the program.[26]

In fact, the 11 December DAB review was canceled, leaving several important issues unresolved. For one thing, General Monahan was eager to proceed with the Brilliant Pebbles program and had hoped to secure the DAB's approval for proceeding with a concept definition study. The aerospace companies working on missile defense programs knew that the BP concept study was in the offing and were very interested in the project. As a result, Monahan was concerned that if the announcement of the contract were not promptly published in the Commerce Daily Bulletin, sensitive contract information might leak out. If that happened, bidders who failed to win a contract might have grounds for protesting that the competition had been unfair. [27]

In response to these concerns, and because of the delays in scheduling a DAB review, DoD told General Monahan that he could proceed with his plans for managing the Brilliant Pebbles program.[28] On 24 January 1990, the BP announcement for the Commerce Daily Bulletin was released. The next day, Monahan established the Brilliant Pebbles Task Force under Colonel Rowland (Rhip) H. Worrell, who reported directly to the Deputy for Projects, Dr. James Carlson. In addition to the nine people assigned to the Task Force, General Monahan instituted a management matrix that identified people in other offices who were to support the Task Force. By June of 1990, the full-time staff of the Task Force was expected to reach fifteen, with eleven coming from within SDIO.[29] Monahan planned to use his Brilliant Pebbles Task Force as the keystone in an innovative approach to managing the development and acquisition of BP.

In December 1989, Monahan launched his management initiative by proposing to Under Secretary Betti that they work together to reform the acquisition system. In Monahan's view (expressed in a memorandum to Betti), the main problems with the acquisition process stemmed from intrusions into program management that were invited by the application of military specifications in the various programs and by the set of forty reports that was required each time the DAB reviewed a program. In Monahan's words:

> One of the problems is similar to that regarding military specifications and standards (wherein we tend to automatically impose them without regard to tailoring).

For every mil spec or standard, there is an engineer or engineering activity somewhere that is advocate/zealot/champion/guardian that seeks to ensure continued application. I tend to think the same is true with DAB documents.

He then argued that the answer to these problems was to apply the principles of Total Quality Management. "The DAB regulations and procedures," Monahan stated, had "been prepared under the system of Pentagon-wide 'coordination' that allows every advocate/zealot/champion/guardian to get his oar in the water. The result is burdens that are laid on without much consideration as to whether or not they are worth it." Monahan argued that he could overcome this difficulty by establishing a process action team (PAT) with a carefully screened membership to provide DAB-type oversight of programs. "Under the PAT approach," Monahan said, "burdens would have to fight their way in."[30]

Six months passed before Betti mounted a significant effort to resolve the problems Monahan had identified in his memorandum. In the meantime, the SDIO director pursued innovations to the extent possible in his management of the BP program. One of the most important developments during this hiatus was the appearance of a report that raised questions about how well SDIO could handle a revolutionary program like Brilliant Pebbles. This report had been prepared by the Brilliant Pebbles Task Force of the Defense Science Board (DSB).

Established in June of 1989 to review and assess Brilliant Pebbles, the DSB BP task force submitted the results of its study to the Secretary of Defense at the end of December 1989. The task force found considerable merit in the Brilliant Pebbles concept and concluded that it could have a profound, positive impact on the U.S. missile defense program. However, the panel was skeptical of SDIO's ability to manage the BP acquisition effectively. At that time, the task force noted, SDIO was focused on "the acquisition of one-of-a-kind or few-of-a-kind satellites." As a result, agency might "find it difficult to take advantage" of the efficiencies associated with acquiring the large numbers of systems (several thousand) that might be required if BP were fielded. The DSB task force urged SDIO to "put more real effort into innovative approaches to manufacturing and launch of space-based interceptors, including automated factories, high-rate missile production techniques and facilities, and factory prepackaged launch and payload vehicles."[31]

Beyond the potential problems associated with SDIO's management orientation, the DSB concluded that the agency also suffered from a split personality as a result of having responsibility for both R&D and acquisition programs. These two responsibilities, the DSB report said, "are in competition especially in view of the nature of the existing acquisition

process." Yet, this competition was unnecessary, for there was "no reason why the processes of exploring and getting ready to build cannot go on in parallel." The members of the task force believed that

> there could be at any time a design that could be implemented, i.e., developed and deployed if necessary or desired, and an exploration of alternatives, with a mechanism for getting new and proven ideas into the current design. This is a reasonable approach if clearly delineated, the balance of the activities defined, and the transfer mechanism described. Once a firm decision to develop and deploy is made, the balance would necessarily change, but no such decision is imminent. There is not now a clear direction to SDIO about which of these objectives they are supposed to pursue and if both, as seems likely, the relative emphasis on the two.

The panel called for the secretary of Defense to resolve this ambiguity for the SDIO director.[32]

In the process of distinguishing between building and exploring, the panel noted that DoD "has a process for building things." Though "costly, difficult, lengthy, and often criticized," this process "does get things built." However, the choice to build necessarily involved choices that limited alternatives. And it is here in the limiting of alternatives that the acquisition process had one of its greatest weaknesses.[33]

The DSB report explored at some length the dilemma that routinely faces the program manager. The search for alternative approaches and new technologies always has the potential to produce innovations that can improve the system he is charged with developing. Yet, at some point, the PM must stop the concept development process and fix the system design so he can produce an operational system in time to meet the threat. In the words of the DSB report:

> The DoD does not have an effective process for doing a thorough exploration of alternative technologies and concepts. Exploration is usually done only as a part of the build process, because exploration is expensive and adequate funds are not made available unless a decision to build has been made. The build process, however, tends to shut off exploration, partly to save money and partly to make sure that no new idea will arise to interfere with decisions already made.
>
> Much of the difficulty now being experienced with acquisition stems from setting detailed requirements before adequate exploration has taken place. Lacking the discipline that real knowledge brings to what is doable and how best to do it, these requirements are usually overstated, leading to the delays, overruns, and performance shortfalls that are so common. Perhaps even more serious, the build process fails to take advantage of new ideas and possibilities, both technical and operational. Serious consideration should be given to revising this procedure. We should explore first and then ask whether a buildable system is worth the cost rather than determining what is required first and then struggling to build it, whatever the cost.
>
> This dichotomy is evident in the SDI program. Although the SDI is supposed to be a research and development program, the build model has been applied and has

led to fixing the system design too early before adequate exploration of alternative technologies was completed. The system has been divided into components, component descriptions have been set in concrete (or at least in molasses), and innovation has been thwarted despite efforts to encourage.

Serious consideration should be given to applying the exploratory design approach (of which Brilliant Pebbles is an example) across the SDI, to both the system and the elements. The same approach should be considered for other DOD programs as well. The exploratory approach involves the design by a capable organization with technical depth and experiment resources, operating under a minimum of procedural restraints, and with system specifications not yet fixed.[34]

Most of the views expressed in the DSB report were in consonance with the approach to BP acquisition that General Monahan was already working to implement. This is one reason that Monahan concurred with most of what the DSB recommended. However, when the panel concluded that "the SDI program appears to suffer from a conflict of purpose," Monahan disagreed sharply. "Do not concur," he responded.

I feel that my tasking in SDIO is quite clear as described in NSD-14. We plan to continue the innovative research required to provide exploration into new technologies while simultaneously preparing to support an informed deployment decision and subsequently the building and fielding of a Strategic Defense System.[35]

Even as Monahan reviewed the DSB report, he was working to establish management procedures for the Brilliant Pebbles program that would encourage innovation while simultaneously ensuring that any innovation would produce a system that could become operational in the shortest possible time. Underlying these procedures was the assumption that a contractor would prudently balance innovation with practical production considerations once he understood that he would have to produce the system he developed. During the conceptualization and development stages, flexible specifications would be used to give contractors the freedom they needed to produce creative and economical approaches to developing Brilliant Pebbles. In short, the emphasis would be on telling the contractors what (broadly speaking) they were expected to develop and then giving them the freedom to devise the best system design and the best way to develop and produce it.[36]

In early 1990, Monahan envisioned a four-phased, "horse-race" approach that would efficiently transition the Brilliant Pebbles program from the laboratories to mass-production by industry. This would start with a concept definition phase that would begin in June with the letting of contracts to four contractors or contractor teams. These contracts were to be for $1 million to $2 million each and run until about February 1991. The concepts that emerged from this first phase were to be evaluated

and the best two or three of the four selected. Starting in the fall of 1991, the two or three winning contractors/contractor teams would more fully develop their concepts during a pre-full scale engineering development stage. Monahan anticipated that the request for proposals (RFP) guiding the contractors would continue to be general and be perhaps no more than fifty or sixty pages in length. Of the philosophy behind this relatively brief RFP, Monahan said:

> We will not impose any milspecs or milstandards, the goodness type specs. We will, however, state such things as we want, certain endurance out of a pebble, because they have to remain on orbit for so many years to operate and all that. But we are not going to tell industry how to go about doing that, but rather tell them what we want done. We will leave the how up to them. We are also asking them for any innovations that they would like to recommend regarding pebbles or anything similar to pebbles. . . . I would hope when we finally write the contracts for the pre-FSD phase that our specs in there would be something along the lines of build the hardware substantially in accordance with your proposal. If you want to deviate very much come talk to us.

Monahan believed this approach would allow SDIO to move through the pre-full scale development (FSD) phase much faster than would be the case if the acquisition followed conventional procedures. "We won't have to be stopping and checking every step of the way," he said, "to make sure that they are complying with lots of milspecs and milstandards. It ought to save a lot of paperwork [and] a lot of unnecessary testing."[37]

The full-scale development phase was to begin in 1993. For this phase, the two or three contractors from pre-FSD would be reduced to a single contractor or contractor team, with a possible additional "follower" contractor serving as a backup to assure that there would be at least two sources available when the program entered the production phase. In this phase, military specifications and standards (milspecs and milstandards) would be carefully controlled by SDIO. "The whole point," Monahan said, "would be to make milspecs and standards fight their way into the program. Make sure that we don't mindlessly apply them, but rather [apply them] very judiciously."[38]

Monahan realized that there was some peril in restricting the use of military specifications and standards, but he felt the risk was worth taking. As he put it: "You waive milspecs and milstandards with some peril because those specs and standards were derived from lessons learned. But lessons learned are always in need of review to make sure that they were the right lessons and that the lessons still apply."[39]

In March 1990, Monahan launched BP's concept definition phase with a bidders' conference. About two months later, SDIO awarded $2

million contracts to each of six contractors who were to develop designs for Brilliant Pebbles over the next eight months. These designs were to be based on conceptual work done by Lawrence Livermore National Laboratory (LLNL) and would incorporate the results of tests already completed by SDIO. As Monahan had intended, no military specifications were imposed on the competing contractors. Rather, they were encouraged "to apply innovate design approaches from within the defense industry." Those contractors who participated in the first stage would then be allowed to compete in the follow-on "pre-Full Scale Development Phase."[40] Ultimately, this program was expected to procure 4,614 interceptors.[41]

As Monahan was implementing his BP acquisition strategy, his efforts were bolstered by the recommendations of Ambassador Henry F. Cooper's independent review of SDI, which had been chartered in December 1989 by Secretary of Defense Cheney in accordance with the requirements of President Bush's National Security Directive 14.[42] Submitted on 15 March 1990, Cooper's report noted that the "development of a streamlined acquisition process that allows decision makers clear oversight of a research, development and test effort" was a matter of critical importance. Furthermore, he specifically endorsed Monahan's management approach for the Brilliant Pebbles program and recommended its application to the entire SDI program. As he put the matter, the "Brilliant Pebbles technology and 'development approach' should be applied to other elements of the SDI program, as also was recommended by the Defense Science Board."[43]

Where the specifics of streamlining were concerned, Cooper proposed organizing the Brilliant Pebbles program so as to

> provide the SDIO/LLNL team with maximum flexibility in conceiving, testing, demonstrating and validating concepts that take full advantage of rapidly changing technology which is itself maturing toward an 'on-the-shelf' status. At the same, the competition being fostered for industry would take advantage of results from the LLNL activities (and industry's own expertise, of course) to design, test and demonstrate particular Brilliant Pebbles concepts in a form that could be economically produced in large quantities. The winning contractor (to proceed with full scale development in FY93) would be selected on the basis of the performance and cost characteristics of the Brilliant Pebbles concept that contractor has demonstrated and validated in a dedicated test program, distinct from the LLNL test program … .[44]

One of Cooper's major reasons for pushing a streamlined acquisition process was to expedite the demonstration-validation phase of Brilliant Pebbles, which he praised strongly. Cooper said BP promised to be affordable, cost-effective, and survivable. Moreover, "no technological roadblocks to the Brilliant Pebbles system concept have been identified."[45]

Cooper's report resulted in the generation of several taskings related to streamlining the acquisition process. Included here was a requirement for the director of SDIO to provide the funding in FY1990 and FY 1991

> to support an accelerated schedule for Brilliant Pebbles research, development and testing aimed at exploiting the success of the program to date and supporting the development of a full range of deployment options for the President's consideration. The Director, SDIO within sixty days will prepare a report assessing the degree of risk associated with a program that completes the currently planned Brilliant Pebbles testing in Fiscal Year 1992, and proposing measures to mitigate any risk identified.

Another tasking required the under secretary of Defense for Acquisition to "prepare for approval within 120 days a streamlined process for DAB oversight of SDI."[46] These taskings strengthened Monahan's hand in his continuing efforts to streamline DoD's management of the SDI program.

Within two weeks of the release of the Cooper Report, Dr. George Schneiter, head of the Strategic Systems Committee, discussed with General Monahan a DAB review that would be held in early May. The focus of this session was to be "the Brilliant Pebbles acquisition approach and how the overall SDI program" would "be handled by the DAB." This would include a briefing by SDIO on its "entire Strategic Defense System (SDS), with particular emphasis on the near-term Phase I SDS that has already passed Milestone I as well as the Ground-Based Radar which is awaiting Milestone I approval." SDIO was to include its recommendations on how the SDI program should be handled in the DAB process, "including milestone reviews, program baselines and exit criteria."[47]

In preparation for the formal DAB meeting, the Strategic Systems Committee reviewed the SDI program on 1 and 8 June 1990. The committee again endorsed the SDIO acquisition strategy for Brilliant Pebbles, as it had done in November 1989. The discussions of how SDI should be managed in the DAB process led to the conclusion that the SSC itself should form a working group to examine the issue of decision authority for the Strategic Defense System "system of systems" concept. The objective of this approach would be to "minimize the administrative burden, allow the flexibility for intra-program tradeoffs and continued technical innovation, and provide a disciplined decision-making process."[48]

During the formal DAB review of SDI that took place on 15 June 1990, General Monahan briefed the Board on the Brilliant Pebbles project the context of the overall SDI program. Additionally, he recommended that the ground-based radar be approved for Milestone I and that it be included in SDS Phase I. Monahan's recommendations were accepted by the Strategic Systems Committee and then approved by USD(A) Betti. On 19 June,

Betti authorized Monahan to proceed with the Brilliant Pebbles program as briefed. Betti also directed the chairman of the Strategic Systems Committee to "define within two weeks, the Terms of Reference for a Process Action Team to make recommendations regarding the role of the DAB in the SDI oversight process as well as the DAB process to be applied to the SDS." Among the things the DAB PAT was to recommend was how the phases of the acquisition process were to apply to the "SDS as an overall system."[49]

It is indicative of the problems the acquisition process posed that almost eight months separate Betti's decision on the DAB PAT and Monahan's original suggestion that such a body be established. On 10 August 1990, Betti finally chartered a PAT "to make recommendations regarding the role of the DAB in the SDI oversight process." The PAT was to prepare its proposals in anticipation of a tasking from the secretary of defense to streamline the defense acquisition process. The PAT's objective was "to recommend a specific framework for the orderly and disciplined, yet streamlined, acquisition of the Strategic Defense System (SDS) and its elements."[50] The results of the PAT's work would not become available until November 1991.[51] By this time, SDIO had a new director and was pursuing a new architecture known as Global Protection Against Limited Strikes, or GPALS.

A "Fourteen-Humped Camel": The Frustrations of Reform

In addition to its affirmation of Brilliant Pebbles and BP's role in furthering acquisition reform, the Cooper report of March 1990 laid out a new vision for missile defenses. This vision flowed from Cooper's assessment of the strategic order that was emerging from a growing restiveness within the Soviet Union and the proliferation of ballistic missile technology. There were two major implications of these new strategic realities. First, there would be an increased likelihood of accidental and limited missile attacks against the United States. Second, theater missile attacks against U.S. interests around the globe, including deployed U.S. forces, would be far more likely. Under these conditions, providing protection against limited strikes (PALS) would be of paramount importance. Therefore, the U.S. should refocus its missile defense program on these newer threats.[52]

To meet the requirements of the new strategic order, Cooper envisioned an architecture centered on a space-based system that would provide an overarching missile defense layer. This space-based layer would contribute to both theater defense and defense of the U.S. homeland. Although Cooper considered Brilliant Pebbles the prime candidate for the space-based system,

he qualified this judgment by noting that the exact capability of BP against limited missile attacks, especially those by shorter range missiles, would have to be evaluated.[53]

In July 1990, Cooper became the third SDIO Director, succeeding General Monahan, who had retired from the Air Force at the end of June. By this time, the downward spiral of the Soviet Union was becoming more apparent, lending credence to the strategic view Cooper had expressed in his March 1990 report. It comes as no surprise, then, that this report became the blueprint for Cooper's efforts to institute an SDI architecture more suited to the post-Cold War environment.

Now called GPALS, this new architecture consisted of four major components. One was a ground-based national missile defense system to protect the United States. Another component was a ground- and sea-based system to defend deployed U.S. forces and the forces and peoples of American allies. A third component was a space-based system (Brilliant Pebbles) that could protect any point on the globe against a limited missile attack. These three elements were integrated into a synergistic system by means of the fourth component of the GPALS architecture, its battle management/command and control system.[54]

After receiving a 31 January 1991 briefing on the new concept, President George Bush decided to adopt the GPALS architecture for the SDI program. Announcing the new orientation for the SDI program in his 29 January 1991 State of the Union Address, the president said he had "directed that the SDI program be refocused on providing protection from limited ballistic missile strikes—whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas, and to our friends and allies."[55]

While pushing to gain acceptance for the GPALS concept, Cooper had also been advancing the BP program through the acquisition process in accordance with the streamlined acquisition strategy that General Monahan had laid out with USD(A) John Betti, who remained in office during the first six months of Cooper's tenure. At the end of 1991, Betti resigned his office and was replaced on 1 January 1991 by his deputy, Donald J. Yockey.[56]

Shortly after Yockey assumed his new duties, Cooper initiated the next stage of the BP acquisition strategy. SDIO had hosted a workshop with the BP competitors and used their suggestions in shaping the solicitation for the full-scale development phase of the BP program. By having the competitors contribute to the development of the RFP that was issued on 18 January, Cooper had enlisted them in the effort to streamline the acquisition process, thereby giving them an interest in the successful outcome of the process.[57]

This solicitation invited contractors to compete for two cost-plus-award-fee contracts. It also sought to drive home to the competitors the importance of the project they would be asked to complete. In the words of Cooper's solicitation:

> As you are aware, the Brilliant Pebbles (BP) program is a cornerstone in the overall strategic defense program. The innovation provided by BP miniaturization makes autonomous operations in space possible. BP innovation also offers the potential to provide a survivable system which can be tested, thereby greatly increasing overall system confidence. I have specifically placed great emphasis on the BP program due to its great potential to revolutionize the space based architecture, its near term availability, and its low cost.[58]

In initiating the pre-FSD phase, SDIO emphasized that its goal for the BP program was to acquire an effective interceptor. To accomplish this goal, SDIO established four objectives for the competitors:

- Finalize the Brilliant Pebble system concept.
- Complete the system design.
- Develop and implement a comprehensive risk management/mitigation program.
- Balance performance, producibility, operability, supportibility, affordability, and schedule.[59]

As SDIO implemented the BP acquisition strategy, the acquisition staff in the Office of the Secretary of Defense became concerned that the new acquisition strategy would not provide adequate oversight for the program. Specifically, Dr. George Schneiter believed that the request for proposal for the pre-FSD contract "did not spell out a definitive program, but rather asked the contractors to propose a program that will ensure readiness for full-scale development at the conclusion of the pre-FSD phase." As a result, Schneiter advised the under secretary of Defense for Acquisition that "there should be, at a minimum, a Strategic Systems Committee (and perhaps a DAB) review of the program prior to contract award." Such a review would aim to "ensure that the contracts will in fact provide the wherewithal for Milestone II readiness–that is, that proper attention is given to technical risk management, test and evaluation, logistics and readiness planning, etc." Additionally, Schneiter pointed out, this review would examine program requirements and ensure the existence of a proper program baseline.[60]

In response to Schneiter's advice, USD(A) Yockey directed Ambassador Cooper to develop a Brilliant Pebbles baseline and present it to the Strategic Systems Committee. Based upon the results of this review, Yockey would then determine if a full scale DAB review of the program were in order.[61]

SDIO leaders considered this review a regressive step in the effort to streamline the acquisition process and had opposed it from the outset. Dr. James Carlson, who presented SDIO's position to Schneiter before his recommendation to Yockey was submitted, had argued against the OSD review. When Carlson advised SDIO's Deputy Director, Army Major General Malcolm O'Neill, of Schneiter's views, the general expressed his objections in a hand-written note. Speaking of the contracts that Schneiter felt obligated to oversee, O'Neill said they are "pre-FSD or Dem/Val contracts which are within MS I approval authority of SDIAE."[62]

In keeping with O'Neill's views, SDIO objected to Yockey's call for an SSC review. O'Neill, signing the protesting memorandum for Cooper, noted that the June 1990 DAB had approved SDIO's aggressive management strategy for the BP program. The missile defense agency would provide USD(A) full insight into the contracting process but believed that an SSC review before the contract was let would disrupt the contracting process.

> Of the many options, one previously identified is to hold the review after the SSA [source selection authority] has made a selection and announcement, but prior to contract award. Please be advised that in the interest of streamlining, the period of time between decision and award is less than one week. Our ability to move quickly to award is based upon use of model contracts which permit contract details to be completed as a part of the BAFO [best and final offer] process. Should renegotiations be required based upon the SSC review, the possibility of contract protests can increase dramatically. Specifically, all competitors should have the opportunity to propose against any revised contract requirements.[63]

On the broader matter of streamlining the DAB process, O'Neill noted that "the need for the Defense Acquisition Board to review the entire GPALS program and approve a streamlined acquisition strategy" for the GPALS missile defense capability was of the "utmost concern." This review would focus on "the system as a whole" and include acquisition strategies for both GPALS and its component elements.[64]

SDIO's protest was in vain. On 26 March, Dr. Schneiter issued instructions to interested parties concerning the review of BP that the Strategic Systems Committee was to hold. In doing so, he provided an explanation of how Brilliant Pebbles had entered the SDS Architecture that had been approved by the secretary of Defense in September 1987 and indicated where BP was in the acquisition process. Brilliant Pebbles, he wrote,

> has replaced the Space-Based Interceptor, which has received Milestone I approval along with the rest of the Phase I Strategic Defense System, in the Phase I architecture. No formal Milestone I will be held for BP. Also, because of the Nature of SDI's acquisition approach for BP, many of the system and program details are yet to be determined.

The purpose of the review will be to ensure that the pre-FSD program will provide the wherewithal for Milestone II readiness–that is, that proper attention is given to technical risk management, test and evaluation, logistics and readiness planning, etc. Also, BP requirements, as derived from previous architecture studies, will be reviewed, along with the initial concept baseline.[65]

Schneiter continued in words suggesting less than full agreement with SDIO's aggressive management approach. He realized that full documentation for the SSC review would not be available. Nevertheless, "it is important to begin now both to establish the framework for the program's acquisition discipline (i.e., the baseline) and to establish the schedule and procedure for establishing exit criteria for Milestone II and providing the necessary documentation (e.g., TEMP, cost estimates, etc.)."[66]

Schneiter's memorandum was followed a couple of weeks later by a directive from USD(A) Yockey announcing his intention to "review RFPs and contracts for selected major defense acquisition programs prior to their release or execution." Yockey's memorandum instructed the military services and defense agencies to notify the USD(A)

at least thirty days in advance of your intention to issue an RFP, announce the offeror selected, or award a contract for the demonstration/validation, engineering and manufacturing development, or initial production phases of a major defense acquisition program. In order to ensure that any necessary changes resulting from my review can still be made with minimum disruption, you may not release the RFP, award, or announce the winner of a contract until the completion of my review.[67]

With this directive, DoD's acquisition staff was reasserting its authority and undermining the innovative management approach that Monahan had so hopefully initiated a scant year earlier. Nevertheless, Schneiter's directive could be seen as being in consonance with the DMR's recommendations concerning the central role of the USD(A) in disciplining the defense acquisition process.

On 12 April, SDIO officials, including Colonel Rhip Worrell, BP Program Manager, met with Dr. Schneiter to plan the upcoming SSC review of Brilliant Pebbles. During this review, the SSC would "assess the adequacy of the pre-FSD effort to reach Milestone II readiness in the fifty-month period of performance." In preparation for this SSC review, which was scheduled for 17 May, SDIO would present a series of four briefings to SSC members. These briefings, the first of which was given on 15 April, were to provide committee members with details on the direction, content, and philosophy of the BP program. Excluded from these briefings was any information that was rendered source selection sensitive by the BP contracting process. Since the 17 May review was scheduled after source selection but prior to contract award announcement, SDIO expected to

present at least some of the information excluded from earlier briefings at the 17 May meeting. Included here would be "design and program details based on the selected contractor proposals." To be sure that sensitive issues would not be raised, all questions to be addressed at the meetings were to be submitted in writing and screened by Dr. Bruce Pierce of OSD's Office of the Director of Defense Research and Engineering (DDR&E) and Colonel Worrell. Spelled out in a memorandum from General O'Neill, this process was designed to minimize "the impacts to the BP acquisition process" while providing "a process to address specific issues identified by members of the SSC."[68]

Up to this point, SDIO had been able to proceed with its streamlined approach to BP acquisition and, by spring of 1991, was touting this approach in public releases on Brilliant Pebbles. SDIO claimed that the BP program was following a "different approach to the design process" in which development was not requirements driven. Instead, the emphasis was on "near-term capabilities over exotic future technology" with cost and vehicle weight being closely monitored. This meant that the BP program was being handled through a streamlined acquisition process that sought to "eliminate non-value added activities and maximize the unique contributions of both industry and the national laboratories. The complement of industrial and laboratory partners permits the program to maintain focus on the development of real capabilities while constantly seeking opportunities for innovation."[69]

Lawrence Livermore National Laboratory was a major participant in this process. Its contributions included the development of BP mockups that were used in the proof of principle flight-testing that was already underway. As these tests were verifying the functional validity of the BP concept, LLNL was also developing more advanced component technologies that could be inserted in the BP system as it matured through the development process. Indeed, the development of these advanced technical components was LLNL's major contribution to the BP program.[70]

LLNL's efforts were complemented by the work of the six contractor teams that had been developing competing BP designs based on technological developments produced through LLNL. A "down-select" process was to be used to reduce these six to two in May 1991 in accordance with SDIO's plans for the pre-FSD phase of the BP program. These two contractor teams would continue efforts to refine the BP design until one design was selected in 1995 for full-scale engineering development.[71]

As planned, on 24 May 1991, SDIO announced that it was awarding cost-plus award fee contracts to Martin Marietta Corporation and TRW for the pre-FSD phase of Brilliant Pebbles. The first contract was for

$318,200,122, while the second was for $340,472,577, with both contracts running for fifty months from the date of the announcement. The two competitors were to develop a BP design that balanced "performance with producibility, operability, supportability, affordability, and schedule." Additionally, perhaps reflecting the impact of the intervention of the SSC into BP management, the contractors were to provide "appropriate documentation and demonstration of their design to support a Milestone II decision to proceed into the Full Scale Development phase" of the acquisition process.[72]

The written, formal approval for issuing these two contracts was not signed until 28 May when Yockey issued a memorandum approving the SSC's recommendation that BP's pre-FSD contracts be awarded in accordance with SDIO's plans. In the same memorandum, he approved the initial Brilliant Pebbles concept baseline and advised SDIO that it would be required to meet a DAB review in the fall. For this review the agency would have to provide "a GPALS System Threat Assessment Report incorporating a system level threat and element level countermeasures, which addresses Brilliant Pebbles." Additionally, SDIO was to present updated versions of the following BP documentation: Test and Evaluation Master Plan, Life Cycle Cost Estimate, Acquisition Baseline, Funding Profile, and Independent Cost Estimate for CAIG review. "At the same time," Yockey continued, "you should also provide a Brilliant Pebbles Integrated Program Summary, as well as Brilliant Pebbles performance requirements, which will be derived from JROC [Joint Requirements Oversight Council] -approved requirements documents." Finally, Yockey advised the SDIO director that he was

> directing the chairman of the Strategic Systems Committee to conduct a review of the program after completion of the System Requirements Review process and prior to the initiation of major flight testing. The purpose of that review will be to approve, before making a large commitment to testing, exit criteria for Milestone II and your updated integrated test plans for determining the satisfaction of those exit criteria.[73]

The next day, Yockey advised the JROC that the recent SSC review had found that "there are currently no quantitative requirements for BP as part of Global Protection Against Limited Strikes." He then asked the JROC to "expedite its efforts to validate the operational requirements document (ORD) for SDS Phase I, which contains quantitative operational requirements for protection against limited ballistic attacks." Additionally, the JROC should "validate a Mission Need States and, as soon as possible after submission, the ORDs for Theater Missile Defense." This documentation was required "as soon as possible to support the planned November DAB review of the GPALS program."[74]

In September 1991, the DAB staged an intermediate review of the GPALS program as a precursor to the formal review scheduled for November. This intermediate review, which took place on 12 September 1991, had two principal aims: to select an acquisition strategy for GPALS and to discuss the content and timing of the November DAB. On 20 September, Yockey approved the recommendations that emerged from the review. The key decision here was that the GPALS program should be treated as six separate major defense acquisition programs. These were the battle management, command, control, and communications system; the Global Missile Defense (Brilliant Pebbles); the National Missile Defense (NMD) system; the Upper Tier Missile Defense (UTTMD) system; Patriot; and Corps SAM. Each of these MDAPS was to have an associated operational requirements document. Yockey also called for the submission within two weeks of a white paper on the GPALS management strategy that would reflect the results of the 12 September DAB review. If there were any doubts that the USD(A) and his staff were reasserting their authority over Brilliant Pebbles and GPALS, it should have been eliminated by the following paragraph.

> There will be two DABs before the end of the calendar year. The first DAB will focus on acquisition baselines, associated requirements, and updates to all other GPALS documentation consistent with the White Paper. The acquisition program baselines as prescribed in DODI 5000.2-M shall be submitted for GPALS, GMD, NMD and UTTMD prior to this DAB. DAES [Defense Acquisition Executive Summary] reporting as prescribed in 5000.2-M for these MDAPS will commence ninety days after approval of these baselines. SARs [selected acquisition reports] (as of December 1991) for each of these MDAPs will be submitted no later than February 1992. The second DAB will be a Milestone I for the UTTMD system with its initial elements, which include the Theater High Altitude Area Defense (THAAD) interceptor and the Tactical Missile Defense Ground Based Radar (TMD-GBR). Issues for the UTTMDS DAB will be provided in a separate memorandum.[75]

With this memorandum, Yockey applied standard DOD acquisition directives to the entire GPALS program, including Brilliant Pebbles.

The White Paper on GPALS Acquisition Management that Yockey had called for was promulgated by a 1 November USD(A) memorandum. It had originated earlier as a draft developed by SDIO during the summer and was then circulated through the defense acquisition community for review and comment. The compromise document that resulted from the coordination process was then reviewed by the Strategic Systems Committee in a 25 July meeting. While the version of the White Paper approved by the SSC did not grant SDIO all its points, it did limit to six the number of DAB reviews required for the GPALS program. Since this number could have gone as

high as twelve, and since each review would normally involve something like forty reporting requirements (some of which require a six-month lead time), SDIO's leadership was reasonably pleased with the end result. Still, that the outcome of this process was less than optimal from the perspective of SDIO is suggested by a comment from Dr. Edward Gerry, SDIO's System Architect, who referred to the compromise management approach as a "fourteen-hump camel."[76]

The White Paper indicates that the defense acquisition establishment had recaptured the BP program and reasserted its authority over all major defense acquisitions. Over the months since Monahan and Betti had agreed to use BP as a flagship program for streamlining the acquisition process, OSD's acquisition staff had stripped away the special features that were to have been the hallmarks of the new approach.

Five weeks after the White Paper was issued, the frustrations of program management under the strictures of the acquisition process boiled to the surface. Chafing under the demands of the Strategic and Conventional Systems Committees, on 9 December 1991, Ambassador Cooper fired off to Yockey a four-page memorandum that was backed up by more than fifty pages of supporting documents. Here, Cooper complained about the deficiencies of the acquisition process, noting that there was no evidence in the acquisition bureaucracy of the sense of urgency that both the president and the Congress had expressed where the GPALS program was concerned. He also expressed pique over the cancellation of a DAB review that could have provided the "adult supervision" missing from meetings of the Strategic and Conventional Systems Committees. Cooper's most caustic comment came in response to difficulties he had experienced in trying to move forward with a traveling wave tube (TWT) project that was critical to radar developments. In his words:

> I find it absolutely ludicrous that this so-called oversight process has not only wasted time and money but is now demanding that I budget substantially more funds than what we are confident would support a TWT DEM/VAL program to cover the bureaucracy's collective incompetence in carrying out our decision to compete the family of radars.[77]

In his March 1990 report, Cooper had strongly endorsed the reforms Monahan was pursuing in his efforts to streamline the acquisition process and had himself worked to implement the reforms. The ire Cooper expressed in his 9 December memorandum indicates that Monahan's reform initiative was dead within six months of the general's retirement from the Air Force in June 1990. How could this have happened to an acquisition strategy based on the streamline precepts advanced in the major acquisition reform documents of the eighties?

Conclusion

The reform efforts of the 1980s had culminated in the Defense Management Review of 1989. Reflecting much of what was said in earlier acquisition reform studies such as the report of the Packard Commission, the DMR report attempted to meld together two competing approaches to acquisition management. On the one hand, it talked extensively about the importance of streamlining the acquisition process through actions like maximizing the authority of program managers. On the other, the report insisted that the USD(A) was the key authority in the defense acquisition process and that he had to discipline the process through a rigorous review process exercised through the defense acquisition board.

When SDIO introduced the Brilliant Pebbles project in 1989, it developed an acquisition strategy based on the streamlining tenets that had been advanced in the 1980s reform literature. Nothing less would do for the development of a revolutionary interceptor concept based on off-the-shelf technology and produced through a cooperative arrangement with industry and a national laboratory. However, when SDIO implemented the BP acquisition strategy, that strategy clashed with the efforts of DoD's acquisition management staff, which was itself intent on implementing reforms that would tighten up the management of DoD's acquisition programs. The DoD office prevailed and the acquisition process slipped back into its established, bureaucratic approach to acquisition management.

There would seem to be a lesson here that goes beyond the story of Brilliant Pebbles. Members of the acquisition community are pulled between two paradigms. On the one hand there is the view flowing out of the experience with the Skunk Works that genius should rule. Truly effective, revolutionary systems come most often and most efficiently from freewheeling, developmental hives such as the Skunk Works where individual initiative is encouraged and short lines of authority prevail.

On the other hand, there is the view of the DoD acquisition staff, jaded and bloodied by its battles with service bureaucracies, Congress, and watch-dog groups, including the press. The perspective here is that without proper oversight, acquisition programs are prone to overrun their budgets, deviate from program schedules, and produce weapons that do not live up to the promises of technology. From the viewpoint of the DoD acquisition staff, the value of efficiency and dramatic advances in weaponry must be weighed against freedom from scandal and the avoidance of catastrophic program failures.

Given these competing concerns and the absence of a major national crisis, we are unlikely to see the application of the Skunk Works model to anything other than relatively small black programs.

NOTES

[1] Eric K. Pratt, S*elling Strategic Defense: Interests, Ideologies, and the Arms Race* (Boulder, Colo.: Lynne Rienner Publishers, 1990), 136–37.

[2] Two works on the Skunk Works are Clarence L. "Kelly" Johnson, with Maggie Smith, *Kelly: More Than My Share* (Washington, D.C.: Smithsonian Institute Press, 1985), and Ben R. Rich and Leo Janos, *Skunk Works: A Personal Memoir of My Years at Lockheed* (New York: Little, Brown and Company, 1994).

[3] Department of Defense, Office of Assistant Secretary of Defense (Public Affairs), News Release No. 483–87, "SDI Gains Milestone I Approval," 18 September 1987.

[4] Ralph Kinney Bennett, "Brilliant Pebbles: Amazing New Missile Killer," *Reader's Digest* (September 1989): 128–33; William J. Broad, *Teller's War* (New York: Simon & Schuster, 1992), 251–53. Bennett's account does not include Teller in the November 1986 breakfast episode. Broad's account, based at least in part on Bennett's earlier article, adds Teller to this meeting. This addition is apparently based on Broad's own 5 December 1989 interview with Canavan.

[5] Lowell H. Wood, "Operational Strategic Defense in the '80s: Very Near-Term Launch Capability for a Nitze-Satisfying SBKKV System," Presentation to Lieutenant General James A. Abrahamson, in the Pentagon (Room 2E252), 24 February 1987.

[6] Bennett, "Brilliant Pebbles," 131–32, states that Wood and Teller first briefed Abrahamson on Brilliant Pebbles in the general's Pentagon office in October 1987. At this meeting, Abrahamson committed himself to visiting Lawrence Livermore National Laboratory to receive a further briefing on the new interceptor concept. Abrahamson supposedly fulfilled this commitment the day before Thanksgiving in 1987.

[7] James A. Abrahamson, Memorandum for deputy secretary of Defense, subj: "'End of Tour Report,'—Information Memorandum," 9 February 1989, Attachment 1, "Lieutenant General Abrahamson's Recommendations: SDI Breakthrough Architectures," 1–1 through 1–3.

[8] George Herbert Walker Bush, "Address on Administrative Goals Before a Joint Session of Congress," 9 February 2001, 6, downloaded from bushlibrary.tamu.edu/papers/1989/ 89020900.html on 5 July 2001.

[9] The President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence*, Final Report to the President (30 June 1986), 41–42, 44.

[10] Ibid., 41–42, 52–54.

[11] George Herbert Walker Bush, National Security Review 11, Memorandum for the acting secretary of defense and the chairman, Joint

Chiefs of Staff, subj: "Defense Management Review," 25 February 1989, 1, 3 (hereafter cited as NSR 11, 25 Feb 89).

[12] U.S. Department of Defense, Secretary of Defense Dick Cheney, *Defense Management: Report to the President*, July 1989 (hereafter cited as Cheney, *Defense Management*), 2–8. See especially 3, 5–7.

[13] Ibid., 6–7.

[14] Ibid., 7.

[15] Ibid., 8–20. The characteristics are listed and briefly defined on 8. The remainder of Section III elaborates on these characteristics.

[16] Ibid., 8–9; emphasis in original.

[17] Ibid., 9.

[18] Ibid., 10. Appendix A of the Cheney report provides information about the defense acquisition structure. It showed a total of 582,131 people (551,764 civilians and 30,367 military) in the acquisition structure. All but 85,402 of these people were in service acquisition agencies. Of this 85,402, 53,929 were in the Defense Logistics Agency.

[19] Ibid., 11.

[20] Ibid., 11–12.

[21] Ibid., 12.

[22] Members of the SDI Organization were stunned and saddened when the general died suddenly of a heart attack at the age of 59, less than three years after his retirement. For obituaries, see *Washington Post*, 6 February 1993; and *New York Times*, 6 February 1993.

[23] Lieutenant General George L. Monahan, Jr., SDIO director, Interview with Lieutenant Colonel Donald R. Baucom, SDIO historian, the Pentagon, Washington, D.C., 6 September 1989, 1–2.

[24] George L. Monahan, Memorandum for under secretary of Defense (Acquisition), Thru: chairman, Strategic Systems Committee, subj: "Review of the Space Segment of the Phase I Strategic Defense System (SDS)," 20 September 1989.

[25] John Betti, Memorandum for director, Strategic Defense Initiative Organization, subj: Defense Acquisition Board (DAB) Review of the Strategic Defense Initiative (SDI) Program," 3 October 1989. The DAB that was to be held in the spring of 1990 was orginally scheduled for the fall of 1989.

[26] George R. Schneiter, Memorandum for under secretary of Defense (Acquisition), subj: Report on Strategic Systems Committee (SSC) Meeting on Space-Based Architecture (SBA) Study, 4 December 1989. National Security Directive 14 provided overall program guidance for the modernization of America's ICBM force and for the development of SDI. NSD–14 refers to George Bush, Memorandum for the vice president et al.,

subj: "ICBM Modernization and Strategic Defense Initiative," National Security Directive 14, 14 June 1989. Where SDI was concerned, this directive called for conducting a "robust program within fiscal constraints." Within this robust program, the secretary of Defense was to determine "the feasibility of promising concepts for effective boost-phase defenses" such as Brilliant Pebbles "on an expedited basis." Furthermore, as a hedge against possible problems with BP, the SDI program should continue to fund other Phase I systems. It was NSD–14 that also charged the secretary of Defense with completing a review of the SDI program (page 4). This charge resulted in the completion of Henry F. Cooper, *SDI Independent Review*, 15 March 1990 (hereafter cited as Cooper, *Independent Review*), which is discussed below.

[27] George R. Schneiter, Memorandum for the under secretary of Defense for Acquisition, subj: "Strategic Defense Initiative (SDI) Program Review," 16 January 1990.

[28] Schneiter, Memorandum, "Strategic Defense Initiative (SDI) Program Review," 16 January 1990; George R. Schneiter, Memorandum for the under secretary of Defense for Acquisition, subj: "Strategic Defense Initiative (SDI) DAB Review," 6 February 1990. In this second memo, Schneiter wrote: "In a previous memorandum, I discussed some outstanding SDI acquisition issues. Following your direction to deal with what I could at my level, I informed the SDI Organization they should take the next steps in their recommended Brilliant Pebbles acquisition approach." Additionally, on 16 January 1990, General Monahan discussed the SDI program with Secretary of Defense Richard Cheney, who had advised Monahan that he expected the General to proceed with the program. Monahan interpreted these instructions as meaning that a DAB was not required for approval of his acquisition strategy for Brilliant Pebbles. Furthermore, the General laid out his plan for releasing the BP concept study RFP in the Commerce Daily Bulletin. (Donald R. Baucom, Notes from SDIO Staff Meeting, 17 January 1990.)

[29] George L. Monahan, Jr., Memorandum for deputies and directors, subj: "Brilliant Pebbles Task Force," 25 January 1990. The date for the release of the CDB announcement comes from Donald R. Baucom, Notes from SDIO Staff Meeting, 26 January 1990.

[30] Monahan, Memorandum, "DAB Process," 28 December 1989. For a critique of the role of military specifications in the acquisition process, see Wendy T. Kirby, "Expanding the Use of Commercial Products and 'Commercial-Style' Acquisition Techniques in Defense Procurement: A Proposed Legal Framework," Appendix H in President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence,* Final Report to the President (30 June 1986), Appendix, 71–107. On page 75,

the reader is told that in the February 1986 interim report, the commission said that "rather than relying on excessively rigid military specifications, DoD should make much greater use of components, systems, and services available 'off the shelf.' It should develop new or custom-made items only when it has been established that those readily available are clearly inadequate to meet military requirements." This same statement also appeared in an April 1986 interim report from the commission. Appendix K presents the results of a survey of the DoD acquisition work force. According to page167, this survey showed that "a strong majority of the acquisition work force (both contract specialists and other members of the acquisition team) agree that military specifications are too extensive for some of the products bought." Additionally, "a strong majority of the acquisition work force agree that the bureaucracy under which defense projects are developed and operated contributes to inefficiency." Brilliant Pebbles is clearly an effort to implement this recommendation.

[31] Report of the Defense Science Board on SDIO Brilliant Pebbles, December 1989, 1, 3.

[32] Ibid., 5.

[33] Ibid., 5–6.

[34] Ibid., 6. One method for dealing with this problem is to fix the design and produce the system and then make necessary modifications at a modification depot before the system enters operational service. This was done in World War II aircraft. More recently, systems are acquired in blocks, with the first and intermediate block designs including interfaces that can be used to incorporate upgrades. More recently, this approach to incorporating more advanced concepts and technologies is referred to as spiral development.

[35] Monahan, Memorandum for the secretary of Defense, 27 April 1990. National Security Directive 14 provided overall program guidance for the modernization of America's ICBM force and for the development of SDI.

[36] George L. Monahan, Jr., Interview with Lieutenant Colonel Donald R. Baucom, SDIO Offices, Washington, D.C., 29 March 1990, 6 [hereafter cited as Monahan, Interview, 29 March 1990]. One sees in this approach to managing the Brilliant Pebbles program Monahan's earlier experience with military specifications and his belief that these specifications tend to introduce a degree of rigidity into the development process. Monahan also summarized his BP acquisition strategy in Monahan and Wood, "BP Press Conference," 9 February 1990, 5–6. This account of the strategy melds together what Monahan said in his 9 February press conference with what he said in the 29 March interview.

[37] Monahan, Interview, 29 March 1990, 6–8. Compare the block quotation in the text with the following Monahan statement made during in the 9 February 1990 press conference:

In pre-full scale development, here's where we're going to really invite the inventiveness and innovative capability of American industry. We're going to tell them to build and flight test so many interceptors and life jackets based on the Lawrence Livermore design. By the way, if they want to provide us with some excursions and say, hey, there's even a better way to do it, find, we'll be happy to address those. We're not going to impose any MilSpecs or MilStandards during this phase. We'll simply say you have to meet certain costs and endurance goals, etcetera. It will be up to the contractors themselves to try to figure out how to do that rather than having an imposition on the part of the government for the top down. I say again, we emphasize simplicity of design, low production costs, short [and] concise proposals–about fifty pages. I don't know if we can do that, but we're going to try something like that. Cost reimbursable contracts . . . I don't think I can perhaps be quite as loose as it says there, but I'd like to be able to specify for that stage that rather than having a detailed system specification from us, that we would simply be able to tell a contractor build substantially in accordance with the proposal you gave us and that we iterated with you. If you want to deviate from that very much, let us know. (page 5)

[38] Monahan, Interview, 29 March 1990, 8.

[39] Ibid.

[40] George L. Monahan, Memorandum for Prospective Offerors, subj: "Solicitation Release for Concept Definition Phase of the Brilliant Pebbles System, FRP No. SDIO84-90-0004," 9 March 1990; [Strategic Defense Initiative Organization], Memorandum for Correspondents, 24 May 1990; Vincent Kiernan, "Technology To Deploy Brilliant Pebbles 'At Hand,' SDIO Says," *Space News* (12–18 February 1990): 4, 28. The six contractors participating in this stage of the BP development program were Ball Space Systems Division, Boulder, Colorado; Boeing Aerospace and Electronics, Seattle, Washington; Martin Marietta Space Systems, Denver, Colorado; Raytheon Company, Missile Systems Division, Bedford, Massachusetts; Rockwell International Corporation, Space Transportation Systems Division, Downey, California; and TRW Space and Technology Group, Military Space Systems Division, Redondo Beach, California.

[41] Monahan and Wood, "BP Press Conference," 9 February 1990, 13. This answer was given in response to a question at the press conference. The number 4,614 was for the number of interceptors procured and not the number to be included in the operational BP constellation. Reports in the press mistakenly related this number to the operational constellation. Kiernan, "Technology To Deploy" states: "Monahan said the constellation would consist of 4,614 pebbles, including spares." Monahan's answer was not phrased like this. A similar error appears in "Pebbles' Progress," *Wall Street Journal*, 28 February 1990: 28, as reprinted in Office of Assistant

Secretary of Defense for Public Affairs, *Current News: Special Edition: Strategic Defense Initiative*, April 1990, 44.

[42] Dick Cheney, Memorandum for secretaries of the Military Departments et al., subj: "Independent Review of the Strategic Defense Initiative Program," 22 December 1989; Larry Burger, Memorandum for the under secretary of Defense (Acquisition), subj: "Terms of Reference (TOR) for the Process Action Team on SDI," 10 July 1990. Burger was an official in DDR&D[S&TNF]. George Bush, Memorandum for the vice president et al., subj: "ICBM Modernization and Strategic Defense Initiative," National Security Directive 14, 14 June 1989, 4.

[43] Henry F. Cooper, *SDI Independent Review*, 15 March 1990 (hereafter cited as Cooper, *Independent Review*), front material and 6.

[44] Ibid., 16–17.

[45] Ibid., Executive Summary, 2.

[46] Ibid., front material.

[47] George R. Schneiter, Memorandum for the under secretary of Defense for Acquisition, subj: "Strategic Defense Initiative DAB Review," 27 March 1990.

[48] George R. Schneiter, Memorandum for the under secretary of Defense for Acquisition, subj: "Report on Strategic Systems Committee (SSC) Meetings on Strategic Defense Initiative SDI," 13 June 1990.

[49] John Betti, Memorandum for Director of the Strategic Defense Initiative Organization and Chairman of the Strategic Systems Committee, subj: Acquisition Decision Memorandum for Strategic Defense Initiative Program, 19 June 1990.

[50] John Betti, "Terms of Reference for the Process Action Team on the Strategic Defense Initiative in the Defense Acquisition Board Process," 10 August 1990.

[51] Don Yockey, Memorandum for the Director of the Strategic Defense Initiative Organization and the Chairman of the Strategic Systems Committee, subj: "Global Protection Against Limited Strikes (GPALS) Management Strategy," 1 November 1991, with attachment, "GPALS Acquisition Management Strategy," White Paper [5 November 1991].

[52] Cooper, *Independent Review*, 4, 25–29. For Cooper's views on trends toward the increasing threat of limited missile attacks see 1, 55–79.

[53] Cooper, *Independent Review,* 26–29.

[54] Strategic Defense Initiative Organization, *1991 Report to the Congress on the Strategic Defense Initiative*, May 1991, 2-2–2-9.

[55] George H. W. Bush, "State of the Union Address," 29 January 1991. Fred Barnes, "White House Watch: Brilliant Pebbles," *The New Republic* (1 April 1991): 10.

[56] Historical Office, Office of the Secretary of Defense, *Department of Defense Key Officials: 1947–2000* (Washington, D.C.: GPO, 2000), 21.

[57] Henry F. Cooper, Memorandum for Pre-Full Scale Development Phase of the Brilliant Pebbles System, RFP No. SDIO 84-91-R-0003, 16 January 1991; [Strategic Defense Initiative Organization], Memorandum for Correspondents No. 038–M, 18 January 1991.

[58] Cooper, Memorandum, 16 January 1991; Memorandum for Correspondents No. 038–M, 18 January 1991.

[59] Memorandum for Correspondents, No. 038–M, 18 January 1991.

[60] George Schneiter, Memorandum for the Chairman of the Defense Acquisition Board, subj: "DAB Oversight of the SDI Program," 6 March 1991.

[61] Donald J. Yockey, Memorandum for the Director of the Strategic Defense Initiative Organization, subj: "Review of the Brilliant Pebbles Program," 8 March 1991.

[62] O'Neill's comment comes in a handwritten note on another handwritten memorandum from Dr. James Carlson. Both notes are dated 6 March 1991.

[63] Henry F. Cooper, Memorandum for the under secretary of Defense for Acquisition, subj: "Review of the Brilliant Pebbles (PB) Program," 22 March 1991. The format of this memorandum is somewhat puzzling. It has Cooper's typed signature block and is signed by O'Neill for Cooper. However, on the previous page, beneath the Defense Department seal the initials DD (deputy director) appear as opposed to D (director). This suggests that the document was typed knowing that O'Neill would sign it. Although Cooper is listed in this note as the author, in the text above, I attribute what is said to O'Neill, since he actually signed the memorandum

[64] Cooper, Memorandum, subj: "Review of the Brilliant Pebbles (PB) Program," 22 March 1991.

[65] George R. Schneiter, Memorandum for secretaries of the Military Departments et al., subj: "Review of the Brilliant Pebbles Program," 26 March 1991.

[66] Ibid.

[67] Don Yockey, Memorandum for secretaries of he Military Departments and directors of Defense Agencies, subj: "Review of Requests for Proposal (RFPs) and Contracts Prior to Solicitation and Award," 11 April 1991.

[68] Malcolm R. O'Neill, Memorandum for chairman of the Strategic Systems Committee, subj: "Brilliant Pebbles (BP) Contract Award Review," 29 April 1991.

[69] SDIO, "Brilliant Pebbles and GPALS" and "The Brilliant Pebbles Program," Fact Sheet [18 April 1991].

[70] Ibid.

[71] Ibid.; Department of Defense, Defense "SDI 'Brilliant Pebbles' Test Flight," Colonel Rowland "Rhip" Worrell, Briefer, 18 April 1991. Worrell discussed the six contract teams and the down-select in May.

[72] Major General Malcolm R. O'Neill, SDIO deputy director, to Senator Hank Brown, Letter, 24 May 1991.

[73] Don Yockey, Memorandum for the director of the Strategic Defense Initiative Organization, subj: "Brilliant Pebbles Contract Award," 28 May 1991.

[74] Don Yockey, Memorandum for Joint Oversight Council, subj: "Requirements for Brilliant Pebbles," 29 May 1991.

[75] Don Yockey, Memorandum for the director of the Strategic Defense Initiative Organization, subj: "Global Protection Against Limited Strikes (GPALS) Acquisition Decision Memorandum," 20 September 1991.

[76] Strategic Defense Initiative Organization, Draft White Paper, 18 July 1991. Lieutenant Colonel Patrick Talty, U.S. Air Force, was the SDIO project officer and had principal responsibility for drafting the paper within the missile defense agency. The response of SDIO's leadership to the general acceptance of the draft White Paper by the acquisition community and the SSC came in comments made by Major General Malcolm O'Neill and Dr. Edward Gerry during an SDIO Staff Meeting on 26 July 1991, which the author attended in his capacity as SDIO historian.

[77] Henry F. Cooper, Memorandum for under secretary of Defense for Acquisition, subj: "UTTMD and GPALS Review/DABs," 9 December 1991. [Italics in original.]

The Origins and Impact of the Defense Acquisition Workforce Improvement Act (DAWIA)

James H. Edgar

The Defense Acquisition Workforce Improvement Act (DAWIA) was enacted in November 1990 by Public Law 101–510, Chapter 87, Title XII. Because of its scope and intent, DAWIA was an attempt to build on the legislative foundation formed by the 1986 Goldwater-Nichols Act and the Defense Reorganization Act of 1958, acts that fundamentally altered the management of U.S. national security institutions. DAWIA was written to bring about systemic and comprehensive changes to the way the Department of Defense (DoD) acquisition workforce was to be managed. This article addresses the origins and context of DAWIA, how DAWIA was enacted, and some of the more salient characteristics of DAWIA that distinguish it from earlier legislative efforts to reform or reorganize the management of defense acquisition personnel. This article also endeavors to place DAWIA in its proper context as part of a larger saga of congressional and Department of Defense struggles to centralize the defense acquisition process.

Background

DAWIA had its origins in a long-standing congressional concern with the professionalism and quality of the defense acquisition workforce. Since the establishment of the Department of Defense in 1947, various studies, reports of commissions, and legislative language alluded to the growing perception that that the defense acquisition process had to be improved. A growing body of documentary evidence illustrated that needless cost overruns, late delivery of systems and equipment, performance failures, and unnecessary noncompetitive procurements were commonplace occurrences in the defense acquisition business. As

policymakers were becoming ever more aware of these problems, a belief emerged that was shared by many in Congress and the Department of Defense that a better-educated and -trained civilian and military workforce of professionals who understood the acquisition process, were committed to a career in acquisition, and empowered with the requisite authority to mitigate or prevent systemic abuses, could make a significant difference in the management of acquisition programs. This view acknowledged that good people were more important than policy, process or organization in getting the job done and making the defense acquisition system work.

During the 1980s, there were a number of acquisition reform initiatives promoted by the Congress; these efforts largely reflected the work of the Military Reform Caucus, an informal coalition of House and Senate members that cut across party and ideological lines. In 1984, Congress enacted Public Law 98–369, legislation that required the head of each executive agency to "develop and maintain a procurement career management program in the executive agency to assure an adequate professional workforce."[1] This measure was in many ways an extension and clarification of President Ronald Reagan's Executive Order 12352, signed in March 1982, that required each department establish career management programs that would promote the development of a highly qualified, well managed procurement workforce.[2] Evidence of the growing movement to standardize acquisition workforce management policy and processes can be found in an another important DAWIA precedent, the Defense Procurement Reform Act of 1984, enacted on 19 October 1984. The Defense Procurement Reform Act established a minimum assignment period for program managers of four years or until completion of a major program milestone. [3] In November 1985, Congress enacted the Defense Procurement Improvement Act, which required a person appointed as program manager of a major defense acquisition program to have completed the Program Management Course at the Defense Systems Management College (DSMC) or a "comparable course," and have at least eight years of experience in acquisition support and maintenance of weapon systems, with at least two of those years performed while assigned to a procurement command. All of these legislative and executive interventions were important steps in the slow centralization of Department of Defense acquisition workforce management, but, in the eyes of some observers, these measures were insufficient to enhance the professional credibility of the workforce and combat the procedural and operational problems that seemed to plague the defense acquisition community.

The widely publicized spare parts horror stories of the mid–1980s inspired President Reagan to establish the Blue Ribbon Commission on

Defense Management by Executive Order on 15 July 1985. Better known as the Packard Commission because of the high-profile chairmanship of David Packard (cofounder of Hewlett-Packard and former deputy secretary of Defense under Melvin Laird, serving from January 1969 until December 1971), the commission was made up of distinguished representatives of the military, industry, and the academy. Among the responsibilities assigned to the Packard Commission was a review of the adequacy of the existing defense acquisition process and an evaluation of the execution of acquisition responsibilities by the military services. William J. Perry headed the commission's Acquisition Task Force, a sub-group established to look at specific acquisition issues. Other key members of the task force included Louis W. Cabot, Charles J. Pilliod, Jr., R. James Woolsey, and Ernest C. Arbuckle.

In 1986, the Packard Commission issued its findings on acquisition practices, observing that the Department of Defense acquisition workforce was in need of "major innovations in personnel management."[4] The commission emphasized the direct relationship between personnel reform and acquisition reform by noting, "[w]hatever other changes may be made, it is vitally important to enhance the quality of the defense acquisition workforce—both by attracting qualified new personnel and by improving the training and motivation of current personnel."[5] This view was reiterated and expanded on in *A Formula for Action*, an April 1986 report prepared by the Packard Commission that encouraged the president and Congress to "amend civil service laws to permit flexible personnel management policies for acquisition professionals, and to expand opportunities for the education and training of all acquisition personnel."[6] With the language included in *A Formula for Action* and the final Packard Commission report, *A Quest for Excellence*, it was clear that despite all of the previous efforts aimed at improving the quality of the acquisition workforce—including changes acknowledged in the February 1986 interim report by the Packard Commission that were "reinforced by legislation"—these gestures were inadequate.[7]

Based on the recommendations made by the Packard Commission, in April 1986 President Reagan promulgated National Security Decision Directive 219, which gave the secretary of Defense sixty days to report back to the president with policy changes designed to strengthen personnel management policies for civilian managers and employees having contracting, procurement, or other acquisition responsibilities. This was important step that demonstrated the commitment of the executive branch to acquisition reform, but dramatic revelations about corruption in the acquisition community gave more urgency to the need for sweeping changes.

In the summer of 1988, following the disclosure of the FBI defense procurement investigation known as Ill Wind, the House Committee on Armed Services initiated a series of hearings on the integrity of the Department of Defense's acquisition system. These hearing, conducted jointly with the Subcommittee on Investigations and the Panels on Defense Policy and Acquisition Policy, were inspired by a growing sense of frustration among legislators over the defense acquisition process, feelings that been stirred up by the spare parts horror stories of the early 1980s and exacerbated by the more shocking Ill Wind revelations. After convening hearings in May and June of 1987 to review acquisition and procurement matters, it was apparent to the House Armed Services Committee that the Department of Defense had committed to implementing the Packard Commission recommendations in spirit, but there was little evidence that reforms were being carried out in practice. During the 100th Congress, the House Committee on Armed Services called for a review and analysis of impact of major commissions and panels created in preceding decades to evaluate defense management and acquisition. The committee observed that, in the findings of earlier defense reform commissions, there were four recurring points of discussion: concerns about the professionalism of acquisition personnel; the need to streamline the acquisition regulations; questions about the influence of the so-called revolving door between government and industry; and acquisition organization. All of these matters had been somehow addressed in earlier proposals and recommendations made by a variety of defense review committees and panels. In the forward to their study of these earlier reform panels and proposals, Congressmen Les Aspin (D–WI), chairman of the Defense Policy Panel, and Nicholas Mavroules (D–MA), chairman of the Acquisition Policy Panel, noted that the "bulk of the cures proposed as far back as 1948 were still being proposed in 1983 because they had never been implemented."[8]

The Development of DAWIA

Starting in 1988, the Investigations Subcommittee commissioned detailed and systematic analyses of the defense acquisition workforce. The previous focus of past studies had been directed towards improving on acquisition policies and procedures and, to a lesser degree, on acquisition organization structure. This new analysis effort yielded three reports. The first, *A Review of Defense Acquisition in France and Great Britain*, was issued in 1989 and was the product of the Subcommittee on Investigations traveling in April 1989 to France and Great Britain to meet with senior

acquisition officials in both countries. The purpose of this study was to understand how foreign defense acquisition systems were organized and staffed, and how the processes worked. Both countries have more centralized and independent (from the operational customer) acquisition organizations. In France, for instance, it was determined that the corps of armament engineers in the Armament Directorate constituted an elite body of well-educated, highly trained professionals. These engineers had a separate personnel system with different rules and pay scales and were promoted on the basis of their engineering and management skills. Their pay was comparable to the private sector.[9]

The other two reports were issued in 1990. The second report, *The Quality and Professionalism of the Acquisition Workforce*, was a detailed and in-depth study of the U.S. defense acquisition workforce. Using the analyses and recommendations of the previous presidential and congressional commissions as a point of departure, this study examined current policies and procedures within the Department of Defense for the selection, training, and career development of acquisition personnel. The focus of the study was on program managers, deputy program managers, and contracting officers. The report posed four major questions for review: (1) Were the services appointing program managers, deputy program managers, and contracting officers with the experience, education and training required by law and regulation, and were program managers of major programs being retained for the mandatory minimum period of time? (2) Was there a career program structure to develop qualified and professional contracting and program management personnel—both civilian and military? (3) Was there an appropriate mix of military and civilian personnel within the workforce? (4) What impediments existed that had to be overcome in order to develop a quality, professional acquisition workforce?[10] To varying degrees, all three services failed to appoint program managers and deputy program managers who had professional backgrounds that reflected the appropriate combination of training and experience. The same could be said about the appointment of contracting officers. The mix of civilian and military personnel assigned to acquisition billets varied among the services. The Air Force had the largest number of uniformed military personnel working in acquisition jobs, but no service was in total compliance with the long-standing Department of Defense policy to appoint civilians to positions that did not require a military officer. A whole range of impediments to developing a quality professional acquisition workforce were found. Some were legal or administrative, such as pay disparities when acquisition jobs were compared to similar private sector positions. The lack of a college educated contracting workforce was

also identified as a serious problem. Other problems were organizational and cultural. While the defense acquisition chain of command—beginning with the under secretary of Defense for Acquisition—had responsibility for the acquisition system, personnel and career management fell within the purview of the military and civilian personnel communities. Additionally, the existing Department of Defense acquisition school structure was totally inadequate for meeting the mandatory acquisition training requirements established by the Department of Defense. This fact was a direct result of a decentralized training approach, funded wholly by the military services, which functioned without the benefit of a central Department of Defense school or oversight structure to facilitate the implementation of existing defense policy.[11] These structural problems were compounded by the culture of the Department of Defense, which seemed to embrace the idea that issuance of a directive or regulation was the same as effective implementation, which was not the case.

The third report, *Life is Too Short: A Review of the Brief Periods Managers of Major Defense Acquisition Programs Stay on the Job*, found that, for all practical purposes, the services had simply disregarded the requirements of the Defense Procurement Reform Act of 1984, which required program managers to serve a minimum of four years or until completion of a major milestone. In only 11 percent of all of the program management cases reviewed were the services even in technical compliance with the 1984 Reform Act. Ironically, the average tenure of program managers had actually *decreased* after the tenure law was passed. The Investigations Subcommittee found this a "most egregious example of the flouting of statutory requirements."[12] There were three root causes for the rapid turnover of program managers: (1) program managers were almost exclusively military; (2) because so many of the military personnel were "comers," the military personnel assignment system viewed these jobs as mere "ticket-punching"; and (3) the program manager position was tied to a particular rank, so when the incumbent was promoted he or she had to move. All of the data showed an "appalling absence of compliance with the law. It is simply an abysmal record."[13] Congress did not want to see a continuation of business as usual.

In early March 1990, the Investigations Subcommittee issued a draft "Proposal for the Creation of a Highly Professional Acquisition Workforce and Acquisition Corps Within Each of the Military Services." This paper was the basic outline of what eventually became DAWIA. The proposal vested a new career management program authority in the office of the under secretary of Defense (Acquisition). The career management program covered accession, education, training, experience, assignment, promotion

and retention for each major functional element within the acquisition workforce and sought to ensure that Service Acquisition Executives established career management systems within their components.

The proposal included a number of important management and reporting requirements designed to prevent the continuation of "business as usual." It called for the establishment of an Acquisition Corps that would have its own selection, assignment, and promotion systems not unlike the Judge Advocate General's Corps for military officers. It also established a positive baccalaureate degree requirement for entry into the contracting career field. The proposal also included many attractive incentives for accessing new entrants into acquisition; set forth a basic management structure (later incorporated into DAWIA); mandated a management reporting system for compliance; and called for the establishment of a Defense Acquisition University.

Standards were an important part of the draft proposal. It introduced new minimum standards for contracting officers (both military and civilian) and standards for entry into the Acquisition Corps. It also established new standards for program managers of major programs, program managers of non-major programs, program executive officers (PEOs), senior contracting officials, and senior officials (general/flag officers and civilian equivalents) in Procurement Commands. These standards were subsequently modified and are discussed in detail below.

Finally, the draft report called for a change in the policy concerning the civilian-military mix to ensure that more civilians could qualify for senior acquisition positions within the Department of Defense. This document was distributed to the Office of the Secretary of Defense and the military departments for comment as well as approximately one hundred individuals, including former secretaries of Defense, chairmen of the Joint Chiefs of Staff, senior acquisition officials from prior administrations, representatives of industry, and academicians.[14]

With such wide distribution, it was inevitable that the proposal would generate controversy and necessitate lengthy follow-up discussions to clarify the scope and intent of the reform effort. Two hearings were held in March and April 1990 in which testimony was received from senior Department of Defense officials and representatives of the private sector and the academy.[15] During the course of these hearings, there were a series of meetings and consultations taking place on two levels. On one level, senior officials of the Air Force, Army, and Navy were meeting with the professional staff members of the Investigations Subcommittee to explain and argue why DAWIA was unnecessary. The bottom line of their presentations was that the services were already addressing the

public policy issues that DAWIA intended to address through the Defense Management Report. However, upon a closer examination, each of the services— arguing that they had a career management program already in place with a nascent Acquisition Corps prototype—had focused exclusively on program managers. For example, Mr. Paul Beach, special assistant to the secretary of the Navy, said that no one in contracting would be included in their program. The Air Force and Army programs concentrated on program management, and, to a very large degree, military officers only. The professional staff members came away convinced that DAWIA was needed more than ever.

Simultaneously, the professional staff members were meeting with senior officials in contracting in the Air Force and Army to receive their input; among these professionals they found enthusiastic support for DAWIA. They also met with program managers from the services. For example, in a meeting with the B–1 program manager, he said that a civilian could just as easily be the program manager for the B–1 program as a military officer. The only impediment was cultural. The warfighters liked to see uniformed individuals serve as their program managers. Feedback from industry officials was supportive of the DAWIA provisions as well.

Congressman Mavroules introduced DAWIA on 28 June 1990 as a stand-alone bill, H.R. 5211. Mavroules reviewed the background leading up to the proposed legislation.

> Actually, there should be little debate about the broad guidelines of what needs to be done. Since World War II, no less than six commissions have grappled with the problems of military acquisition and offered prescriptions to fix them. These commissions—including the two Hoover Commissions of 1949 and 1955, the Fitzhugh Commission of 1970, the Commission on Government Procurement In 1972, the Grace Commission of 1983, and the Packard Commission of 1986—have all recognized the need for competent, trained, and educated civilian and military acquisition personnel. Their recommendations have been echoed by many outside experts for more than four decades. The problem has been in implementing these recommendations. There has been plenty of talk and lots of paper, but there has not been a lot of action….My intention here is to ensure that the sound, commonsense recommendations made by all those numerous Commissions are, in fact, implemented. And I believe that legislation is needed to ensure that the changes we propose are institutionalized since you and I—and our friends at the Pentagon—might not be here tomorrow.[16]

He then proceeded to outline the legislative proposal, emphasizing the bill's features, which encompassed career management, experience, education and training, the Acquisition Corps concept, contracting professionalism, the civilian-military mix, greater job tenure, and mobility.

Mavroules concluded by acknowledging that this was a proposal of "historic proportions that should result in a cultural change in the way the Department of Defense approaches acquisition. No longer would acquisition assignments be made as rewards for performance in unrelated fields, or for officers who want to civilianize their resumes. No longer would key acquisition assignments, such as program managers, be given to amateurs or dilettantes. Only qualified professionals would be allowed to hold key acquisition jobs. They would be appointed by the individuals responsible for acquisition in the Department of Defense and their performance would be evaluated by these same people. . . . What we have proposed should not be startling or esoteric; it is really based on common sense and sound management principles."[17]

The introduction of the legislation was followed by press releases to gain additional support for DAWIA as the military services awakened to what was about to befall them. Mavroules noted that in 1984, program managers averaged twenty-five months on the job and today, "they average only twenty-one months. Some improvement!" Representative Larry Hopkins, ranking Republican on the Investigations Subcommittee said: "The services are simply ignoring the law. . . . With only twenty-one months on the job, they barely have time to find where the executive washroom is." A Pentagon spokeswoman replied, "We know the law is on the books. We're trying hard to work on the spirit of the law."[18] One of the key selling points was the blatant failure of the services to comply with 1984 tenure law for program managers. Citing the *Life is Too Short* report, the *New York Times* noted that "one reason for the high turnover is the military's historical tendency to treat all officers as potential admirals and generals and to expose them to a broad array of duties."[19]

During this period, there were challenges to the proposed legislation and additional input was received from a number of sources. Some observers had legitimate concerns, such as the issue of "grandfathering" current employees, especially in the contracting occupational series, to hold them harmless from the new, higher educational standards. Certain professional staff members met with contracting civilian employees at Wright-Patterson Air Force Base to hear their complaints about the unfairness of the proposed legislation. Waivers proved to be another point of contention between Congress and those potentially effected by the new legislation. The professional staff members worked long and hard to address these concerns and to ensure that DAWIA was comprehensive and would promote the cultural change required.[20]

The wrangling over the details of H.R. 5211 prompted some very high-level interventions. On 7 August 1990, the under secretary of Defense

(Acquisition), John Betti, wrote to Congressman Nicholas Mavroules noting that several provisions included in DAWIA would cause the department significant difficulty. It was also during this period that DAWIA encountered its gravest challenge, and it came from the Office of Personnel Management (OPM), which was historically and unalterably opposed to establishing a positive education requirement for the GS–1102 (contracting) workforce. OPM requested a separate hearing from the Post Office and Civil Service Committee to voice its objections to DAWIA. However, after discussions between Congressman Mavroules and Representative Gerry Sikorski (D–MN) and the intercession of Representative Pat Schroeder (D–CO), who sat on both committees, as well as Representative Benjamin Gilman (D–NY), it was decided that a hearing for OPM was unnecessary.

On 11 September 1990, Congressman Mavroules introduced DAWIA as a part of the National Defense Authorization Act for Fiscal Year 1991.[21] Noting that Congress enacted major procurement reform legislation every year from 1982 through 1986, Mavroules, said it was time for a new approach that would "address not the symptoms but the root causes" of the failures of the defense acquisition system.[22] "While previous efforts were all well-meaning and rational, they failed to take into account the most vital and critical area: the quality and capabilities of the people who must work within the structure. My amendment provides a comprehensive framework for developing an acquisition workforce with the skills and attributes required for effectively managing the defense acquisition process."[23]

DAWIA encompassed three themes: quality, professionalism, and empowerment. There was general bipartisan support of DAWIA during the debate, and it was regarded as a "good government" bill. In support of DAWIA, Representative Dennis Hertel (D–MI) said: "I stand here to say President Hoover was right, President Eisenhower was right. The only way to improve DoD acquisition is to improve the skills of the people making acquisition decisions, and then retain those very good people."[24] Representative Bill Dickinson (R–AL), the ranking minority member of the Armed Services Committee had received input from the Department of Defense opposing DAWIA. In his remarks, he brought these concerns to the floor: extensive and detailed reporting requirements, the size of the acquisition corps, and finally the tone and detail of the many of the directive provisions that appear to bind the flexibility of the department to manage effectively the acquisition workforce. Nonetheless, Congressman Dickinson had no objections and intended to vote in favor of DAWIA. This legislation also had the full backing of Representative Les Aspin (D–WI), chairman of the Armed Services Committee. On a roll-call vote, the House passed DAWIA overwhelmingly, 413–1.

Following passage in the House of Representatives, officials opposing DAWIA turned to the Senate to either defeat or ameliorate the provisions that were most objectionable. During the Senate-House conference on DAWIA, the Senate side wanted to give more management flexibility to the secretary of Defense and the secretaries of the military departments and retain a greater role for the personnel community (military and civilian) by calling for close coordination between the under secretary of Defense (Acquisition) and the assistant secretary of Defense for Force Management and Personnel in the development and implementation of acquisition personnel policies. Within each of the military departments, the service acquisition executive (SAE) should coordinate closely with the Department's assistant secretary for Manpower and Reserve Affairs and the senior military personnel officer within the department in the development and implementation of acquisition personnel policies.

As a result, the secretary of Defense was authorized, after 1 October 1993, to transfer the responsibilities assigned to the under secretary of Defense for Acquisition to a different senior official. "This provision is intended to provide future secretaries of Defense with discretion to reorganize the Office of the Secretary based on changing circumstances or needs. The conferees emphasize, however, that any such transfer must be to a single official, and that this authority may not be used to divide the responsibilities among more than one official."[25]

Significantly, in terms of tenure requirements for assignments to critical acquisition positions or as program managers and deputy program managers, there would be a limited waiver authority which could be exercised only in exceptional circumstances: "It is the conferees intent that this waiver authority be exercised only in limited circumstances involving matters such as relief for cause or poor performance, extreme personal hardship, or a higher critical requirement in the department. The conferees intend that the justification for use of such waiver authority is carefully documented and not simply declared. Routine personnel practices such as promotions or routine service assignment policies should not be used as the basis for a waiver."[26] The conferees expected the secretary of Defense to establish a charter and an organizational structure for the defense acquisition university. Finally, the conference agreement would phase in the new requirements wherever possible to ease the transition from the present acquisition workforce structure. At the end of the conference, the basic provisions of the House version of DAWIA were largely intact, with only the few modifications discussed above. On 5 November 1990, President George H.W. Bush signed the National Defense Authorization Act for Fiscal Year 1991, including DAWIA, into law.

Salient Provisions of DAWIA

DAWIA is characterized by a very comprehensive and detailed set of interlocking components that are intended to ensure the cultural change in the performance of the Defense acquisition system intended by Congress. There are, interestingly, certain key provisions that stand out: management, civilian-military mix, standards, education and training, and accountability.

Management

The secretary of Defense, through the acquisition chain of command, will establish policies and procedures for the effective career management of the acquisition workforce and implementation shall be uniform across the Department of Defense to the maximum extent practicable. Previous efforts at implementation had been fragmented and had mixed results as was demonstrated by the various studies that were used as the basis for DAWIA. It was also clear that the responsibility for acquisition and the authority to supervise the acquisition workforce should not be bifurcated. Thus the under secretary of Defense for Acquisition, assisted by the respective service acquisition executives, subject to the authority, direction and control of the secretary of the military department concerned, would ensure implementation within that department by carrying out all powers, functions and duties of the secretary concerning the acquisition workforce.

The framers knew that authority and responsibility had to be conjoined; but they also knew that this alone was insufficient. There must be a *capacity* for effective action. Therefore, the legislation created the position of director, Acquisition Career Management (DACM). This is a key position in the scheme of things. The intention was that this would be a full-time job at a sufficiently high level—major general or rear admiral or civilian employee in a position in the civil service the rate of pay for which is equal to Level V of the Executive Schedule. The DACM would assist the SAE in implementing DAWIA. This was an explicit rejection of the traditional approach of assigning these responsibilities as an "additional duty". The DACM is responsible for the administrative "heavy lifting" to ensure effective execution of DAWIA. The DACM was authorized to waive tenure requirements under DAWIA. DAWIA also mandated the establishment of Acquisition Career Program Boards within each military department to advise the cognizant SAE in managing the accession, training, education and career development of military and civilian personnel. Composition of the board would consist of the DACM (or representative), the assistant secretary responsible for manpower (or representative) and the military

and civilian officials responsible for personnel development in the various acquisition career fields, such as contracting. The idea here was to get the best advice and input from the functional leadership responsible for carrying out acquisition missions. The acquisition career program boards were authorized to waive educational requirements for contracting personnel and for Acquisition Corps membership.

Civilian-Military Mix

One of the most contentious issues in DAWIA was the proper utilization of civilians within acquisition and the civilian-military mix. One of the findings of the studies supporting DAWIA was that the Department of Defense had failed to implement its own policies concerning the use of civilians in positions that did not require military officers. Coupled with this was the perception that many military officers lacked the necessary experience; this was tied to the traditional use of civilians as deputies to provide continuity while officers often got on-the-job training. At the same time, there was also a perception that civilians tended to "homestead" and lacked the breadth of experience needed for more senior positions. Thus, one of the objectives of DAWIA was to make officers more like civilians and civilians more like military officers through specific programmatic actions.

There was a specific prohibition against a requirement or preference for military personnel in filling acquisition positions unless a member of the armed forces is required for that position by law, is essential for performance of the duties of that position, or is necessary for another compelling reason and an annual report of such positions is required. The secretary of Defense is required to ensure that civilian personnel are provided the education, training and experience to qualify for the most senior acquisition positions and that the selection for positions is based on the "best qualified," not whether the individual is military or civilian. The secretary of Defense was also enjoined to ensure the acquisition workforce was managed from 1 October 1991 through 30 September 1996 so that there was a substantial increase in the proportion of civilians as compared to military serving in critical acquisition positions, as program managers, and as division heads as compared to the proportion as of 1 October 1990. The secretary of Defense is required to establish a policy on assigning military personnel to acquisition positions that provide a balance between the need for personnel to serve in career broadening positions and the need to serve a sufficient time to provide the stability necessary to effectively carry out the duties of the position. The secretary of Defense is required

to establish a procedure under which the assignment of each person to a critical acquisition position is reviewed on a case-by-case basis after five years by the cognizant acquisition career program board to determine whether the government and the individual would be better served by a reassignment to a different position. The secretary of Defense is to establish a rotation policy encouraging the rotation of Acquisition Corps members to new assignments after completion of five years of service in critical acquisition position. This policy was designed to "ensure opportunities for career broadening assignments and an infusion of new ideas into critical acquisition positions."[27] The secretary of Defense was required to establish a centralized job referral system to ensure that persons selected for critical acquisition positions are considered without regard to geographic location of the applicants. Lastly, the secretary of Defense was to establish an exchange program to broaden the experience of members of each Acquisition Corps. This was to be a test program in which corps members of one department would be assigned or detailed to another Department or Defense agency.

Standards

Significantly, DAWIA set forth new educational, training and experience standards for the contracting (GS–1102) workforce, contracting officers, members of the Acquisition Corps and individuals assigned as program managers of major defense programs, deputy program managers of major defense programs, programs managers and deputy program managers on non-major defense programs, program executive officers, general and flag officers and civilian equivalents in critical acquisition positions, and senior contracting officials. Membership in the Acquisition Corps requires a baccalaureate degree (or certification by the appropriate acquisition career program board that the person has demonstrated potential for advancement) plus twenty-four semester credit hours in "business acumen" (accounting, business finance, law, contracts, purchasing, economics, industrial management, marketing, quantitative methods, and organization and management) from an accredited institution of higher education or twenty-four semester credit hours in the person's career field (if not contracting or business and finance) *plus* twelve semester credit hours in the "business acumen" disciplines. In addition, four years of acquisition experience (in an acquisition position) was required.

Contracting personnel (GS–1102) now had a positive education requirement: a baccalaureate degree or twenty-four semester credit hours in the "business acumen" disciplines. Contracting officers had to meet the same educational standards as the GS–1102 plus have completed all

mandatory contracting training at their grade level and have at least two years of contracting experience. Program managers of major programs must meet the Acquisition Corps requirements, have at least eight years of acquisition experience—two years of which were performed in a systems program office, and have completed the Program Management Course at the Defense Systems Management College.[28] All of these new requirements were subject to "grandfathering" provisions or some form of waiver.

Education and Training

In addition to the requirement to establish a Defense Acquisition University structure, DAWIA established the requirement to use a number of recruiting tools to ensure the infusion of a quality civilian workforce: this included the establishment of an intern program within each military department to provide highly qualified and talented individuals an opportunity for accelerated promotion, career broadening assignments, and specified training to prepare them for entry into the Acquisition Corps; the establishment of a cooperative education program; the establishment of a scholarship program; a tuition reimbursement and training program; and provisions for the repayment of student loans.

Accountability

Congress was clearly intent on establishing clear lines of accountability for implementation of DAWIA by squarely placing responsibility within the acquisition chain of command. Accountability took two other forms. First, DAWIA established a minimum three-year assignment period for Acquisition Corps personnel who were assigned to critical acquisition positions. In addition, the tenure requirements for program managers and deputy program managers was set at completion of the first major milestone that occurs closest in time to the date on which the person has served for four years. The concept behind this requirement was to hold acquisition managers accountable for their actions by avoiding "ticket punching" and careerism.

The second area of accountability was in the requirement to establish within the Department of Defense a management information system and to report annually to Congress on the implementation of critical elements of DAWIA. There were thirteen categories of data that were to be reported, including critical acquisition positions, waivers, and promotion rates for officers. The concept behind this series of reporting requirements was to help ensure that the Department of Defense was able to manage and implement DAWIA; thus, the requirements for reporting were intended

more as a tool to help the under secretary of Defense for Acquisition and the service acquisition executives than it was for Congress.

Conclusion

DAWIA was significant legislation that was written to bring about a lasting cultural change in the defense acquisition system by introducing workforce standards backed by legislation and regulation. Reporting requirements increased the visibility of the acquisition workforce within each of the military services, and provided valuable data to the Office of the Secretary of Defense, information that could be used to guide the development of acquisition-related policies. A complete analysis of DAWIA's implementation across the Department of Defense is beyond the scope of this paper and has yet to be written. From an acquisition management standpoint, DAWIA is still very much a work in progress. It is worth noting that the General Accounting Office is required to report annually on DAWIA implementation, but there has never been a Congressional oversight hearing on DAWIA. Thus, the management and oversight of DAWIA implementation has remained the responsibility of the Office of the Secretary of Defense and, to a lesser degree, the military services. As might be expected, each component has implemented DAWIA differently. The civilian-military mix and the selection of "best qualified" has been an issue for all the components. Nonetheless, the Department of Defense acquisition system has benefited from DAWIA.

NOTES

[1] House of Representatives, Committee on Armed Services, *The Quality and Professionalism of the Acquisition Workforce*, 101st Cong., 2d sess., Committee Print No. 10 (8 May 1990), 63

[2] Executive Order 12352 directed the "heads of executive agencies engaged in the procurement of products and services" to "[e]stablish career management programs, covering the full range of personnel management functions, that will result in a highly qualified, well managed professional procurement work force; and Designate a Procurement Executive with agency-wide responsibility to . . . enhance career management of the procurement work force;" EO 12352 is also significant because it called upon the Director of the Office of Personnel Management, working closely with the heads of various executive agencies, to "ensure that personnel policies and classification standards meet the needs of executive agencies for a professional procurement work force." EO 12352 was subsequently revoked on 13 October 1994 by EO 12931; see 59 FR 52387.

[3] PL 98–525, Sec. 1243.

[4] See President's Blue Ribbon Commission on Defense Management, *An Interim Report to the President* (28 February 1986), 14.

[5] See President's Blue Ribbon Commission on Defense Management, *A Quest for Excellence,* Final Report to the President (June 1986), 66.

[6] See President's Blue Ribbon Commission on Defense Management, *A Formula for Action,* A Report to the President on Defense Acquisition (April 1986), 32.

[7] *An Interim Report*, 14

[8] House of Representatives, Committee on Armed Services, *Defense Acquisition Major U.S. Commission Reports (1949–1988)*, Vol. I, 100th Cong., 2d sess., Committee Print No. 26 (1988), V.

[9] House of Representatives, Committee on Armed Services, *A Review of Defense Acquisition in France and Great Britain* (Washington, D.C.: GPO, 1989).

[10] See House of Representatives, *The Quality and Professionalism of the Acquisition Workforce: Report of the Investigations Subcommittee of the Committee on Armed Services*, 101st Cong., 2d sess. (1990).

[11] In August 1985 Deputy Secretary of Defense Taft had issued a policy memo requiring that all Defense components would ensure that 85 percent of their acquisition workforce would be trained in mandatory courses annually. Subsequently a small Acquisition Enhancement Program Office (ACE) was established at the Defense Systems Management College in May 1987 to oversee and manage implementation. But it was hampered in

its work by a lack of centralized funding and control. See DoD Directive 5160.55, 22 August 1988.

[12] House of Representatives, Committee on Armed Services, *Life Is Too Short: A Review of the Brief Periods Managers of Major Defense Acquisition Programs Stay on the Job*, 101st Cong., 2d sess., Committee Print No. 12 (4 July 1990), 6.

[13] Ibid., 10

[14] See House Committee on Armed Services, Investigations Subcommittee, "Proposal for the Creation of a Highly Professional Acquisition Workforce and Acquisition Corps Within Each of the Military Services" (draft), 8 March 1990.

[15] In the first, on 28 March 1990, the Investigations Subcommittee heard testimony from Mr. Math of the General Accounting Office and Mr. Everett Pyatt, former senior acquisition official within the Office of the Secretary of the Navy. Both endorsed the concepts proposed in the draft legislation. This was followed by testimony from the Honorable John A. Betti, under secretary of Defense (Acquisition), the service acquisition executives, Major General Charles Henry, deputy director (Acquisition Management) Defense Logistics Agency, and Major General Lynn Stevens, commandant, Defense Systems Management College. In general, the official position of the witnesses was that this legislation was unnecessary as the issues that had been identified were being addressed through the secretary of Defense's Defense Management Review. The second hearing was held on 24 April 1990 and consisted of a panel chaired by Mr. David Packard. Mr. Packard was accompanied by Mr. Norman Augustine, chairman and CEO of Martin-Marietta, Dr. Ron Fox of the Harvard Business School, and the two former under secretaries of Defense (Acquisition): Mr. Godwin and Mr. Costello.

[16] *Congressional Record*, Vol. 136, No. 85, Part II (28 June 1990), E 2207.

[17] Ibid., E 2210.

[18] "Military Revolving Door Quickens," *Washington Post*, 3 July 1990.

[19] "Quick Transfers in Arms Programs Criticized," *New York Times*, 2 July 1990. Also see for additional press coverage: "Degree Would Be Needed for Select 'Acquisition Corps,'" *Federal Times*, 16 July 1990: 4; "Mavroules To Seek Professional Military 'Acquisition Corps,'" *Defense Daily*, 27 June 1990: 502; and *Insight*, "Rx for Ailing Procurement System," 30 July 1990.

[20] Professional staff members were Colleen Preston, Warren Nelson, Arch Barrett, Cathy Garmen, and Robert Rangel. They also included James Edgar, an American Political Science Association congressional fellow

from the Department of the Air Force, and Julia Denman from the General Accounting Office.

[21] *Congressional Record*, 10 September 1990, H 7271.

[22] *Congressional Record*, 11 September 1990, H 7377.

[23] Ibid.

[24] Ibid., H 7386.

[25] Ibid.

[26] *Congressional Record*, 23 October 1990, H 12208.

[27] 10 U.S.C., Chapter 87, Sec. 1734(e).

[28] All of the following would be critical acquisition positions and the Acquisition Corps membership would apply. Program managers of non-major defense programs must have completed the Program Management Course and have six years of acquisition experience. Deputy program managers of major defense programs must have completed the Program Management Course and have six years of acquisition experience, two years of which were performed in a systems program office. Deputy program managers of non-major programs must have completed the Program Management Course and have at least four years of acquisition experience. Program executive officers (PEOs) must have completed the Program Management Course, have ten years of acquisition experience, at least four years of which were performed while assigned to a critical acquisition position, and have served as either a program manager or deputy program manager. General and flag officers and civilian equivalents must have ten years of acquisition experience, four years of which were performed in a critical acquisition position. Senior contracting officials must have four years of contracting experience.

PART V

Post-Cold War Acquisition

Defense Acquisition in an Uncertain World: The Post-Cold War Era, 1990–2000

Philip L. Shiman

Introduction

The period from roughly 1989 to 2003 was one of both evolution and revolution. Key changes occurred in the strategic realm, as the Cold War ended and the Persian Gulf War ushered in a new era of global activity in a chaotic and unpredictable world. Ten years later, the 11 September terrorist attacks on New York and Washington, and the subsequent wars in Afghanistan and Iraq, again altered the strategic picture. Meanwhile, accelerating technological change, especially in information technology, were transforming the lives and activities of civilians, warfighters, and acquisition specialists alike, and they gave rise to visions of a revolution in warfare as profound as the day when armies first took up muskets and cannons. Changes were slower to come in acquisition practice. The age-old quest for acquisition reform—a quest that has continued as long as there has been acquisition—entered a new phase, with a determined effort to overhaul acquisition at a fundamental level. The reform efforts of the 1990s led to a dramatic overhaul of all aspects of the acquisition process in the early 2000s, with the adoption of new regulations and procedures for the acquisition system, requirements-generation process, and the planning and budgeting system.

The Defense Management Review, 1989–1991

As the decade of the eighties waned, the pressure for reform of the defense acquisition grew. The Cold War was winding down and the Reagan military buildup was over. The massive defense spending of the first half

of the decade—much of which was devoted to acquisition programs—had given way to retrenchment as the fear of economic weakness and massive budget deficits came to overshadow the military threat from a visibly weakening Soviet Union. The country was weary from the various scandals that had come to taint the acquisition program, from the apparent price-gouging of the early eighties to the widespread corruption exposed by Operation Ill Wind in 1988. Public confidence in defense acquisition dropped as the outcry against waste, fraud and abuse grew louder. Relations between the government and the defense industry grew frayed as the Depatment of Defense (DoD) blamed the scandals on its contractors. Congress, irritated by what it considered the Reagan administration's foot-dragging on the issue of reform, increasingly involved itself in DoD affairs, demanding information, scrutinizing every budget request and passing ever more stringent regulations.

By 1986, public pressure forced the administration to establish the President's Blue Ribbon Commission on Defense Management, better known as the Packard Commission after its chairman, David Packard. The commission recommended some sweeping reforms, which would be the blueprint for reform efforts for the next fifteen years. Some of the proposals were quickly adopted; in 1987, Congress acted on the call for an "acquisition czar" for the Pentagon by creating the position of under secretary of Defense for Acquisition (USD[A]). But other recommendations languished for at least two years, such as a more streamlined acquisition organization and improved professional standards for both uniformed and civilian acquisition officials. By 1989, Congress began to entertain ideas for reforms far more radical than those put forward by the Packard Commission, such as the consolidation of all DoD acquisition into a central agency run by civilians.

President George H. W. Bush was mindful of both the anger of Congress and of the complaints from industry about overregulation. Within days of his inauguration, in his first address to Congress, he announced that he was directing the secretary of Defense to develop "a plan to improve the defense procurement process and management of the Pentagon, one which will fully implement the Packard Commission report." He noted that many of the required changes would require congressional action, "and so, I ask for your help. We need less bureaucracy. We need multiyear procurement and two-year budgeting. And . . . we need less congressional micromanagement of our nation's military policy."[1]

The review was carried out under Secretary of Defense Richard Cheney, who presented the *Defense Management Report*, or DMR, in July 1989. As the name suggested, the thrust of the paper was a set of organizational

changes intended to improve the management of the Defense Department. At the top, the DMR sought to provide the Office of the Secretary of Defense (OSD) with tighter control over the planning and decision-making process. For example, the deputy secretary of Defense was to chair the Defense Planning and Resources Board (DPRB) that replaced the old Defense Resources Board (DRB), "to develop stronger links between our national policies and the resources allocated to specific programs and forces." The Defense Acquisition Board (DAB) was reduced in size and, under the leadership of the USD(A), was to "rigorously oversee major systems acquisition" to ensure that the process met DoD policy. The under secretary's task, the plan noted, was "to *discipline* the acquisition system through review of major programs by the DAB." The Joint Requirements Oversight Council (JROC) was also given broader role in articulating military needs and validating performance goals. Managerial streamlining would be achieved by reducing redundancy and centralizing services. For example, financial accounting, then spread among a range of contract administrative services offices and the Defense Logistics Agency (DLA), was to be consolidated in the Defense Contract Management Agency (DCMA).[2]

Yet the DMR also noted that the Packard Commission had called for more profound changes in the acquisition process. The report admitted that "efforts to date have not produced the tangible results envisioned by the commission." It, therefore, laid out the means for promoting clear command channels within the services for program officials, program stability, and limited reporting requirements according to the concept of "management by exception." The DMR paid particular attention to the problems of the acquisition workforce identified by the Packard Commission, including poor training, poor pay, and lack of appropriate experience. It called for the professionalization of the civilian workforce through improved education and attractive, better-defined career paths, modeled in part on a highly successful experiment performed at the Navy facility at China Lake. Military acquisition personnel were also to be provided with better training and more stable careers, made more attractive with assurances of promotion.

To improve systems development, the DMR specified new procedures for reviewing the development of major systems, including the milestone-review process by the DAB. In procurement policy, the DMR endorsed the Packard Commission's emphasis on increasing reliance on commercially available products and adopting competitive practices that focused less on the bottom line than on a mix of cost, past performance, and other considerations in order to achieve the "best value" for the government.

Addressing the contracting scandals of the previous administration, the DMR warned that "DoD will not tolerate illegal or unethical behavior on the part of *anyone* in the acquisition systems." It ordered the formation of a DoD Ethics Council, but otherwise called for industry to police itself better.

The DMR acknowledged that there was much that OSD and the services needed to do to implement the plan. However, echoing Bush's February speech, the DMR emphasized that congressional support would be necessary, both to pass the requisite enabling legislation and to reduce the regulator burden on DoD and the contractors. It cited a recent report by the Office of Technology Assessment (OTA), which had declared that "while Congress did not intend the [acquisition] system to be slow, cumbersome, and inefficient, laws passed to foster goals other than efficient procurement have made it so."[3] Furthermore, congressional oversight had become micromanagement, the DMR suggested: Every day saw three new General Accounting Office (GAO) audits of DoD, 450 written and 2,500 telephone inquiries from Capitol Hill, and three separate reports to Congress averaging 1,000 man-hours and $50,000 in expenses.

The DMR was sometimes accused of being a "top-down" document.[4] Yet its attempts to achieve fundamental reforms were ambitious, though it may be questioned whether they had a significant impact below the OSD level. In any event, the DMR became the guiding document for the remainder of Cheney's administration of DoD, and a determined effort seems to have been made to implement its provisions. For example, DoD pushed forward its review of the myriad regulations and instructions governing the acquisition process. By 1992, DoD had "examined more than five hundred acquisition directives and instructions and identified almost four hundred for cancellation, consolidation, or revision." More than half of those 400 were cancelled. The 5000 series acquisition documents were overhauled, with fifty separate directives and fifteen policy memoranda being eliminated or reduced into a single directive (5000.1), instruction (5000.2), and manual (5000.2–M). The Defense Federal Acquisition Regulation Supplement (DFARS) was likewise overhauled and rewritten, its length being cut in half. The new DFARS took effect on 31 December 1991.[5]

These revisions appeared to represent a far-reaching attempt to streamline the acquisition process, but they did not necessarily simplify it. The three new 5000 series documents totaled 900 pages long—no previous versions had ever exceeded sixty pages. In place of congressionally mandated regulation, they imposed OSD-mandated regulation. They now covered all acquisition programs, not just the major systems, though they divided the programs broadly into four acquisition categories (ACATS),

with ACAT I being major systems. On the whole, the new 5000 series documents centralized control within OSD and sought to impose discipline by replacing the informal, personal-based communication with formal, written reporting.[6]

Congress responded to the administration's plea for legislative support. Responding to a DMR white paper that reviewed Congressional oversight, Congress eliminated 30 percent of the recurring reporting requirements.[7] Another significant congressional action was the creation of the Acquisition Law Advisory Panel. Established in Section 800 of the National Defense Authorization Act of 1991, the committee, more commonly known as the "Section 800 Panel," consisted of experts from academe, industry, and the government who were charged with recommending changes in the acquisition laws in order to streamline the defense acquisition process. The panel would report in January 1993.[8]

To promote the professionalization of acquisition personnel, Congress passed a key piece of legislation called the Defense Acquisition Workforce Improvement Act (DAWIA). The Packard Commission and the *Defense Management Report* had emphasized the importance of improving the workforce, and the legislators' own studies led to the same conclusion. DAWIA, a part of the National Defense Authorization Act of 1991, directed DoD to provide for the career management of the acquisition workforce. Each service was to establish a special Acquisition Corps with its own selection, assignment, and promotion policies, and to establish clear and effective policies for balancing the use of civilians and military officers in acquisition capacities. To ensure this was done, the act established a full-time Director, Acquisition Career Management (DACM). It set standards for qualifications of acquisition officials, and established the Defense Acquisition University with specifications as to how the workers were to be trained.[9]

DAWIA was probably the most important law to come out of this period, because acquisition reform depended heavily on the cooperation and even the initiative of the workforce itself. In the past, the Office of the Secretary of Defense, Congress, or some outside commission had imposed reform upon the acquisition bureaucracy, which was large and fragmented into various agencies and services that had their own traditions, policies, and administrative imperatives. Yet as the reformers of the 1980s had recognized, it was not enough simply to rework the organization and procedures of the acquisition agencies; the broader culture itself required change. Under Cheney, OSD acknowledged but did not emphasize this fact, and suggested that a few training sessions for the procurement community would suffice.[10] Cheney's successors would consider more fundamental

cultural change essential and would make such change central to their reform efforts. DAWIA potentially laid the groundwork for those efforts, though its effects could not be felt for some time.

The Peace Dividend

Throughout the Bush presidency, the world was changing rapidly. In late 1988 Soviet President Mikhail Gorbachev announced that he was unilaterally cutting the Soviet military; a few months later he began withdrawing forces from Eastern Europe. In 1989, the communist regimes in Eastern Europe collapsed; the Berlin Wall fell in November, and Germany reunified nearly a year later. The Warsaw Pact and NATO signed the Conventional Forces in Europe (CFE) Treaty in November 1990, drastically reducing the deployed forces. For all practical purposes the Warsaw Pact existed in name only, and it was finally dissolved formally in July 1991. Meanwhile, the Soviet Union itself was disintegrating. Gorbachev's campaigns of *glasnost* ("openness") and *perestroika* ("restructuring"), intended to strengthen the Soviet state, instead unleashed the centrifugal forces that would tear it apart. The various republics began to break away, beginning with the Baltics. The collapse of the central state accelerated after the attempted coup of the hardliners in Moscow in August 1991, and by the end of the year the Soviet Union no longer existed.

The Bush administration was initially wary of the transformation occurring in the East, but by 1990, the fall of the Soviet empire in Europe had pushed the Soviet Union's military frontier back to its own unstable border. The conventional military threat to NATO was over, at least for the foreseeable future. In a major address to the Aspen Institute at Aspen, Colorado, on 2 August, the President declared that "the Cold War is now drawing to a close" and that "[w]e're entering a new era." Bush announced a major shift in U.S. strategy. Henceforth, the decades-long focus on deterring an attack on Western Europe would give way to one that emphasized engagement around the world, helping to guide and manage change and deter or defeat threats wherever they might arise. "[T]he world remains a dangerous place with serious threats to important U.S. interests wholly unrelated to the earlier patterns of the U.S.-Soviet relationship. These threats . . . can arise suddenly, unpredictably, and from unexpected quarters." The United States should reduce its armed forces, but it still needed a military capable of protecting its interests and those of its friends and allies. It must remain forward deployed, engaged with the world, and ready to deploy quickly in the event of a major regional conflict. This address would lay the foundations for American military strategy in the 1990s.[11]

With the Soviet threat receding, other, more domestic issues began to loom larger, in particular the state of the economy. After years of high interest rates, a burgeoning deficit, and poor gains in productivity, the economy was weak, and by early 1990 there were growing calls for a "peace dividend." Significant cuts in the defense budget and force structure were inevitable. Following a plan developed by the chairman of the Joint Chiefs of Staff, General Colin Powell, the administration planned to cut 25 percent from the services by 1995 to achieve a level known as the "Base Force." This would include a total personnel level of 1.6 million, down from 2.14 million in FY 1990. The number of active Army divisions would drop from 18 to 12, the Air Force tactical fighter wings from 24 to just over 15, and the Navy's ships from 600 to 451, including 12 carriers.[12] Meanwhile, the Base Realignment and Closure (BRAC) Commission had already begun the politically painful process of closing bases to reduce infrastructure that would not be needed in the post-Cold War world.

The debate over the defense budget was particularly fierce, waged between a cautious administration and a divided Congress demanding larger reductions. In 1990 the showdown between the two branches led to a budget agreement in November. Between FY 1990 and FY 1993, the defense budget declined 15 percent in real terms, from $381 million to $321 million (in constant FY 2001 dollars). Acquisition was hardest hit; procurement accounts dropped 40 percent in real terms, while research, development, test and evaluation declined by only 4 percent.[13] The administration tried to protect its major developmental programs, especially such strategic systems as the B–2 stealth bomber and the Strategic Defense Initiative, while cutting legacy procurement programs and some developmental conventional systems, especially the Marine Corps V–22 Osprey tiltrotor aircraft and the Navy's troubled A–12 Avenger II Stealth bomber program. Pressure from Congress saved the V–22, but the A–12 was plagued by rampant cost and weight overruns and egregious management problems. By the time Cheney shut it down in 1991, it had provoked a scandal that led to the unprecedented disciplining, reassignment, or resignation of several OSD and Navy officials, including Under Secretary of Defense for Acquisition John Betti.[14]

The drop in procurement accelerated the ongoing decline of the defense industrial base. Unlike the post-Vietnam slowdown, the international situation meant that there was little prospect of a new boost in defense spending for the foreseeable future, and companies across the country cut their workforce and closed plants. This caused particular concern as the country slipped into a recession by 1991, and the administration had few solutions to offer. The cutbacks threatened not only the industrial base but also the research and development (R&D) infrastructure, which was

considered critical to maintaining the country's technological edge over its potential adversaries. One of the pillars of Bush's National Military Strategy was the concept of "reconstitution": If the Soviet Union (or another peer competitor) should revive, the United States should be able to restore its military strength with reasonable speed.[15]

Thus, while reducing the armed services' force structure, the administration sought to maintain their technological edge. This is why the R&D funding remained steady under this administration even as procurement declined. There was considerable debate in the defense community and Congress over proposals to promote the development of prototypes that would then be put "on the shelf" until needed. Other proposals called for a "fast-track" acquisition process that would rapidly field successful prototypes, bypassing the traditional acquisition pipeline. DoD rejected both of these ideas in their extreme form. In 1992, Cheney reaffirmed that acquisition programs had to pass through the multiphase pipeline as defined in the 1991 revision of the 5000 series regulations. Defense acquisition would emphasize research and development, including the development of prototypes and "advanced technology demonstrators" (ATDs) to test concepts and system components. However, DoD would procure only those systems that were absolutely required in the field and that had been demonstrated to be low-risk. Cheney's plan was very controversial, especially in the defense industry, which feared the loss of procurement contracts in favor of less-lucrative R&D work.[16]

The Revolution in Military Affairs

On 2 August 1990—by a bizarre coincidence, only hours before President Bush's Aspen address—Iraqi forces crossed the border and seized the Emirate of Kuwait. This act was the sort of naked aggression that Bush feared in the post-Cold War "New World Order"; it was, in fact, exactly the sort of regional conflict he had warned about at Aspen.[17] The resulting coalition operations, DESERT SHIELD (August 1990–January 1991) and DESERT STORM (January–March 1991), represented the largest American military buildup and operations since Vietnam.

DESERT STORM marked a watershed in warfare. At first, it appeared to pit two Cold War-era forces against each other. The Iraqis used only basic Soviet-made equipment but were battle-hardened by years of war with Iran, while the Coalition forces were well-trained and technologically sophisticated but largely untested in battle. Yet the outcome was unexpectedly lopsided: The Iraqi forces were routed with heavy losses in men and equipment, while the Coalition suffered surprisingly light losses

in personnel (293 deaths, only half in battle) and negligible losses of equipment. The five-week air campaign was devastating, and the ground attack took only 100 hours to expel the Iraqis from Kuwait.

What largely impressed observers around the world was the remarkable array of new high-technology systems. The war saw the first use of stealth aircraft and Tomahawk cruise missiles, which helped neutralize the sophisticated Iraqi air defenses. Precision munitions such as laser-guided bombs struck fixed targets and stationary vehicles with seeming ease. Night vision and thermal imaging equipment gave Coalition armored forces a decisive advantage over the Iraqis tanks, which were often destroyed before they even realized they were in danger. Forward-looking infrared (FLIR) sensors gave Apache helicopters the same advantage. AWACS aircraft kept close watch on enemy air movement, and the airborne Joint Surveillance Target Attack Radar System (Joint STARS)—which was still only a prototype when DESERT STORM began—tracked moving targets on the ground. Unmanned aerial vehicles provided tactical reconnaissance for the Marines. Far overhead, satellites provided high-resolution surveillance imagery, navigation data, and instant communications. Coalition units and even individual personnel navigated effectively in the trackless desert using the new Global Positioning System (GPS).[18]

This was not, of course, the first time that high-tech equipment was used in war. Guided munitions had made their appearance as far back as World War II and had proved effective in Vietnam, the Middle East in 1973, and the Falklands in 1982. Nor was DESERT STORM an entirely high-tech war. Stealth aircraft (i.e., the F–117) conducted only 2 percent of the 112,000 sorties, and the smart bombs constituted only 7.4 percent of the total tonnage of ordnance dropped.[19] Although personal computers were used extensively for command and control, the headquarters were hardly digitized; electronic data had to be carried from machine to machine by floppy disk, and operational orders—including the massive Air Tasking Orders (ATO) that coordinated the air campaign—still had to be delivered by hand in hard copy, even to ships in the Persian Gulf. There are still questions about the effectiveness of some of the technology. The Air Force proved unable to locate or destroy mobile missile launchers in its "Scud hunts." And to this day, analysts debate the effectiveness of the Patriot missile batteries against the Scud attacks in Saudi Arabia and Israel, with some claiming that few—if *any*—hits occurred.[20]

Nonetheless, the performance of the new weaponry was impressive—and made all the more so by the daily press briefings that carefully highlighted video footage from the most successful precision strikes. To many observers, the war merely confirmed that the new technologies would have profound,

even revolutionary, consequences for warfare. "The Gulf War provided the world with a vivid demonstration of the revolution in military technology that is reshaping the nature of warfare," Secretary Cheney wrote in his annual report in February 1992. "High technology systems vastly increased the effectiveness of our forces. . . . The exploitation of these new technologies promises to change the nature of warfare significantly."[21]

This was hardly a new idea. A number of theorists, including Andrew Marshall of the Pentagon's Office of Net Assessment, had long foreseen such a development. As far back as the 1970s, the Soviets had predicted a "Military Technical Revolution." But the images of bombs hitting bridges and buildings lent force to these visions of future warfare, which were soon gathered under the heading of the "Revolution in Military Affairs," or RMA. An extensive literature soon grew up around this highly complex concept.[22]

Some theorists focused largely on the technological components of this so-called revolution, in particular on the impact that information technologies (IT) would have on future warfare. Based largely on the rapid development of the microprocessor and related technologies (such as digital networks), IT was expected to give the United States and its allies a decisive advantage over their enemies. It would allow forces equipped with highly precise weapons, networked command and control and sensor systems, and advanced navigation systems to lift the "fog of war," giving them the ability to conduct operations with a minimum of casualties or collateral damage. Admiral William Owens, vice chairman of the Joint Chiefs of Staff during the mid–1990s, foresaw the seamless linking of sensors, weapons, and decisionmakers in what he called the "system of systems."[23] The role of information came to loom so large in these visions of warfare that it gave rise to the closely related concept of "information warfare," which calls for securing the intelligence and communications of friendly force while disrupting the enemy's ability to collect, process, and disseminate accurate information of his own. As Admiral Owens stated to Congress in February 2001, ". . . if we are able to view a strategic battlefield . . . and prevent an enemy from doing so, we have dominant battlefield awareness, and we are certain to prevail in a conflict."[24] Another subsidiary, information-based concept was the "Revolution in Military Logistics," intended to support the mobile forces with a leaner, more efficient processes and organization.[25]

Other theorists linked these technological changes more to the evolving international situation, where the threat of major war, even on the scale of DESERT STORM, appeared to be overshadowed by the small but nasty local conflicts around the world, often involving separatist guerrilla movements, drug and crime syndicates, ethnic nationalists, and other nonstate actors.

According to these thinkers, large, conventionally equipped and organized armies that were designed to fight other armies were incapable of adapting to the new mode of warfare, where combat could occur unexpectedly, probably in a dense population center against an uncertain enemy. The battle in Mogadishu, Somalia, in October 1993, during what had begun as a humanitarian operation, was a vivid and painful example of such a conflict. And with the proliferation of advanced weaponry, even a second- or third-tier regional power could become a dangerous opponent when armed with cruise or ballistic missiles and weapons of mass destruction. Therefore, the theorists said, the mass armies of the past must give way to small, light, lethal forces using the new technologies for greater speed and battlefield effectiveness. Thus, in their eyes, the Gulf War was not an example of an RMA conflict, in spite of its use of RMA technologies, but instead perhaps the last of the old-style wars requiring a large-scale mobilization, an extended buildup phase, and a mass attack by ponderous armored forces supported by a massive logistical infrastructure.

The military services began—slowly—to adopt and even embrace some of the RMA concepts. The first was the Army, under Chief of Staff General Gordon Sullivan (1991–1995), who envisioned a "digitized" Army he called Force XXI. As early as 1992, he ran a series of exercises called the Louisiana Maneuvers—named for those that introduced the Army to armored warfare in 1940—to explore the impact of the new information technology on Army organization and doctrine.[26] At the end of the decade, Chief of Staff General Erik Shinseki (1999–2003) embraced the notion of making the Army more mobile and lethal, and through a process called "transformation" he promoted acquisitions such as the wheeled Stryker vehicle and a light, distributed "Future Combat System" in place of the heavy tank. The Air Force emphasized stealth, precision munitions, and command and control networks as part of its "Global Reach, Global Power" concept. The Marine Corps tested concepts for fast, mobile operations called "Operational Maneuver From the Sea" and "Ship-to-Objective Maneuver," and the Navy embraced the system-of-systems approach with its concept of Network-Centric Warfare. In 1997, the Joint Chiefs of Staff itself formally endorsed a variation of RMA doctrine with its publication of *Joint Vision 2010*.[27]

There were, however, severe obstacles in the way of the universal adoption of RMA thinking. First, the concept was by no means universally accepted. Not everyone was willing to embrace the changes that it would entail or even agreed that the idea is valid. There was, indeed, cause for concern that overemphasis on the technological factors of warfare could lead to the dangerous neglect of the human element. The organizational

and doctrinal changes needed to implement fully the RMA concept would be disruptive to career paths and traditional lines of authority, a disquieting notion to those with careers invested in the traditional military.

Second, the various reviews that set official policy in the nineties—the Base Force plan of the Bush Administration, the Bottom-Up Review of the first Clinton administration, and the first Quadrennial Defense Review of the second—all emphasized the threat of a regional rogue power fighting a conventional, Persian Gulf-style "major regional contingency" or "theater war," and the United States steadfastly sought to maintain a force structure suitable to fighting two of them. Indeed, to many observers it seemed dangerous to risk the military fortunes of the United States on an untried theory while such threats existed.[28]

A third problem was that the services remained committed to Cold War-era legacy acquisition programs, and with the budget squeeze of the 1990s, funding for the development and procurement of new, advanced technology was limited. Once a program is well along it hangs on for dear life, often with congressional help, and when budgets are declining the tendency is to stretch it out rather than end it altogether. Cheney's experience with the V–22 and the A–12 were instructive: He failed to kill the first and, though he succeeded with the second, the issue went into expensive litigation that was not finally settled until more than a decade later.

A final problem was that the Department of Defense had particular difficulty adapting its acquisition process to the research, development, and procurement of the information technology so central to the RMA concepts. IT typically has product development cycles measured in months, while defense cycle times average years and even decades. Most new weapons acquisition programs used obsolete technology—sometimes by several generations—well before they even went into production. Many systems operational at the end of the century still used the equivalent of the Intel 80286 chip, which had not been in widespread civilian use for almost fifteen years. The insistence on applying military standards and military specifications to defense procurements prevented timely purchase of commercially available parts, and few companies were willing to adapt their products for military purposes. Indeed, given the good market for commercial IT during the 1990s and the onerous burdens associated with government procurement, many companies were unwilling to do business with the government at all.[29]

An example of the bureaucratic problems inherent in commercial-off-the-shelf (COTS) IT purchasing occurred during the Gulf War. The Army placed an emergency order for 6,000 widely marketed commercial radio receivers, and the urgency was such that it waived all military requirements

and specifications. However, no procurement official could be found who was willing to take responsibility for waiving the requirement for the company to certify that the Army was being offered the lowest available price. No company official would make such a certification either, for fear of making an accidental misstatement that would constitute a felony. The impasse was broken only when the Japanese government bought the radios without certification and donated them to the U.S. Army as part of its contribution to the war effort.[30] Any serious effort to make information technology central to defense acquisition would have to find a way to cut through such regulations. This became a major focus of the next administration.

Reinventing Defense Acquisition, 1993–1997

The Clinton Administration entered office committed to fundamental reform, far more than any of its predecessors. The idea was to "reinvent government," the stated goal of the National Performance Review headed by Vice President Al Gore. Procurement reform was a centerpiece of this effort, not just in DoD but throughout the federal government. The "reinventing government" philosophy was based on two basic ideas: the embrace of information technology, from putting computers in the classroom to the overhaul of government operations; and the empowerment of the federal workforce through deregulation, decentralization, and the encouragement of innovation. This second objective ran counter to the principles of the reform movement of the 1980s, which emphasized heavy regulation of the workforce on the theory that it could not be trusted. Indeed, some of the early opponents of the Clinton administration's reforms were the old Democratic committee chairmen in Congress.[31]

DoD itself was staffed with such reformers as Les Aspin, Clinton's first secretary of Defense; Bill Perry, Aspin's deputy and successor; John Deutch, under secretary of Defense for Acquisition (soon renamed under secretary of Defense for Acquisition and Technology, or USD[A&T]); and Paul Kaminski, Deutch's successor when the latter became Perry's deputy. They were predisposed to reform, but in any event they had little choice: The acquisition system could not continue to function in the traditional ways. As a candidate, Clinton had pledged to reduce the last Bush defense budget by a further $60 billion. The budget, in decline since 1985, continued to fall throughout Clinton's first term. The overall defense budget dropped almost 21 percent in real terms from fiscal 1993 to fiscal 1997; during that time procurement dropped 25 percent while R&D spending fell about 9 percent.[32] Overall, procurement had fallen almost 70 percent since the 1980s. The

administration also reduced the force structure below that of the Base Force, until it leveled off at just under 1.4 million personnel.

Yet Secretary Aspin's Bottom-Up Review in 1993 adhered to the fundamental strategy laid down by its predecessor, that of preparing to fight two major regional contingencies. Under fire from the start for its supposedly antimilitary leanings, the administration was unable or unwilling to confront the defense establishment directly over acquisition. It made little attempt to challenge the services' major acquisition plans and programs, preferring instead to starve them slowly. Under these circumstances, DoD could no longer afford to pay a premium for defense-specific technologies or to support a bloated defense industry and infrastructure. Furthermore, new approaches were required to obtain the required high technologies that would be difficult or impossible to obtain from defense industries alone. DoD would have to learn to work with commercial industry, which meant adjusting its own acquisition practices.

Deputy Secretary—and later Secretary—Perry was the driving force behind DoD's reform effort. He had overseen weapon system R&D and procurement in the Carter administration, and after returning to industry and academe, he promoted acquisition reform as a member of various panels, including the Packard Commission and the Defense Science Board. He had given much thought to acquisition reform during his long career, and he understood that the problems were complex and would require careful and sustained effort.

Perry realized that the first requirement was to institutionalize reform, giving someone the full-time job to plan and monitor it. Soon after entering the administration, he and Aspin established the position of deputy under secretary of Defense for Acquisition Reform (DUSD[AR]), with a dedicated staff to plan and oversee all reform activities. To this key position he appointed Colleen Preston, a lawyer and long-time congressional staff member who had worked on the Competition in Contracting Act of 1984, the Defense Procurement Reform Act of 1984, the Defense Procurement Improvement Acts of 1985 and 1986, and the Defense Acquisition Workforce Improvement Act in 1991. As general counsel of the House Committee on Armed Services under Aspin, she had been a driving force behind the Section 800 Panel, and she now made its recommendations a centerpiece to her initial reform efforts.[33] She was hard-driving and energetic. An administration colleague and fellow reformer later noted that she was "acquisition reform's legendary streetfighter during the tough years of bureaucratic battles within the Pentagon over the direction and pace of reform."[34] To ensure that the reform effort penetrated down to the services, similar acquisition reform offices were established in each of the military departments.

Preston immediately began working with Perry and Deutch to devise a program for acquisition reform. Within a week of his confirmation as secretary of Defense in February 1984, Perry released the plan, titled *Acquisition Reform: A Mandate for Change*. The plan outlined a comprehensive program calling for flexibility, streamlining, and low-level initiative in procurement, and emphasizing the importance of commercial purchasing. It also indicated that reform would be an ongoing process, with new ideas tried and implemented as appropriate.[35] To advise on the implementation of the plan and to build consensus for it within DoD, Preston organized the DoD Acquisition Reform Senior Steering Group (ARSSG), comprising senior acquisition officials in OSD and the services, the director of the Defense Logistics Agency, the vice chairman of the Joint Chiefs of Staff, and the DoD inspector general.[36]

The administration decided to attack the problem of acquisition reform in three rounds, reflecting immediate, near-term, and long-term goals. The first round sought to achieve actions with a high-payoff or one-time opportunity to effect change. One of these was to assemble a package of legislative proposals for Congress based on the recommendations of the Section 800 Panel, which had reported in January 1993. Second- and third-round activities depended on priority and available resources. The administration's goals were to reduce the requirements for government-unique specifications and standards, promote the use of commercial practices, improve the decision-making process for major systems, streamline the procurement process through improved source selection procedures and approved business practices, improve contract administration and regulation, and define metrics for success. Responsibility for formulating the various initiatives and policies to accomplish these goals was assigned to interagency groups of experts and practitioners called process action teams (PATs).[37]

Although following the acquisition principles espoused by the Packard Commission (which had been formulated under Perry's guidance), this reform program differed significantly from earlier efforts, including Cheney's *Defense Management Report*. It was not limited to organizational rearrangements and managerial improvements at the OSD level, but instead focused on the low-level business practices of program managers and other acquisition officials and workers. These included the replacing of military with commercial specifications and standards and the purchase of COTS technology where feasible. Perry also promoted a variety of other innovative practices, such as the use of the Single Process Initiative and Integrated Product Teams, an outgrowth of Total Quality Management (TQM) popular in the 1980s and early 1990s. To encourage the adoption of these methods,

Perry and his subordinates issued letters, memoranda, and instructions urging or ordering their use. Many of these concepts were enshrined in a new revision of the 5000 series acquisition documents issued in 1996.[38]

Congress cooperated fully in providing the necessary authority for regulatory changes. This was partly because there were no longer any outspoken opponents of reform, as in the eighties; reform was a bipartisan issue, with leaders of both parties in favor. Indeed, after 1995, this was one of the few issues on which the Republican-controlled Congress and the Democratic administration could agree. Furthermore, the administration included many former congressional staffers such as Preston, who had close ties with Capitol Hill and could work closely with it to fashion the legislation to everyone's satisfaction. Finally, the report of the Section 800 Panel provided a clear, unambiguous course of legislative action acceptable to both the executive and legislative branches.[39]

The legislative package presented by the administration was enacted in 1994 as the Federal Acquisition Streamlining Act (FASA or FASTA).[40] FASA made procurement easier by exempting commercial items from unique government requirements, allowing the use of simplified buying procedures for inexpensive purchases, and promoting the use of electronic commerce. It also called for performance-based management and the increased reliance on commercial products. This was a landmark piece of legislation, not because it fully overhauled the government's acquisition system—it did not—but because it signaled to the workforce that the reform movement had full congressional support and the force of law. Indeed, acquisition workers would often justify innovative procurement actions on the basis of FASA, whether or not the law actually applied to the particular case. Two years later Congress passed a pair of laws, the Federal Acquisition Reform Act (FARA)[41] of 1995 and the Information Technology Management Reform Act of 1995 (ITMRA), which together were known as the Clinger-Cohen Act.[42] These acts further streamlined the acquisition process, especially for information technology.

The reformers understood that all the reform edicts in the world would not stick unless the culture of the acquisition workforce changed. They believed they had to create a new, reform-minded culture. The new leaders tirelessly promoted reform by giving frequent speeches and interviews, holding symposia and conferences devoted to reform, publishing reform newsletters and reform-oriented articles in the established journals, publicizing acquisition reform "success stories," and publicly rewarding innovators and effective managers. They held holiday-like Acquisition Reform Days—the first was on 31 May 1996—when all workers stopped their regular routine to learn about reform. The Acquisition Reform

Communications Center (ARCC) was established under the auspices of the Defense Acquisition University to provide additional educational tools. The various professional educational courses were reworked to explain the new approaches, and certification standards were tightened. The reformers promoted the use of the Internet to improve communication among and disseminate information to the workforce, to "get the message out." The acquisition reform offices in OSD and the services all set up websites making information and ideas widely available. One important new resource was the Defense Acquisition Deskbook, an online reference tool and instruction book. The deskbook included both mandatory regulations and discretionary guidance, with emphasis on the latter. The goal was to teach and encourage workers to use their own judgment in devising plans and making decisions, which was difficult after the long years of frequent audits, persistent investigations, well-publicized scandals, and zealous prosecutions. "That's [something] we have talked about for a long time," Preston said, "but nobody has been able to break the code and change the culture of everybody living in fear of the [inspector general]."[43] Through all these efforts, acquisition reform became the mantra of the nineties.[44]

The military departments responded by issuing their own directives and instructions matching those of OSD. They also launched their own initiatives, again mirroring those of OSD. For example, the assistant secretary of the Navy for Research, Development, and Acquisition (ASN[RDA]), John Douglass, declared in 1996, "Acquisition Reform is a top priority within the Navy." The service issued a new version of SECNAVINST 5000.2, its equivalent of DoD's 5000 series documents, adopting many of the reform ideas. The Navy also established an Acquisition Center of Excellence (ACE).[45] The Air Force issued its "Lightning Bolts," initiatives intended to achieve some of the goals of the reformers, albeit in a more limited way.[46]

The reformers attacked various aspects of the acquisition problem. One key effort was to speed the fielding of new technologies and systems, partly by improving the input by the warfighters into both the requirements and developments process. With regards to the requirements process, Admiral William Owen set about reorganizing the Joint Requirements Oversight Council, which he chaired from 1994 to 1996. Established under the Goldwater-Nichols Act, the JROC comprised the service vice chiefs under the leadership of the vice chairman of the Joint Chiefs of Staff. It was intended to promoted jointness in the development of requirements, the first step in the acquisitions process. In practice, however, the original JROC had proved a disappointment. It relied on consensus for making decisions and, as a result, became more of a discussion group and a rubber

stamp for service wish lists than a vigorous participant in the origination, selection, and definition of requirements. Civilians in OSD and the military departments tended to dominate the process in their capacity as budget and program planners. Owens reformed the JROC to strengthen its influence and authority even outside of its narrow acquisition functions, and he devised a new organization to link it more closely with the Joint Staff, the regional commanders-in-chief (CINCs), and the services in the analysis of future warfighting requirements. Owens's reforms had only moderate success. The very nature of JROC, with its need for consensus, sharply limited the influence it could exert. It proved useful for ensuring that joint issues were considered in service acquisition programs, but it still did not take a forward role in shaping the direction of major systems acquisition.[47]

The administration also tried to improve warfighter input into the R&D process through the establishment of Advanced Concept Technology Demonstrations (ACTDs). These were an outgrowth of the Cheney's Advanced Technology Demonstrations (ATDs) of 1992. Aspin adapted the idea with a new name and a somewhat new objective. Aspin intended the ACTDs to be used to interactively refine the operational concepts for the new technologies and to perfect the system designs. He did not intend for the prototypes to be fielded. However, Perry realigned the concept by adding the idea that the ACTD systems should be fielded if they prove successful, in the way that Joint STARS was fielded during the Gulf War. However, he also restricted them to smaller, simpler systems that had joint applications, such as a countermine system, an enhanced fiber-optic guided missile, and a high-altitude endurance unmanned aerial vehicle. In other words, they were not to be large-scale, complex platforms such as a manned aircraft or armored vehicles. Many of the later projects approved as ACTDs represented information systems (especially command and control systems) of use in a high-technology military force or defenses against sophisticated weaponry. The ACTDs were to help provide the services with RMA-oriented enabling technologies as quickly and as inexpensively as possible.[48]

A key goal of the reformers was to promote the integration of civilian and military industry by shifting from reliance on a defense-specific industry to one that provided dual-use, commercially available technologies. This was done in part through regulatory reform, based on the recommendations of the Section 800 Panel. On 29 June 1994, Perry instituted a performance-based (versus a standards-based) solicitation process and mandated the replacement of military specifications with commercial standards. Instead of specifying the detailed characteristics and design of a system, the services were to indicate the desired performance standards and allow the contractors to come up with ways to accomplish

them.[49] By easing the requirements for the use of military specifications and standards, as well as a host of other regulations governing reporting and contracting, the reformers hoped to lure commercial firms into doing business with DoD. Meanwhile, companies were encouraged to invest in dual-use technologies marketable for both defense and civilian applications. The Technology Reinvestment Project (TRP), authorized by Congress in the fall of 1992, provided grants to companies to make such investments in suitable technologies of interest to DoD.[50]

For those defense-oriented companies that could not or would not convert to civilian or dual-use production, however, the administration initially had little sympathy. Aspin and Perry set off a frenzy of mergers after a 1993 dinner that industry leader Norm Augustine famously referred to as "the Last Supper." The DoD leaders bluntly told industry officials that the defense budget would continue to decline and that "we expect defense companies to go out of business. We will stand by and watch it happen." This consolidation actually accelerated what had already begun in the 1980s. Of approximately fifty major defense companies in 1982, only five remained by 1997.[51] This led to fears about the lack of competition, and the administration was forced to devise ways to ensure that not only was more than one company available to bid on a contract, but that the work of production would be spread among all appropriate companies, so that alternate suppliers would always be available and the loss of a major competitive procurement would not put any company out of business. The administration that began by proclaiming that it did not care if companies went out of business, soon found itself propping them up often to the detriment of the tightly stretched procurement accounts.

The "Death Spiral," 1997–2001

The second Clinton administration continued its emphasis on reform. Underscoring that fact, in early 1997 the White House published the *Blair House Papers*, a pocket guide to the reform concepts espoused by Gore's National Performance Review.[52] Reform continued to be emphasized at DoD also, but under a new set of reformers. Perry stepped down as secretary and was succeeded by William Cohen, a Republican senator who had sponsored reform legislation such as the Clinger-Cohen Act. His deputy, John Hamre, was another former congressional staff member who served as the Pentagon's comptroller in the first administration. The new under secretary for Acquisition and Technology (soon to be the under secretary for Acquisition, Technology, and Logistics, or USD[AT&L]) was Dr. Jacques Gansler, a well-known defense intellectual who had written a

number of books and articles on acquisition policy and reform (largely on the problem of civil-military integration) and participated in acquisition reform studies, including the Packard Commission.[53] His new deputy for acquisition reform would be Stan Soloway, a consultant and lobbyist who had been an active member of the Acquisition Reform Working Group, an industry organization.

Even more than the first administration, the second took strongly to the RMA idea as expressed in *Joint Vision 2010.* However, like the first, the second administration effected no major structural, strategic, or acquisition changes. The congressionally mandated Quadrennial Defense Review (QDR), released by DoD in May 1997, was widely seen as promoting the fundamental status quo, with continued emphasis on defending against two major regional contingencies (now called "major theater wars"). Although the defense budget had leveled off and even began showing modest growth, much of this was eaten up in the cost of the various peacekeeping and humanitarian deployments and in the rising costs of maintaining current equipment. In spite of all its reform activities and in spite of the budgetary pressures, the first administration had been unable to significantly bring down the cost of developing major systems.

The dilemma was that as the existing equipment—much of it procured during the 1970s—aged, the cost of keeping it in operating condition rose dramatically, especially when it received heavy use in such operations as combat in Serbia in 1999 and the extended enforcement of the no-fly zones over Iraq. The procurement accounts, already too small to permit large-scale modernization of the force, were often raided to support operations and maintenance, causing considerable program delays, disruptions and instability, as well as shortages of spare parts. Newer and more modern systems were increasingly unaffordable, but the longer modernization was delayed, the older and more fragile the existing equipment became, and therefore the more expensive it became to maintain—thus further eating up scarce defense dollars. Gansler aptly termed this vicious circle the "death spiral," and he gave dire warnings of the ultimate consequences if left unchecked, including the prospect of major program terminations.[54]

The financial pressure was even making itself felt in the reform movement. Although the reformers had introduced a number of concepts to be applied to programs, one came to dominate: Cost as an Independent Variable (CAIV), which essentially meant that the cost of a system would be considered along with its usefulness, added value, risk, and the time required to develop it. Instead of being one factor under consideration, cost in many cases became the primary factor, and affordability became a standard buzzword in briefings and sales pitches. Gansler himself issued

a paper in January 1999 entitled *Into the 21st Century: A Strategy for Affordability.*[55] Meanwhile, programs continued to stretch and, in the long run, grow more expensive.

In lieu of canceling major programs, DoD sought to squeeze yet more efficiencies out of them. In accordance with the QDR, Secretary Cohen formed a bipartisan Defense Reform Task Force and, in the fall of 1997, announced a new effort, the Defense Reform Initiative (DRI). This initiative would seek to accomplish a "Revolution in Business Affairs," fundamentally changing the way the Pentagon operated by streamlining DoD functions, adopting the best business practices of the private sector, consolidating redundant organizations, outsourcing as many activities as possible and allowing industry to compete with the government, and eliminating excess infrastructure. The plan would make heavy use of information technology, for example, by seeking paperless transactions. In many respects, it harkened back to early reform plans: While maintaining and using the concepts introduced under Perry, the DRI focused on improving *management* and saving money by eliminating waste, increasing efficiency, and cutting seemingly bloated staffs. It should be noted that the DRI was not a substitute for acquisition reform but was meant to complement it. A separate office directed the DRI, initially under the secretary directly but after 1999 under the auspices of the deputy under secretary for acquisition reform.[56]

In the years following the release of the Defense Reform Initiative, DoD continued its efforts to improve systems acquisition. Greater emphasis was placed on promoting joint interoperability, reducing cycle times, and lowering the total ownership costs of the weapons, including maintenance, overhaul and upgrade, and deactivation costs. And, of course, DoD sought to reduce acquisition costs overall. Although the ultimate outcome of these various reform initiatives remains to be seen, some signs were not promising. In spite of the occasional success story, the cost of acquisition remained high and civil-military integration was still a dream. A report by Senator Fred Thompson (R–TN) in 2001 warned of financial chaos in DoD's accounting system and quoted Senator Robert Byrd (D–WV) as saying, "The Pentagon's books are in such utter disarray that no one knows what America's military actually owns or spends."[57] Another serious concern was the shape of the acquisition workforce. Studies warned that the workforce—which had already shrunk dramatically over the past ten years because of cutbacks and automation—would be hit with a wave of retirements during the first decade of the twenty-first century, and far fewer young people had an interest in government service, especially in acquisition-related fields. A similar problem, and a particularly worrisome one given the growing

movement toward RMA concepts and technologies, was the mounting shortage of qualified technicians, engineers, and scientists—both civilian and military—who were capable of designing, producing, operating and maintaining the new high-technology equipment.

Yet positive changes did begin to occur, especially in acquisition practices. Important concepts such as joint interoperability, cycle-time reduction, and total ownership costs were being adopted and, increasingly, having an impact. The use of computer modeling and simulation was drastically reducing the costs and time of design engineering. The 5000 series acquisition regulations, newly revised in 2000,[58] moved still further away from traditional, Cold War approaches to acquisition. For example, they specified that there were a number of possible ways to conduct and acquisition program, not just one. The new regulations gave preference to an approach called "evolutionary acquisition," in which the capabilities of a given system were advanced incrementally through a series of "block" changes (the first fielded system would be "Block I"). This approach was intended to provide a usable system relatively quickly, avoiding the long delays and cost overruns associated with a high-risk development program that sought to achieve ambitious technological goals in a single jump.

The services themselves began, hesitatingly, to experiment with new acquisition concepts. The Navy, for example, which was struggling with an underfunded shipbuilding budget, tried a new approach in its Arsenal Ship program, a joint effort conducted with the Defense Advanced Research Projects Agency in the mid–1990s. This program deliberately eschewed the Navy's traditional procedures for ship acquisition. Ship concepts were proposed by competing contractor teams who were given freedom to prepare their own designs without restrictive requirements, as long as they met broad performance and firm cost goals. A four-page Ship Capabilities Document (SCD) replaced the thousands of pages of requirements and specifications usually presented to the contractors. The small joint program office worked with the teams but did not interfere too heavily with the design process, allowing the teams to explore various ideas. Although the program was ultimately canceled because of funding problems and concerns about the concept, the participants were enthusiastic about the approach used, elements of which were later adopted for the *Zumwalt*-class DD–21 destroyer program.[59]

Acquisition for a New World War, 2001– 2003

The Republican administration of President George W. Bush, which took office in January 2001, was considerably less interested in the reform

initiatives of its predecessor. Many of the innovative policies and procedures established by Aspin, Perry, and Cohen remained in place, but in general, the fifteen-year quest to implement the Packard Commission recommendations was over. Indeed, the very term "acquisition reform," the watchword of the Clinton years, was virtually abolished, to be replaced by the amorphous "acquisition excellence."

This is not to say that the new administration wished to preserve the status quo. Far from it. During his campaign, candidate George W. Bush spoke in favor of the transformation of the military into a lighter, high-technology force capable of conducting aggressive mobile campaigns anywhere in the world. His secretary of Defense, Donald Rumsfeld, strongly favored such transformation and pressed the cause against considerable resistance among the services. As a member of a conservative, pro-military administration, Rumsfeld was in a much stronger position to effect substantive changes to the acquisition program than his immediate predecessors had been. In particular, Rumsfeld shocked the defense community when he canceled the Army's program to develop Crusader, an armored, automated, self-propelled howitzer, because the secretary believed it was too heavy and slow for the sort of force he envisioned.

Rumsfeld also wanted to shake up the status quo within Pentagon and service organizations. He scorned the bureaucracies, which resisted change and clung to the old, traditional ways of conducting business. But whereas the Clinton reformers had sought to encourage cultural change with fanfare and hoopla, Rumsfeld took a combative approach: He declared "war on bureaucracy." With characteristically strong language, he declared that the Pentagon bureaucracy

> is an adversary that poses a threat, a serious threat, to the security of the United States of America. This adversary is one of the world's last bastions of central planning. It governs by dictating five-year plans. From a single capital, it attempts to impose its demands across time zones, continents, oceans and beyond. With brutal consistency, it stifles free thought and crushes new ideas. It disrupts the defense of the United States and places the lives of men and women in uniform at risk. . . . In this building [i.e., the Pentagon] . . . money disappears into duplicative duties and bloated bureaucracy—not because of greed, but gridlock. Innovation is stifled—not by ill intent but by institutional inertia.[60]

Rumsfeld announced his war on bureaucracy on 10 September 2001. The next day, he had a much larger war to worry about. The terrorist attacks on the World Trade Center and the Pentagon shocked the nation and led to a period of defense expansion and aggressive military operations overseas. By October, the United States was engaged in a campaign in Afghanistan against the Al Qaeda terrorist group and its Taliban protectors.

The campaign reflected Rumsfeld's approach to military operations: a minimal commitment of heavy troops and equipment and a heavy emphasis on mobile special forces and the use of high technology to locate and strike the enemy with precision. Rumsfeld used that basic philosophy against Iraq in 2003. Although that campaign involved more heavy forces than the one in Afghanistan, Operation IRAQI FREEDOM relied on a far smaller force than was used in 1991, and it began with a precision strike against the person of Saddam Hussein himself instead of a long strategic air campaign. Despite some setbacks, the Army and Marine units seized Baghdad and toppled Saddam's regime in three weeks.

The Iraqi campaign demonstrated the technological advances in the U.S. military that had occurred in spite of the "procurement pause" of the 1990's, and the fruits of the emphasis on jointness. It is interesting to note that in terms of the basic platforms, the force that invaded Iraq in 2003 was virtually the same as that which had fought the Iraqis in Kuwait twelve years before. Indeed, with the exception of the B–2 stealth bomber (in a conventional role—its nuclear mission had disappeared with the Soviet Union) and perhaps the FA–18E/F, there were no new major platforms. Yet many of the tanks, aircraft, and other systems had much advanced capabilities, thanks to selective high-technology upgrades and the expansion of high-bandwidth communication networks linking platforms, headquarters, and units in the field—even among the several services. Coalition aircraft were often able to destroy Iraq's conventional weapons systems and forces before they became a threat to advancing coalition forces. Whereas in 1991 only a small percentage of the bombs dropped were "smart," twelve years later 90 percent were, thanks in large part to one of the most successful acquisition programs of the nineties, the Joint Direct Attack Munition (JDAM). A model joint program and an acquisition reform success story, the JDAM was an inexpensive guidance system that could be attached to an old "iron" bomb, turning it into effective precision-guided munition at a fraction of the cost of a new weapon.[61] While large, expensive platforms such as the B–2, the F–22 fighter, and the *Seawolf*- and *Virginia*-class submarines garnered the most public interest during the nineties, the high-technology upgrading of the military with systems such as the JDAM, the Longbow for the Apache helicopter, the Predator unmanned aerial vehicle (UAV), and various network development programs, elicited little attention but ultimately had the greatest impact on the improvement of American military capabilities.

The rise of joint interoperability—the ability of the various platforms and units of any service to share data and information—was one of the most significant yet little publicized developments. Throughout the era of

the Cold War, the services and other DoD components had created their own unique information and communication systems that usually used proprietary or specially developed hardware and software. These stovepiped systems could not interact with each other, were expensive to produce and maintain, and chained the government to the suppliers of the proprietary technology. During the 1990s DoD made a concerted effort to force the services and defense agencies to adopt common architectures and standards and to use non-proprietary "open systems." In the early part of the decade, DoD created the Defense Information Infrastructure (DII) and in 1993 published a set of standards called the Common Operating Environment (COE). The COE included software components, programming standards, and an overall architecture to allow new defense systems to plug into the DII the way commercial computer applications can "plug and play" in Microsoft's Windows™. As an open system, it permitted the DII to incorporate nonproprietary developments from a wide variety of sources. In 1996, DoD released the Joint Technical Architecture (JTA) v. 1.0, which specified common interfaces to be used by the information technology in new defense systems. Then Under Secretary for Acquisition Paul Kaminski directed that all acquisition programs were required to adhere to the JTA. Every couple of years a new version of the JTA was released with new, upgraded standards; version 4.0 was approved in 2002.[62]

However, the campaigns in Afghanistan and Iraq also revealed the limitations of high technology and of Rumsfeld's vision of winning wars with small but lethal forces. An unconventional, low-tech opponent could better evade the sophisticated sensors and precision-guided munitions of the U.S. forces. At Tora Bora in Afghanistan, a sizable force of al Qaeda fighters escaped through the rugged terrain to Pakistan. During the advance on Baghdad and even after the end of major operations, coalition forces were plagued by attacks on their lines of communications by mobile and lightly armed guerillas and paramilitary fighters. In such instances, technology could not entirely substitute for manpower. Furthermore, in spite of the great strides that precision weapons made in avoiding "collateral damage," it was still impossible to avoid killing and maiming civilians and destroying nonmilitary targets if the enemy chooses to mix in with the population and use schools and hospitals for military purposes—as he is increasingly likely to do as our targeting capabilities improve. In such cases, the use of high technology cannot help U.S. forces in the field escape the cruel dilemmas that war inevitably imposes.

As the Pentagon prosecuted the war on terror and on Iraq, Rumsfeld prosecuted his own war on the Pentagon bureaucracy and the traditional ways of doing business. He launched the most radical reform of defense

processes in a generation. In October 2002, his office canceled the existing acquisition regulations embodied in Directive 5000.1 and Instruction 5000.2, and issued new regulations the following May.[63] These new documents sought to eliminate the prescriptive approach of the previous regulations (especially those of 1991) and, like the 2000 regulations, they called for flexibility in program management because "[t]here is no *one* best way." Again, they emphasized evolutionary acquisition, in which the program produced a system of lesser capability that could then be improved with incremental upgrades (formerly known as block changes). By sacrificing some capability, the program would reduce risk and, it was believed, be more likely to field a usable system in a reasonable amount of time. Only then, after the system had been demonstrated, would a decision be made whether the improvements justified the cost and risk. Within the evolutionary acquisition model, the regulations specified two processes. "Incremental development" called for achieving a required capability—say, a desired range or level of accuracy of a missile—through several intermediate steps. "Spiral development" was a more iterative process in which the decision to pursue incremental advances depended on the maturation of the technology and the evolution of the requirement. In other words, the program was not seeking to achieve any predetermined ultimate capability. For example, the bandwidth on a communications network could be steadily upgraded as the technology allows and as military requirements demanded. The regulations stated a preference for spiral development.

The revision of the requirements generation system, published soon after in coordination with the overhaul of the acquisition system, was even more dramatic.[64] Traditionally, the military services controlled the process of generating their requirements. They determined their own needs and produced the documents (such as the mission needs statement and the operational requirements document) laying out the desired capabilities. This was usually done independently of the other services. The Joint Requirements Oversight Council had, as its name indicated, an oversight and coordinating role. This process produced service-unique weapons systems that could not interact with systems of the other services. There would be considerable duplication among the programs, as each service would have its own unique aircraft, missiles, communications equipment, and so on. Furthermore, while the various programs addressed the services' tactical needs and took advantage of technological opportunities, they had little relationship with national military strategy and strategic objectives. There was little connection between policy and acquisition.

The Joint Capabilities Integration and Development System (JCIDS), as the requirements generation process was now called, removed the

responsibility of requirements generation from the control of the military services and gave it to an expanded JROC. Requirements were to be developed, not by service organizations, but by joint bodies known as functional capabilities boards (FCBs), which had strong representation from the Joint Staff, the unified and specified commands, and civilians in the Office of the Secretary of Defense. These boards were intended to ensure that consideration was given first to nonmaterial solutions to operational problems, that the requirements were reasonable in light of the state of technology, that joint interoperability was considered, and that the requirements accorded with the national military strategy and policy. In other words, strategy would determine acquisition, not the other way around.

It is, of course, too early to know as of this writing (2003) what the ultimate impact of these ambitious reforms would be. In one sense, however, they sent an important message: that Rumsfeld was determined to change DoD's approach to acquisition and achieve the transformation of the U.S. military to an efficient, light-but-lethal high-tech force. Only time will tell whether that goal, too, is successful.

NOTES

[1] George H. W. Bush, "Address on Administration Goals Before a Joint Session of Congress," 9 February 1989, http://bushlibrary.tamu.edu/papers/1989/89020900.html.

[2] Secretary of Defense Richard Cheney, *Defense Management: Report to the President* (Washington, D.C.: U.S. Department of Defense, July 1989), 3–7, 17 (hereafter cited as DMR). In practice, the DCMA was established as the Defense Contracts Management Command (DCMC) within DLA; DCMA was not finally spun out from DLA until the late 1990s. See U.S. Secretary of Defense, *Annual Report to the President and the Congress* (January 1991), 31 (hereafter cited as DoD, *Annual Report*, 1991).

[3] DMR, 25. The quote comes from U.S. Congress, Office of Technology Assessment, *Holding the Edge: Maintaining the Defense Technology Base*, OTA–ISC–420 (Washington, D.C.: GPO, April 1989), 9–10.

[4] DoD, *Annual Report*, 1992, 36.

[5] Ibid., 28.

[6] Joe Ferrara, "DoD's 5000 Documents: Evolution and Change in Defense Acquisition Policy," *Acquisition Review Quarterly* (Fall 1996): 121–22.

[7] DoD, *Annual Report*, 1992, 29.

[8] U.S. Congress, *National Defense Authorization Act for Fiscal Year 1991*, PL 101–510, Title VIII, sec. 800.

[9] U.S. Congress, *Defense Acquisition Workforce Improvement Act*, PL 101–510, Chapter 87, Title XII; Dr. James H. Edgar, "The Origins of the Defense Acquisition Workforce Improvement Act (DAWIA)," in this volume. See also "Discussion of the Acquisition Workforce Improvement Act" (http://www.acq.osd.mil/ar/dawiadis.html).

[10] DoD, *Annual Report*, 1993, 41.

[11] George H. W. Bush, "Remarks at the Aspen Institute Symposium in Aspen, Colorado," 2 August 1990, http://bushlibrary.tamu.edu/papers/1990/90080206.html.

[12] DoD *Annual Report*, 1993, 27. For the development of the Base Force concept see Lorna S. Jaffe, *The Development of the Base Force, 1989–1992* (Washington, D.C.: Joint History Office, Office of the Chairman of the Joint Chiefs of Staff, 1993); Don M. Snider, "Strategy, Forces and Budgets: Dominant Influences in Executive Decision Making, Post-Cold War, 1989–91," National Defense University, Strategic Studies Institute, Feb. 1993, http://carlisle-www.army.mil/usassi/ssipubs/pubs93e/budgets/budgets.pdf.

[13] These figures are from *Department of Defense Key Officials, 1947–2000* (Historical Office, Office of the Secretary of Defense, 2000), 86; DoD, *Annual Report*, 1994, B–1.

[14] For the A-12 scandal, see James P. Stevenson, *The $5 Billion Misunderstanding* (Annapolis, Md., 2001).

[15] DoD, *Annual Report*, 1992, 9.

[16] Ibid., 25; DoD, *Annual Report*, 1993, 36–38; Director of Defense Research and Engineering, Defense Science and Technology Strategy, July 1992. One Air Force officer with experience in prototyping considered Cheney's proposal highly flawed; see Devin L. Cate, Where Have All the Prototypes Gone? The Failure of the Prototyping Initiatives of the 1990s, Research Paper submitted to Research Department, Air Command and Staff College, AU/ACSC/0009/97–03, March 1997, esp. 25–29.

[17] Bush first used the term in a speech to Congress on 11 September 1990, http://bushlibrary.tamu.edu/papers/1990/90091101.html.

[18] U.S. Department of Defense, *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, D.C.: GPO, April 1992), 173–74, 176–77, 563–66, 569–70, 702–03, 709–11, 722–24, 775–76, 806–09.

[19] *Conduct of the Persian Gulf War*, 164; "Airpower in the Gulf War," Air and Space Power Mentoring Guide Essays 2:73 (available online at www.cadre.maxwell.af.mil/ar/MENTOR/VOL2/5.pdf). Although the F–117s made only 2 percent of the sorties, they accounted for 40 percent of the strategic targets struck (*Conduct of the Persian Gulf War*, 164).

[20] For the debate over the effectiveness of the Patriot missiles, see Jeremiah D. Sullivan et al., "Technical Debate over Patriot Performance in the Gulf War," *Science & Global Security* 8 (1999): 40–97 (available on-line at http://www.gbhap-us.com/journals/709/patriot/patriot.htm); Robert M. Stein, John P. Kantelis, and Peter D. Zimmerman, "Response to Science and Global Security Article 'Technical Debate over Patriot Performance in the Gulf War,'" http://www.gbhap-us.com/Patriot_Missile; U.S. General Accounting Office, *Operation Desert Storm: Data Does Not Exist to Conclusively Say How Well Patriot Performed,* Report B25035 (September 1992); Steven Hildreth, "Evaluation of U.S. Army Assessment of Patriot Antitactical Missile Effectiveness in the War Against Iraq," prepared for the House Government Operations subcommittee on Legislation and National Security, http://www.fas.org/spp/starwars/congress/1992_h/h920407h.htm, 7 April 1992. Other reports can be found at the Federation of American Scientists website (*www.fas.org*).

[21] DoD, *Annual Report*, 1992, 6.

[22] Good introductions to the RMA and its ramifications for the U.S. military are James R. Blaker, *Understanding the Revolution in Military Affairs: A Guide to America's 21st Century Defense*, Progressive Policy Institute Defense Working Paper No. 3, January 1997; Theodor W. Galdi, *Revolution in Military Affairs? Competing Concepts, Organizational*

Responses, Outstanding Issues, Congressional Research Service Report to Congress, 11 December 1995; and Richard O. Hundley, *Past Revolutions, Future Transformations: What Can the History of Revolutions in Military Affairs Tell Us About Transforming the U.S. Military?* RAND Research Report MR–1029–DARPA, 1999, http://www.rand.org/publications/MR/MR1029. These documents and many others can be found at the website of the Project on Defense Alternatives (http://www.comw.org/rma/). This site is an excellent source of information, references, and even full-text articles and books.

[23] William A. Owens, "The Emerging System of Systems," *U.S. Naval Institute Proceedings* (May 1995), 36–39, also *Military Review* (May–June 1995): 15–19; Owens, "The Emerging U.S. System-of-Systems," *National Defense University Strategic Forum,* no. 63 (February 1996), http://www.ndu.edu/inss/strforum/forum63.html.

[24] "Statement of Admiral William A. Owens, USN (RET)," 12 February 2001, http://www.senate.gov/~budget/democratic/testimony/2001/owens_defhrng021201.pdf.

[25] Daniel G. Brown, "Revolution in Military Logistics at the Operational and Tactical Level," http://160.150.55.11/TACarchive/Acsumfal99/MGBrown.htm; Johnnie E. Wilson, John G. Coburn, and Daniel G. Brown, "Our Revolution In Military Logistics—Supporting the 21st Century Soldier," http://www.almc.army.mil/alog/JanFeb99/MS%20401.htm.

[26] See Gordon R. Sullivan, *The Collected Works of the Thirty-Second Chief of Staff, United States Army* (Washington, D.C.: The Department of the Army, 1996); Gordon R. Sullivan and James M. Dubik, *Envisioning Future Warfare* (Fort Leavenworth, Kans.: U.S. Army Command and General Staff College Press, 1995).

[27] U.S. Joint Chiefs of Staff, Joint Vision 2010.

[28] Les Aspin, *Report on the Bottom-Up Review* (Washington, D.C., October 1993); Department of Defense, *Report of the Quadrennial Defense Review* (Washington, D.C., 1997).

[29] See Jacques S. Gansler, *Defense Conversion: Transforming the Arsenal of Democracy* (Cambridge: MIT Press, 1995). Numerous other studies have also dealt with this issue.

[30] Donald A. Hicks, cited in U.S. Department of Defense, *Acquisition Law Advisory Panel, Streamlining Defense Acquisition Laws: Report . . . to the United States Congress, Introduction* (January 1993), Defense Technical Information Service Report No. AD–A262 699, I–6.

[31] Al Gore, *From Red Tape to Results: Creating a Government that Works Better and Costs Less-Report of the National Performance Review* (Washington, D.C.: GPO, 1993), esp. chapter 3; Steven Kelman,

"Implementing Federal Procurement Reform," Spring 1998, http://www.innovations.Harvard.edu/occasional/kelman.pdf.

[32] These figures are from Department of Defense Key Officials, 86–87; DoD, *Annual Report*, 1998.

[33] DoD, *Annual Report*, 1994, 108; "Mrs. Colleen A. Preston, Deputy Undersecretary of Defense for Acquisition Reform: Executive Profile," http://www.acq.osd.mil/ar/text/tpreston.htm; Ken Allard to "Bob," Defense Systems Management College, Acquisition Law Advisory Panel Archive, File Ad4.2, "LMI."

[34] Steven Kelman, "Reform Wonk Applies Know-how to PenRen," *Federal Computer Week*, 5 October 1998, http://www.fcw.com/fcw/articles/1998/fcw_100598_1190.asp.

[35]U.S. Department of Defense, *Acquisition Reform: A Mandate for Change* (Washington, D.C.: 9 February 1994), http://www.navsea.navy.mil/acquisition-reform/man.pdf.

[36] DoD, *Annual Report*, 1995, 101.

[37] Ibid., 101–06.

[38] DoD, *Annual Report*, 1997; Ferrara, "DoD's 5000 Documents," 122–24.

[39] U.S. Department of Defense, Acquisition Law Advisory Panel, Streamlining Defense Acquisition Laws.

[40] Federal Acquisition Streamlining Act of 1994, PL 355, 103d Cong., 2d sess., 13 October 1994.

[41] *National Defense Authorization for Fiscal Year 1996*, PL 106, 104th Cong., 2d sess., 10 February 1996, Div. D, secs. 4001–4402.

[42] Ibid., Div. E, secs. 5001–5703.

[43] John Stein Monroe, "Reform at Defense," *Federal Computer Week*, 16 September 1996, http://www.fcw.com/fcw/articles/1996/FCW_091696_982.asp. The Deskbook can be accessed at http://web2.deskbook.osd.mil/default.asp.

[44] DoD, *Annual Report*, 1995, 1996, 1997; see also various issues of *Program Manager Magazine*, *Acquisition Review Quarterly*, *Acquisition Reform Today*, and similar publications, as well as the resources available online at http://www.acq.osd.mil.

[45] SECNAVINST 5000.2B, ASN(RD&A), 6 December 1996, http://www.acq-ref.navy.mil/pdf/sn50002b.pdf; "Department of the Navy, Acquisition Reform, Acquisition Center of Excellence Catalyst," *Implementation of Acquisition Reform Manual*, http://www.acq-ref.navy.mil/implman/cata/cata01.html.

[46] For the Air Force Lightning Bolts, see http://www.safaq.hq.af.mil/acq_ref/bolts99/.

[47] M. Thomas Davis, "The JROC: Doing What? Going Where?" NSSQ (Summer 1998), http://www.Georgetown.edu/sfs/programs/nssp/nssq/tdavis.pdf. Owens saw his JROC reforms as promoting the adoption of RMA ideas; see William A. Owens, "JROC: Harnessing the Revolution in Military Affairs," *Joint Forces Quarterly* (Summer 1994): 55–57.

[48] DoD, *Annual Report*, 1994, 137; DoD *Annual Report*, 1995, 107–10; Cate, Where Have All the Prototypes Gone? 14–23.

[49] William Perry, Memorandum for secretaries of the Military Departments et al., 29 June 1994, subj: "Specifications & Standards—A New Way of Doing Business," http://www.dsmc.dsm.mil/jdam/contents/perrymemo.htm.

[50] James J. Richardson et al., *A Review of the Technology Reinvestment Project*, (Potomac Institute for Policy Studies Report PIPS–99–1, Arlington, VA., 30 January 1999); U.S. Department of Defense, Advanced Research Projects Agency, *Program Information Package for Technology Reinvestment Project, FY 95 Competition* (Fall 1994).

[51] John A. Tirpak, "The Distillation of the Defense Industry," *Air Force Magazine* 81, no. 7 (July 1998), http://www.afa.org/magazine/0798industry.html.

[52] Bill Clinton and Al Gore, The Blair House Papers, *National Performance Review*, January 1997, available at http://clinton2.nara.gov/WH/New/html/BOOK.PDF.

[53] Jacques Gansler, *The Defense Industry* (MIT Press, 1980); *Affording Defense* (MIT Press, 1989); idem, *Defense Conversion: Transforming the Arsenal of Democracy* (MIT Press, 1995).

[54] "Gansler: DoD in a 'Death Spiral,' Program Terminations Likely," *Defense Daily*, 3 September 1998.

[55] This paper is available at http://www.defenselink.mil/pubs/affordability04091999.pdf.

[56] Daniel Verton, "Soloway Tapped to Head Defense Reform Initiative," *Federal Computer Week*, 5 April 1999, http://www.fcw.com/fcw/articles/1999/FCW_040599_286.asp.

[57] Thompson, *Government at the Brink*, Vol. I, *Urgent Federal Government Management Problems Facing the Bush Administration* (Committee on Governmental Affairs, United States Senate, Washington, D.C., June 2001), http:www.senate.gov/~thompson/pr060501.html.

[58] Department of Defense Directive 5000.1, "The Defense Acquisition System," 23 October 2000; Department of Defense Instruction 5000.2, "Operation of the Defense Acquisition System," 23 October 2000; Interim Regulation DoD 5000.2-R, Mandatory Procedures for Major Defense Acquisition Programs (MDAPs) and

Major Automated Information System (MAIS) Acquisition Programs," 1 January 2001.

[59] Robert S. Leonard, Jeffrey A. Drezner, and Geoffrey Sommer, *The Arsenal Ship Acquisition Process Experience: Contrasting and Common Impressions from the Contractor Teams and Joint Program Office*, RAND Report MR-1030-DARPA (RAND, 1999), http://www.rand.org/publications/MR/MR1030/; Charles S. Hamilton, *Arsenal Ship: Lessons Learned* (Arsenal Ship Joint Program Office, 31 December 1997).

[60] "DoD Acquisition and Logistics Excellence Week Kickoff—Bureaucracy to Battlefield," remarks delivered by Secretary of Defense Donald H. Rumsfeld at the Pentagon, 10 September 2001, http://www.defenselink.mil/speeches/2001/s20010910-secdef.html.

[61] Cynthia Ingols and Lisa Brem, *Implementing Acquisition Reform: A Case Study on Joint Direct Attack Munitions (JDAM)* (Fort Belvoir, Va.: Defense Systems Management College, July 1998), http://oamweb.osec.doc.gov/pbsc/library/JDAMsuccess.pdf.

[62] Doug Gardner, "The DII COE: Basic Principles and Future Challenges," *CrossTalk: The Journal of Defense Software Engineering* (October 2001): 10–14, http://www.stsc.hill.af.mil/crosstalk/2001/10/gardner.pdf; "Plug and Play for the Warfighter," *AdaIC News*, Fall 1997, http://archive.adaic.com/news/Newsletter/1997/fall/7.htm; "Defense Information Infrastructure Common Operating Environment (DII COE)," *Software Technology Review*, Carnegie Mellon University Software Engineering Institute, September 2000 (available on-line at www.sei.cmu.edu/str/descriptions/diicoe.html); Judy Kerner, "Joint Technical Architecture: Impact on Department of Defense Programs," *CrossTalk: The Journal of Defense Software Engineering* (October 2001): 4–5, http://www.stsc.hill.af.mil/crosstalk/2001/10/kerner.pdf; James Erickson et al., "Impact of Joint Technical Architecture on Navy Acquisition," *PM* (November–December 1998): 34–38.

[63] Department of Defense Directive 5000.1, "The Defense Acquisition System," 12 May 2003; Department of Defense Instruction 5000.2, "Operation of the Defense Acquisition System," 12 May 2003. See also "New Acquisition Policy, 12 May 2003," briefing by the Center for Program Management, Defense Acquisition University, 16 May 2003.

[64] Chairman of the Joint Chiefs of Staff Instruction (CJSCI) 3170.01C, "Joint Capabilities Integration and Development System," 24 June 2003; Chairman of the Joint Chiefs of Staff Manual (CJCSM) 3170.01, "Operation of the Joint Capabilities Integration and Development System," 24 June 2003. See also "JCIDS 3170," multimedia briefing located at www.dau.mil/presentations/JCIDS3170/JCIDS3170.html.

Reducing Acquisition Cycle Time: Creating a Fast and Responsive Acquisition System

Ross T. McNutt

The Air Force and Department of Defense (DoD) have developed and are implementing programs to reduce acquisition response time. Acquisition response time is the time the acquisition system uses to take advantage of new technology, respond to an emerging threat, or respond to a change in military strategy. It is a critical factor in the ability of the Air Force, and the military as a whole, to maintain the proper forces with the best equipment to counter today's threats and tomorrow's uncertainties. The ability to respond rapidly to changes and opportunities is key to maintaining a long-term, sustainable military advantage that comes with an affordable price. Today, for many major defense systems, this response time can easily exceed 20 years—hardly a rapid response capability that ensures our technological edge and facilitates cost savings.

The Air Force Cycle Time Reduction Program, which was started by Art Money (who was then serving as assistant secretary of the Air Force for Acquisition), is based largely on the research and recommendations of the Lean Aerospace Initiative, a consortium of Massachusetts Institute of Technology, Air Force and Department of Defense, and the defense industry. Through their cooperation, this coalition of interests has formed a solid basis for action. The Air Force program has been conducted in close coordination with the Defense Systems Affordability Council's Cycle Time Reduction Task Force, established by the Defense System Affordability Council led by Joe Eash, then deputy under secretary of Defense for Advanced Technology. Together, these efforts have yielded a dramatic change of approach in the acquisition of defense programs and application of acquisition reform measures. Due in part to the work of these groups, major changes have been made to defense acquisition policy, changes incorporated in major rewrites of several key regulations, including DoD

5000 *Defense Acquisition System* and CJCSI 3170 *Requirements Generation System*. The work of the Air Force Cycle Time Reduction Program and the Defense Systems Affordability Council also resulted in numerous other changes to the process, including evolutionary acquisition and spiral development, enhanced schedule-based incentives (for both government and contractors), schedule development tools, Cost of Delay Analysis, and effective portfolio management.

Collectively, these efforts represent the most effective attack ever made on a persistent problem in defense acquisition, namely reducing acquisition response times in order to produce effective and efficient acquisition systems that can quickly respond to changing threats while taking full advantage of new and emerging technologies at an affordable price. It continues to be a long and difficult journey to achieve significant cycle time reductions, but major steps have already been taken and the path is clear. This paper explores the strides made in recent years to make structured improvements to the acquisition process in the name of efficiency and expediency, and it provides some historical background on the quest for cycle time reductions.

Current Acquisition Response Times

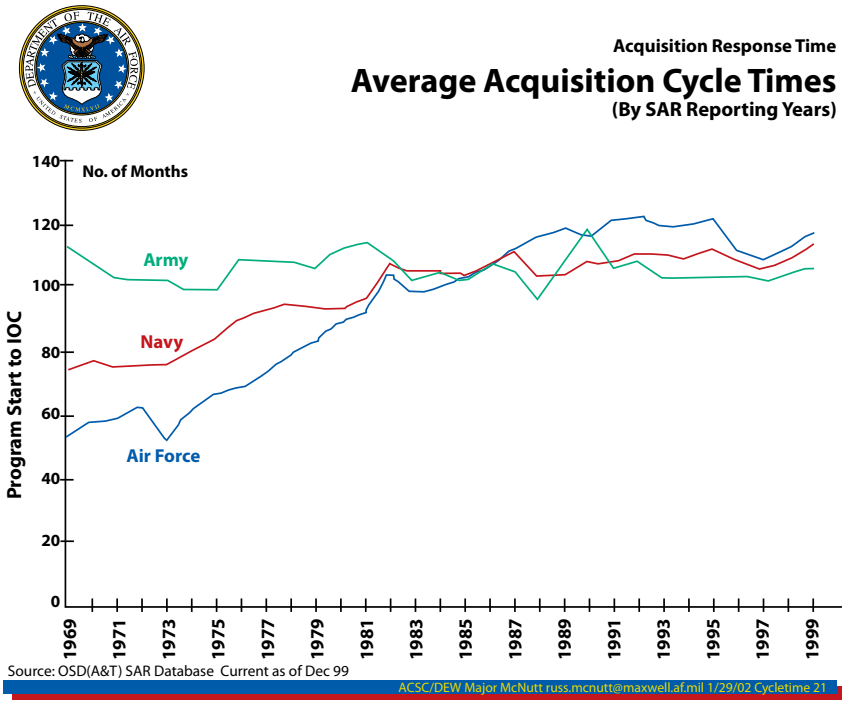
Acquisition response time consists of three components: recognition time, decision initiation time, and acquisition cycle time. Recognition time is defined as the period from when either military strategy changes, a new threat emerges, or a new technology with military potential is developed. Recognition time ends when a formal acknowledgement is made that there is a need for a new system designed to respond to new threats or exploit a new technology. Because of the delays associated with building a consensus about strategy, new threats, or new technology in order to promote the requirement for a new system, recognition time can increase acquisition response time from two to five years.

Decision initiation time is the period from when the need for a new system is recognized until an acquisition project or program is planned, funded, and approved. This process can also take from two to five years because of the various review procedures associated with starting new defense acquisition programs.

Finally, acquisition cycle time is defined as the period from when an acquisition project is started until it is available for use by the warfighter usually considered to be the initial operating capability (IOC). The acquisition cycle time includes the research, development, design, prototyping, and manufacturing process development.

Unfortunately, there is little hard data available to show the full duration of acquisition response times. Based on Selected Acquisition Report data we do know, however, that the acquisition cycle time is increasing. Since the 1970s, the Air Force's acquisition cycle time has doubled for major weapon systems. Today, the acquisition cycle time—the third and crucial period of acquisition response time—averages more than eleven years (*Figure 1*). Because of these delays, DoD and Air Force leadership have taken actions to reduce acquisition response time in each of the three periods.

Figure 1: Acquisition Cycle Times for Major Defense Acquisition Programs



Efforts to Shorten Development Times

Although the nomenclature has changed, long acquisition cycle times have been a problem since the Revolutionary War when military quartermasters were tasked with selecting and procuring equipment for the fledgling American army. The problem of getting the right military equipment into the hands of the right people has continued to the present. The President's Blue Ribbon Commission on Defense, or Packard Commission (1986), cited acquisition cycle times as a central

problem from which most acquisition problems stem. Despite this finding, however, and the flurry of reform activity that followed the release of the Packard Commission report, very little real effort was directed at reducing development time.

Instead, lowering costs was a primary aim of acquisition reform efforts in the 1980s and early 1990s. Acquisition initiatives that focused primarily on cost included Cost as an Independent Variable (CAIV) reviews, the elimination of military specifications and standards to reduce development expenses and encourage the use of commercial-off-the-shelf (COTS) equipment, the single-process initiative (SPI), the promotion of performance-based specifications, calls for clear accountability in design, and the manufacturing development initiative.

A few efforts were aimed at shortening acquisition schedules; these included the 1983 Affordable Acquisition Approach Study and the 1986 Packard Commission findings. These efforts are discussed below.

Cycle Time Reduction Efforts in the 1980s

Affordable Acquisition Approach Study

The 1983 Air Force Systems Command Affordable Acquisition Approach Study focused on two questions: Are projects taking longer? And what can be done about it? The study found that development times had increased significantly over the previous thirty years. The study also found that the major cause of increased development and production times was the overcommitment of resources within the Air Force budget.[1] Over time, however, the focus of the study shifted, and less attention was given to development time. The emphasis on development time decreased as the study progressed and is evident in the change of the project's name from its original name as the Accelerated Acquisition Approach Study to the Affordable Acquisition Approach Study. Few identifiable actions resulted from the study, but the lessons learned from the exercise were not lost on the participants. One notable contributor to the study was the TASC, Inc., contract leader, Dr. Jacques Gansler, who, in the late 1990s, served as the under secretary of Defense for Acquisition and Technology. In his parallel role as the Defense Acquisition Executive in the 1990s, Dr. Gansler dedicated considerable time and energy to improving the acquisition system.[2]

The Packard Commission

Perhaps one of the most widely known reform efforts, the 1986 Packard Commission looked at the entire defense acquisition process. In

reports released to the public, the commission cited long development times as a central problem from which most other acquisition problems stem. The Packard Commission's stark assessment identified problems at all levels, from program managers to Congress. Among the commission's major recommendations was a proposal to cut acquisition time in half by encouraging DoD to emulate successful commercial firms with world-class customers. In its *Formula for Action* report, the Packard Commission stated:

> Acquisition problems have been with us for several decades, and are becoming more intractable with the growing adversarial relationship between government and the defense industry, and the increasing tendency of Congress to legislate management solutions. In frustration, many have come to accept the ten to fifteen-year acquisition cycle as normal, or even inevitable.
>
> We believe that it is possible to cut this cycle in half. This will require radical reform of the acquisition organization and procedures. It will require concerted action by the executive branch and Congress, and full support of the defense industry. Specifically, we recommend that the administration and the Congress join forces to implement the following changes in the defense acquisition system.[3]

With the bold charge to cut acquisition time in half, strong support from the president and Congress, and a quick response by DoD, one would have expected dramatic results. However, although DoD implemented many of the commission's recommendations, it did not actively embrace the goal of slashing development time. Despite the high profile of the Packard Commission and the enthusiasm that marked the release of its findings, few people realized that reducing development time was even a significant objective identified in the recommendations appearing in the Packard Commission reports.

Cycle Time Reduction Efforts in the Early 1990s

The focus of recent acquisition reform efforts, at least since the mid–1980s, was on cutting costs, not reducing development time. Only a few of the hundred or so reform initiatives were aimed at reducing development times. In 1996, one senior acquisition reform leader told this author that if an effort did not directly impact cost, she was simply not interested. Of all the acquisition reform efforts that were initiated in the early to mid–1990s, only two were direct attempts to address product development time. These were the DoD Advanced Concept Technology Demonstrations (ACTDs) and the Air Force Acquisition Reform Initiative known as Lightning Bolt #10.

Advanced Concept Technology Demonstrations (ACTDs)

Advanced Concept Technology Demonstrations, an initiative of the Office of the Secretary of Defense (OSD), were designed to make use of readily available technologies to meet pressing military needs. Introduced in early 1994, the ACTD program was created to promote the rapid development and deployment of matured technologies. Authorized by the deputy under secretary of Defense for Advanced Technology and assigned to a service or joint sponsor, ACTDs stood as an important bridge between the R&D lab and the operator in the field.

The idea behind the ACTD concept was to allow the warfighting community to play a larger role in evaluating a technology's military utility before a service or joint organization committed the resources to underwrite a major development effort. OSD expected these demonstration programs to last between two and four years. ACTDs were supposed to reduce cycle time by allowing the acquisition process to begin at later milestones, such as full-scale development (FSD) or subsequent production milestones. ACTDs appear to have recently shifted focused to smaller-scale efforts as opposed to such system-level efforts such Global Hawk, in part because of the funding difficulties involved with transitioning large development projects into full-scale development or production.

AF Lightning Bolt Initiative #10

Just after his 1996 confirmation as assistant secretary of the Air Force for Acquisition, Arthur Money began a new initiative to cut the time to develop and field new Air Force systems in half. This new initiative, identified as Lightning Bolt #10, had an aggressive objective: "[T]he time from initial effort by a buying office to satisfy a user's validated requirements (for a new product, services, parts, etc.) until delivery will be reduced by 50 percent."[4]

However, the initiative's scope was quickly narrowed to focus on cutting the time from receipt of requirements and allocated funds to contract award in half without taking into account the time to deliver the product. The acquisition community therefore limited the complicating factors and focused only on those parts under its control.[5] The objective of the initiative was changed to read:

> Reduce by 50 percent the amount of time to award contracts that meet our customers' needs. This time begins with receipt of a validated user requirement and funding commitment, and ends with contract award. Lightning Bolt #10 applies to efforts to develop and acquire systems, and support their operational readiness.[6]

The Lightning Bolt #10 group conducted interviews with program managers and documented a set of best practices and new ideas to reduce time to contract award. The Lightning Bolt #10 Team was led by Colonel Ben McCarter and overseen by Mrs. Darleen Druyun both in SAF/AQ.

The Lightning Bolt #10 group disbanded after issuing its report in 1997 and placing its "tool box" of ideas on the Internet and conducting a series of training conferences.

Current Cycle Time Reduction Efforts

Starting in mid- to late 1990s, there was an increasing awareness of the need to reduce acquisition cycle times; a number of efforts undertaken in the latter half of the 1990s are still going on. One such program, the Lean Aerospace Initiative (LAI), is a consortium involving industry, government, and academia, organized to conduct detailed research on the issue of cycle times. This effort, and the dramatic reductions in cycle times made by the commercial firms in the 1990s, in turn led to the establishment of the Defense Systems Affordability Council OSD Cycle Time Reduction Task Force and the Air Force Cycle Time Reduction Tiger Team. These efforts focused directly on reducing development times.

The Lean Aerospace Initiative (LAI)

The Lean Aerospace Initiative is a consortium of interests led by MIT that is intended to reduce the cost, development, and production time for military products by half by infusing commercial lean practices throughout the defense aerospace industry. Participants in the LAI consortium are conducting research in all phases of development and manufacturing, including factory operations, supplier relations, and government policy. This approach contrasts with most efforts to reduce development time, which have tended to focus only on limited aspects of the acquisition response times such as contract award time.

LAI conducted groundbreaking research on the causes and impacts of long development times for military systems. In 1997, it published its findings and a large number of specific recommendations ranging from determining the business case for reducing development time, developing tools for effective schedule development, providing schedule-related incentives, and using effective project portfolio management practices to eliminate funding-based schedule limitations.[7] These findings and recommendations were briefed to the Air Force, DoD, and industry leadership and were well accepted. The LAI research and recommendations

became the basis for the Air Force Cycle Time Reduction Program and the solid foundation to support the efforts of the OSD Cycle Time Reduction Task Force.

Air Force and DoD Cycle Time Reduction Programs

In 1998, based in part on the increased awareness of the problem and the strength of the MIT research and recommendations, the Air Force and DoD established cycle time reduction programs, the first significant efforts in many years to address this long-standing problem. The OSD Cycle Time Reduction Task Force was established by the Defense Systems Affordability Council and championed by Joe Eash in the Office of the Under Secretary of Defense for Acquisition and Technology. The Air Force team was established by the Senior Business Leadership Group under the supervision of Arthur Money (assistant secretary of the Air Force for Acquisition) and was run by the Office of the Secretary of the Air Force for Management Policy and Program Integration (SAF/AQXA). Both the DoD and Air Force groups worked closely together to create a range of programs and major policy changes. Because of the solid results of LAI, the Air Force team, and the DoD Task Force, an unusual consensus was reached that facilitated major policy changes, including substantive rewrites of DoD 5000 *Defense Acquisition System* and the CJCSI 3170 *Requirements Generation Systems*. These rewrites placed an increased emphasis on reducing acquisition cycle time. In addition, major steps were taken from building a solid business case, developing methods to determine the value of time through Cost of Delay Analysis, and enhancing incentives throughout the process, developing methods for rapid project initiation such as the Warfighter Rapid Acquisition Process.

Unfortunately, the consensus that promoted these acquisition enhancements has since been lost because of the rapid turnover of people and the loss of key leadership. While the objective of reducing cycle time is still widely known, there does not appear to be a clear path that can be taken to achieve it. The OSD team was very fortunate to have the support of such leaders as Joe Eash; the efforts were bolstered by strong team leadership from John Smith, Tom Perdue, Dr. Joe Ferraro, and Ric Sylvester, all of whom were willing and able to push though significant changes. However, most of these key figures have left government service. Following their departure, the momentum for promoting OSD-level changes to the acquisition process was lost.

The Air Force team was equally fortunate to have a highly motivated team of people drawn from across the Air Force, all of whom worked hard to

make meaningful changes. Such leaders as Tom Graves of the Aeronautical Systems Center, Bill Floyd of the Space and Missile Center, Larry McKee of the Aerospace Command and Control Intelligence Surveillance and Reconnaissance Center (AC2ISRC) worked tirelessly, leading various teams without any significant recognition. The Air Force team was also fortunate to have the top-level support of leaders like Lt. Gen. Gregory "Speedy" Martin, SAF/AQ, and General Lester L. Lyles, commander of Air Force Materiel Command.

Below is a summary of the work done by the LAI, OSD, and Air Force Cycle Time Reduction teams. Their actions and findings are summarized; this overview is accompanied by a more detailed description of the Air Force Cycle Time Reduction program. In addition to highlighting the results obtained by the Air Force team, the section that follows also identifies areas where additional work will be required in the future.

Overview of Recent Cycle Time Reduction Findings, Efforts, and Results

Impact of Long Acquisition Cycle Times

According to the 1986 Packard Commission report, "the excessively long acquisition cycle, ten to fifteen years, is a central problem from which most other problems stem. . . . It leads to dated technology in our fielded systems, excessive high cost, and the very gold plated requirements that are one of its causes." The most immediately apparent result of long acquisition times is the fact that systems are not ready or available when they are needed. For example, global positioning system receivers for troops, tanks, and aircraft and JTID terminals and Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) pods for fighter aircraft had been in development for a considerable time prior to Operation DESERT STORM, but these systems were not widely available for use in the field when the conflict began. Although it is difficult to measure the real cost of delays attributable to long acquisition cycles, not having advanced equipment in the right hands is always a missed opportunity with potentially disastrous implications for the warfighter.

Because of the length of acquisition cycles, obsolete and outdated technology is often fielded as parts of new systems that languished in development are finally introduced. For instance, many new weapons systems have computer processors that are very slow by contemporary standards, even though only a few years may have passed since the system

first went into production. Systems with obsolescent computer components are expensive and difficult to maintain, and require suppliers and vendors to maintain stocks of old parts, often at great expense to the government. Shortening the acquisition cycle will mitigate some of this problem; the rapid advance of technology, especially in the electronics field, will always confound acquisition program managers.[8] But increasing the rate of development, production, and fielding may well reduce some of the inefficiencies associated with this kind of system obsolescence.

Finally, long development times significantly increase both development costs and sustainment costs. Data collected by MIT shows that development costs increase exponentially with planned development time. MIT studies also show that the longer a project spends in development, the higher percentage of the total systems cost is used to develop the project. As a result, less money is available to produce the product for the warfighter. MIT's research also shows that the longer a project is in development, the more likely it is that funding problems and leadership changes will threaten its stability.

In sum, long system development times translate to higher sustainment costs. Lengthy cycle times result in a kind of vicious cycle, wherein it takes longer to replace high maintenance systems, and the replacement systems that are ultimately produced cost more to maintain because of spare parts shortages that may begin before the system even reaches the field.

The Commercial Example

Many commercial firms have recognized the advantages of responding quickly to customer needs; model firms identify those needs early and are quick to create products or services that meet existing and emerging client requirements. In recent decades, industries as diverse as aerospace, automotive, chemical, and consumer manufacturing have reduced their product development times by 50 percent to 70 percent. Shorter development times have yielded higher quality products at lower cost that better match the customers' needs. Quick and efficient development processes have also facilitated an explosion in the number of products available to consumers.

Many industries closely associated with the defense industry have achieved these reductions. For instance, development times for automobiles decreased markedly during the past twenty years. In the late 1980s, automakers took an average of eighty-four months to bring a new car to market. Today, the same process takes about twenty-four months. The same trend can be seen in civilian aircraft development. Previously, new

commercial aircraft took about eight years to develop. Contemporary aircraft, such as the Boeing 777, were fielded in less than five years. Boeing's current goal for new aircraft development projects is two and one-half years. Commercial satellites that once took eight or more years to develop are now completed much faster. Today, such companies as Hughes can go from contract award to on-orbit operations in as little as eighteen to twenty-four months.

Shorter development times allow these companies to decide how to compete with competitors rather then being in a reactive mode. Firms that can respond faster can include newer technologies, incorporate more current marketing information, and respond to a competitor's products faster. The results can be dramatic, yielding either higher profits or increased market share. According to Kim Clark, the dean of the Harvard Business School and an author on product development practices, rapid product development capability is the key to a company's long-term sustainable competitive advantage.[9]

What Drives Long Military Acquisition Cycle Times?

MIT Lean Aerospace Initiative research on 320 defense projects identified what drives long acquisition response times.[10] Although the recognition time and decision time can be long, the research identified the acquisition cycle time, and in particular the product development time, as the longest period in determining the acquisition response time. Despite the fact that 80 percent of the users or clients surveyed indicated that their project's end product was needed immediately, and 70 percent of the projects reviewed were needed to meet current operational deficiencies, the research showed that the schedule was most often rated by project managers as the fourth of four project objectives, far below performance, development cost, or operational cost. An analysis of the research data showed the tremendous impact of the government's initial project schedule on the contractor and the resulting development time. The primary determinants of the government initial project schedule were found to be the expected development and production funding rates and not the development-related requirements of the project, such as technology development, engineering requirements, or manufacturing process development. The research showed that schedule-based information or tools were rarely used to develop a program offices' initial schedule.

The initial government schedule, however, is the basis from which the contractors build their proposed schedules. Project managers reported that 80 percent of the requests for proposals (RFPs) specified an expected

schedule to the contractors. Contractors report that the government's expected schedule is by far the dominant factor in determining their proposed schedules. Some 66 percent of contractors surveyed stated it was the sole determinant of their proposed schedule. In a vast majority of project proposals, the contractors proposed schedules that exactly match the government expected schedule. Contractors state that to do otherwise "is not a winning strategy."

The research further showed that there were few incentives (if any) and significant barriers for both the government and contractors to accelerate projects once under contract. For this reason, few projects have ever been accelerated, and many projects slip their schedules. Project managers and program element monitors estimate that if properly funded and schedule were considered a high priority, the average project could be completed in 50 percent to 65 percent of the scheduled time. The research showed that these factors were consistent across programs of all size, all levels of technological advances, and all different types of systems.

Air Force Cycle Time Reduction Program

The Air Force Cycle Time Reduction Program is aimed at reducing the response times of acquisition efforts. The program consists of three phases: building awareness, building the necessary infrastructure, and addressing the systemic constraints. The Air Force Cycle Time Reduction action plan was approved by General Lyles, then vice chief of staff of the Air Force, and is the basis for a wide range of reform and process improvement actions.

As discussed earlier, there are actions aimed at each of the key phases of acquisition response time: recognition time, decision initiation time, and acquisition cycle times. Recognition time is being shortened through use of innovation-oriented activities such as experimentation, Battlelabs, ACTDs, and Science and Technology (S&T) efforts. Following up on a Corona-level effort to select quickly and fund the successful results of these innovation activities, the decision/Initiation time problematic for the most urgent projects is being addressed through an effort by SAF/AQ. To shorten the longest period of acquisition response time, the acquisition cycle time, the Air Force is undertaking a wide range of actions ranging from promoting evolutionary acquisition and spiral development, making changes to established requirement processes, enhancing incentives (for both contractors and government representatives), developing effective scheduling tools, and increasing effectiveness of the project portfolio management. Below is a summary of the Air Force program. Many of

these efforts were and are conducted in close coordination with and directly supported by the OSD Cycle Time Reduction Task Force.

Phase I—Building Awareness

The first phase of the cycle reduction program focused on building the case for reducing cycle times, correcting the requirements process to account for time, building an understanding of the processes involved in making positive changes to the system, and establishing general goals for various types of systems. Based on acceptance of leadership and large parts of the OSD and Air Force bureaucracies of the need to shorten development times, Phase I can be called a success.

Cycle Time Reduction Business Case

The Air Force team built a business case that highlighted the effects of long acquisition cycles on the warfighter, the acquisition community, the budget, and the sustainment community. Based on MIT's research, the business case described, with specific examples, the impact of equipment not being available to the warfighter in time, the impact of dated or obsolescent technology built into newly fielded equipment, and the impact on operational performance of our systems. The Air Force team's case study also examined the business aspects of acquisition cycles, including how development costs increased exponentially as the planned development time increased, and how cost and schedule overruns tended to increase dramatically with long development times. The case also detailed the impact of multiple changes of leadership at the OSD and Air Force levels, as well as the role of program office staffs in the success of the development program. The Air Force Cycle Time Reduction Business Case was developed into a briefing and presented as a central part of the PEO/SYSCOM conference in fall of 1999 by Joe Eash of OSD. Eash also presented the briefing to the senior leadership of the other Department of Defense services, a number of major OSD organizations, and several congressional staffs. This business case was instrumental in changing the attitude about acquisition cycle time and identifying it as a significant issue worthy of additional attention from the Defense Department's leadership.

Cost of Delay Analysis

Although a generalized business case advertised the importance of the cycle time reduction issue, another tool had to be developed to measure

the actual impact of cycle time on specific systems. To accomplish this, the Air Force team worked closely with Don Reinertsen of Reinertsen and Associates, a leading commercial product development consultancy, to adapt his commercial-application Cost of Delay Analysis method to evaluate defense products.[11] Cost of Delay Analysis allows one to determine the value of time on a project and compare it to the impacts of development cost, production cost, and system performance. After a review of hundreds of commercial projects, Reinertsen found that the value of time was not intuitive to members of development teams. Often, people working on the same project had factors of fifty to eighty differences in their perceived value of time. Disparities of this magnitude lead to poor and conflicting project decisions and an inability of project leaders to make effective schedule-related trades and compromises. The Air Force team found similar results after a review of Air Force projects. Cost of Delay Analysis provided the team with an analytical framework leading to a firm measure of the value of reducing time. The method also highlighted the importance of tactical decision rules that can be applied by those associated with the project. This provides a basis for making cost, schedule, and performance tradeoffs, developing of schedule related incentives, and tradeoffs between various projects within a product development portfolio. The Air Force has demonstrated the use of Cost of Delay Analysis on defense programs and has developed training to implement the analysis on Air Force programs.

Acquisition Processes Changes—Acquisition Process Modeling

Analyzing and modeling the Air Force and DoD product development process was essential to understanding what drives long cycle times. The "front end" of the Air Force product development process includes the modernization planning process, the requirements process, the funding process, and the acquisition approval process. After a thorough review and with the aid of process maps, the Air Force cycle time team found that the official process included twenty-four separate reviews by the various requirements, budget, and acquisition communities necessary to start a project within the Air Force Headquarters alone. That assumes everything is successful the first attempt and within a single budget year.

This process, when followed, could add two to five years to the time to initiate a development project. Research conducted by MIT's Lean Aerospace Initiative found some processes that appeared to be disconnected. As an example, one mission area plan identified 673 projects to undertake. Of these, seventy-two made it into a major command submission, and none made it into the Air Force POM.[12] MIT also found that senior leadership shortened

the process 42 percent of the time by directing projects to be initiated, an indication of their frustration with the process. Modeling the acquisition process was a key to understanding the issues involved and how to address them.

Warfighter Rapid Acquisition Process (WRAP)

In order to develop a rapid method to approve the initiation of projects, the Air Force developed Warfighter Rapid Acquisition Process (WRAP). Modeled on a successful Army program, the WRAP process integrates the requirements, acquisition, and funding approval processes for projects into a single sixty-day Integrated Headquarters Review. Projects are competitively selected based on their value and cost of delay. The rapid approval process combined with execution-year transition fund allows for a limited number of highly successful demonstrated projects to clear the initiation process in sixty days as opposed to the two to five years it currently takes. The Air Force demonstrated the use of WRAP in 2000 and is implemented the full WRAP process in September 2001. The Air Force WRAP program is funded for transition funding of projects at $25 million to $30 million per year across the fiscal year. The WRAP process was explicitly designed to be expandable to incorporate all smaller ACAT III-sized programs vastly simplifying the efforts required to initiate new development efforts while establishing a competitive selection/screening process between projects.

Evolutionary Acquisition/Spiral Development

Through this analysis the Air Force and DoD identified the necessity for evolutionary acquisition strategies and the ability to deliver capability incrementally and modify systems to meet current needs. The Air Force established the Evolutionary Acquisition Reinvention Team led by Tom Graves of the Air Force Aeronautical Systems Center that developed a guide to assist project managers and MAJCOMs in the application of evolutionary acquisition strategies for weapon systems acquisition.[13] The DoD Cycle Time Reduction Team efforts led to the significant rewrite of DoD 5000, which now calls for evolutionary acquisition to be the primary approach for acquisition of major defense systems. Based in part on the efforts of the Air Force and DoD cycle time reduction teams, the evolutionary acquisition approach has been adopted by the Joint Strike Fighter Program, and the spiral development approach has been adopted by the Global Hawk UAV program.

Requirements Processes Changes—Requirements Generation and Approval Streamlining: HAF 2000 Requirements Reengineering Team

It averaged 463 days for the Air Force and DoD to approve a mission needs statement or requirements document. The average Air Force requirement officer developed a single requirements document during his or her career. The Air Force established a headquarters level team led by Colonel Tom Kelly to shorten the requirements generation and approval process. The Requirements Reengineering Team found ways to streamline the requirements generation process and develop a core group of requirements officers to speed the process. The team's recommendations were approved by the CORONA conference and Air Force leadership and are being implemented.

Time-Based/Time-Phased Requirements

During Phase I, the Air Force team developed concepts to change the requirements process to account for the impact of time and to support evolutionary acquisition practices. The Air Force team developed the concepts of time-based and time-phased requirements that specified user's needs over time (time-based) to meet their operational requirements and the matching of those needs with the available technology and systems development requirements with the acquisition community in a phased manner (time-phased). This allows the system requirements to be defined to allow effective evolutionary development of a system. This approach would allow for phasing of the capability, cost schedule and performance tradeoffs, and matching the budget and the technology over time while fully allowing for the flexibility in future blocks to allow for changes as they arose. The Air Force included a portion of this approach in its requirements regulation during an update in 1998.

The opportunity arose to include the support of evolutionary acquisition in the requirements process as part of the Section 912 Studies. With the support of DoD Cycle Time reduction team leadership, the portion of the Section 912 Study on Acquisition and Requirements lead by Dr. Joe Ferraro and Ric Sylvester developed a coordinated position on time-based and time-phased requirements. Time-based requirements and time-phased requirements are now included as part of CJCSI 3170, the regulation governing the requirements generation process and part of the DoD 5000 the Defense Acquisition System regulation. Time-based and time-phased requirements will be required in all future requirements documents.

Science and Technology and Transition Planning Changes—Innovation Activities

The Air Force has a wide range of innovation activities aimed at identifying an array of solutions to Air Force needs. Air Force activities include Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations, Air Force Battlelabs, Joint Expeditionary Force Experiments, and warfare centers. These efforts identify new and innovative uses of commercial and defense technologies and evaluate their use in realistic scenarios. These efforts help reduce the recognition time.

Transition Planning

The U.S. scientific community develops many technologies and solutions to the military's needs. Unfortunately too few of these make it to warfighters in a timely manner. One aspect is the lack of transition planning and preparations to enter the acquisition system or to be directly fielded. Effective transition planning can help speed and ensure smooth transition into the acquisition systems or directly to the work force. Following the successful completion of an experiment that has proven successful is too late to start thinking of the how to transition and field a capability. The Air Force AC2ISRC has developed a Transition Planning Guide to assist ACTDs, ATD, experiments and other innovation activities to ensure adequate transition planning at the appropriate time in order to speed transition once complete. Transition planning assists in reducing decision and initiation time.

Phase II—Building Infrastructure

The process of change is currently in Phase II with efforts being carried out across the Air Force. This phase builds the necessary infrastructure within the acquisition community to support and execute shorter development times.

The Air Force Schedule Incentives Reinvention Team lead by Bill Floyd of the Air Force Space and Missile Center is determining how to best enhance and correct the current schedule-related incentives for both contractors and government employees. To be effective, contractor incentives must work both during the source selection and once on contract. The Schedule Incentives Team has developed a range of recommendations for enhancing both government and contractor incentives to shorten development time where and when appropriate. The Schedule Incentives

Team, in conjunction with the Schedule Tools Team, has developed the Air Force Guide to Developing and Managing Air Force Schedules.

Schedule Development and Evaluation Tools

The Air Force Schedule Development and Evaluation Tools Reinvention Team is led by Aeronautical Systems Center. This team is determining if or what type of schedule development and evaluation tools are required to develop and evaluate appropriate project schedules. These tools when developed will assist program office and the planners determine realistic schedules for planning purposes, and will allow program offices to assess the risk and value of a contractors' proposed schedule. Some of the new tools being evaluated by the team include Theory of Constraints and Critical Chain Scheduling developed by Dr. Eli Goldratt. A pilot project is underway on the F–22 finishing program and the Avionics Flight Test Program.

Building Awareness

Phase II also looks at increasing awareness of the impacts of long cycle times and the efforts underway in order to build support across the warfighter, workforce, and industry communities for the difficult but necessary steps required during Phase III. These are planned to include symposia and training to increase awareness of the issues and demonstrate leadership commitment to achieving the results.

Phase III—Removing Systemic Constraints

Implementation of Phase III has not begun, and the specific steps for Phase III are in development. Research is being undertaken as to how to best implement the necessary changes. Below is a sample of the action necessary.

Project Portfolio Management

Phase III requires the obvious funding-based limitations to be addressed. Today 80 percent of projects report that their project schedules are limited by the available funding and not by the engineering or technical requirements. Many commercial firms suffer from the same problems. Classic signs in the commercial industry of less-than-optimal development portfolio management are many projects are late or behind schedule, quantities expected to be sold are not met, and requirements are changed

late in the development cycle. There are considerable similarities with the experience on Defense projects. Commercial firms have addressed these issues using several methods; the most central is to require that all development projects be fully funded based on their development-related requirements.

In order to do this, a company must limit the number of projects in the development pipeline to the number it can effectively support and execute in an efficient and effective manner using the resources available. Properly funding projects that are in development makes the development process more efficient and results in significantly more products being complete over time. This is accomplished though the use of a development funnel with strict phases and gates that allow only the highest payoff projects through and limits the number of projects in each phase of development. Within the Air Force we must also find a way to remove the systemic barriers to shortening schedules based on funding constraints.

Planning, Programming, and Budgeting Process

Changes to the funding processes for development projects must be considered. The current processes encourage partial or minimal funding of many projects resulting in less than optimal funding for most projects. Alternatives exist in commercial and other countries' defense acquisition systems. Milestone funding or full capital funding of development programs would ensure that the necessary funds would be available but would require a significant change in the budgeting approach. Capital funding of development projects would ensure funds are available to accelerate projects as opportunities arise and would significantly simplify the Planning Programming and Budgeting System as projects would meet the budget process only at a milestone review.

Workforce Training

An essential part of Phase II is training the workforce and spreading and maintaining the necessary skills to achieve the cycle time objectives. The Air Force is currently developing a set of initial courses that will provide training on all aspects of the Air Force Cycle Time Reduction Program. This, however, is only the start. Long-term training programs must be established to provide Air Force acquisition personnel and future leaders with the best business practices being developed across all industries. Much as the technology changes, so do acquisition and product development practices. Just as industry does, the military must continue to train its future

leaders and work force. The recommendations include sending twenty-five field grade officers a year to the top five business schools to learn about best product development practices. These officers would become leaders of the acquisition community.

Pilot and Demonstrations

The Air Force plan calls for transformational pilot programs to demonstrate the implementation of these efforts. Pilot programs are to be on a project level to demonstrate specific skills and practices and also on a portfolio level to demonstrate the synergistic effects across a range of products and product lines. These pilots have not been identified but efforts have been undertaken through efforts such as the C2 Acquisition Agility Study to determine how to implement the practices across an entire class of products or product development center. Efforts are underway to determine projects and initiatives to demonstrate the partial and full implementation of the Air Force Cycle Time Reduction Program.

Summary

A focus on acquisition response time is critical to the effort to make a faster and more responsive acquisition system that can field new technology quickly, respond rapidly to changing threats, and accommodate changes in our national military strategy. This is key to maintaining a long-term sustainable competitive advantage at an affordable price. The path to achieving the capability to develop and field high-quality systems rapidly will not be easy. It will require significantly more than just inputs and recommendations from the acquisition community to achieve these goals; direct intervention on the part of senior defense leaders is necessary. The programs described in this paper demonstrate that there is a commitment among acquisition professionals and senior DoD officials to promote changes to the acquisition system. As such, we have started down the right path, but we still have a long way to go. It is, however, a journey that we must take.

NOTES

[1] Air Force Systems Command, *Affordable Acquisition Approach*, Andrews AFB, Md., 1983.

[2] Dr. Jacques S. Gansler worked for TASC, Inc., from 1977 until 1997, when he was appointed to the position of under secretary of Defense for Acquisition and Technology. According to DoD Directive 5134.1, the under secretary of Defense for Acquisition and Technology is required to serve as the Defense Acquisition Executive with "full responsibility for supervising the performance of the DoD acquisition system." Prior to assuming these responsibilities, Dr. Gansler served in a number of other key government acquisition positions, including deputy assistant secretary of Defense for Material Acquisition and assistant director of Defense Research and Engineering (Electronics).

[3] President's Blue Ribbon Commission on Defense Management, *A Formula for Action,* A Report to the President on Defense Acquisition (April 1986), 15.

[4] Air Force Acquisition Reform Online newsletter, March/April 1996.

[5] Personal discussion with Col. Ben McCarter, Lightning Bolt 10 Leader, 13 June 1996.

[6] Air Force Acquisition Reform Online newsletter, June/July 1996.

[7] Ross T. McNutt, "Reducing DoD Product Development Time: The Role of the Schedule Development Process" (Ph.D. diss., Massachusetts Institute of Technology, 1999).

[8] Neither the problem nor possible solutions are new to the acquisition community: "How can a program manager reconcile the fact that, while his weapon systems may have a life cycle measured in decades, important elements of that weapon system, especially the electronics subsystems, are being rendered obsolete, through the rapid advance of technology, every three or four years?" See Carroll Eugene Garrison, "Technological Progress in Electronic Components: A Life Cycle Support Problem," *Defense Systems Management Review* 1 (Winter 1976): 25–37.

[9] See Steven Wheelwright and Kim Clark, *Revolutionizing Product Development: Quantum Leaps in Speed, Efficiency, and Quality* (New York: Free Press, 1992).

[10] McNutt, "Reducing DoD Product Development Time."

[11] Donald Reinertsen is a product development consultant and the author (with Preston G. Smith) of *Developing Products in Half the Time: New Rules and Tools* (New York: John Wiley & Sons, 1991). He also wrote *Managing the Design Factory* (New York: Free Press, 1997). Both are best-selling product development books.

[12] Results of LAI research conducted by Robb Wirthlin presented to the LAI Executive Forum in Groton, Conn., 1999. Joseph Robert Wirthlin, "Best Practices in Users Needs/Requirements Generation" (master's thesis, Massachusetts Institute of Technology, 2000), http://www.lean.mit.edu.

[13] Draft Air Force Evolutionary Acquisition Guide available on-line in draft form at http://www.safaq.hq.af.mil/acq_ref/cycletime.

The Transition Dilemma: Research and Development in the 1990s

Mark L. Montroll

As the decade of the 1990s began, the Berlin Wall was down, the Warsaw Pact was dissolved, the United States and its allies were preparing for Operation DESERT STORM, and the American people were beginning to give some consideration to what their national security infrastructure should look like in the post-Cold War era. In 1990, President George H. W. Bush gave a speech in Aspen, Colorado, in which he introduced the concept of "reconstitution" as a pillar of his defense policy. In his Year 2000 National Security Strategy, President Bush codified reconstitution as a specific strategic policy. Reconstitution—defined as rebuilding military forces to "guard against a major reversal in Soviet intentions" and protect American interests from other emerging global threats—lasted only until 1994, when President Bill Clinton issued his own National Security Strategy, effectively removing reconstitution as a formal policy goal of the United States.[1] The National Security Strategies adopted by both presidents were born of uncertainty, the non-specific but very real dangers of global instability, and the need to sustain fighting forces capable of defending diverse interests. Advanced technology played an important role in the defense strategies promoted by both presidents, and techniques used to support defense research and development were influenced in part by circumstances that followed the end of the Cold War.

During the military buildup of the 1980s, defense research experienced a sustained period of stability and importance. While the overall defense procurement budget grew to unprecedented levels during this period, defense research programs grew modestly, but gained enormously in stature, in part because of the high-profile role of new and exciting technologies being developed for emerging weapon systems. As procurement budgets grew, more and more acquisition programs were established, many drawing on

new technologies under development in ongoing research programs. In many cases, because research programs did not grow commensurate with stated procurement objectives, research budgets were inadequate to keep up with the demands of acquisition programs. Since there were so many different acquisition programs running simultaneously, however, a technological discovery or development could usually find a procurement program in an appropriate stage of its development cycle to accept insertion of the latest technological development.

But by the end of the 1980s, the environment was changing dramatically. As Cold War threats subsided, acquisition budgets were slashed and procurement programs were delayed, reduced in scope, consolidated with other programs, or simply cancelled outright. The Reagan-era bonanza was followed by austerity and uncertainty in defense spending; a consequence of this new fiscal reality was that fewer procurement programs were being funded, and those that were funded were often severely reduced in scope. Hobbled by smaller budgets, advanced technology programs suffered. Because research programs were at least anecdotally assessed as to how well they support ongoing procurements, this environment created dilemmas for both researchers and policymakers: Should research continue to be funded at current levels in order to support a research base capable of achieving real technological advancements, even though these advancements may not be incorporated into ongoing procurements as a result of time-phase or budget mismatches? And, if research funding continued to flow, what measures of merit or standards could be used to evaluate technologies that were not incorporated into fielded military systems? Should the Department of Defense subsidize innovations that had no immediate application to military weapon systems?

These policy questions dominated the scene during the 1990s. The Defense Department and military services developed numerous means for dealing with them. This paper explores some of the more significant programs established to sustain a credible defense research and development infrastructure and to ensure strong linkages between technological research and the military operations that defense research programs are supposed to support.

Defense Research and Development Processes in the 1990s

In 2000, Dr. Delores M. Etter, deputy under secretary of Defense for Science and Technology, noted that "the mission of the defense science and technology program is to ensure that warfighters today and tomorrow have superior and affordable technology to support their missions and to provide

revolutionary capabilities."[2] This emphasis on "revolutionary capabilities" reflects the tectonic shifts that fundamentally altered the American political and social landscape in the late 1980s and early 1990s. Traditional 1980s management techniques were not effective tools for managing science and technology programs in the 1990s. First, the Cold War had effectively ended, resulting in a significant reduction in defense procurements; and second, the ongoing digital technological revolution—which was moving at a breathtaking speed—was beginning to shape social and cultural expectations. It was not unheard of for computer technology to improve so rapidly that, by the time computer systems were ordered and delivered, the "new" equipment was already obsolete if measured by commercial standards. The speed with which digital technology improved often caused paralysis among defense decision-makers who were unwilling to commit resources to defense-related technology development projects that might be outpaced by civilian industry. For the defense acquisition community, this meant that not only were there fewer platform and major system procurements to transition technological advances into, in many cases, these technological advances were occurring so rapidly that even when they were successfully transferred, they were obsolete by the time the systems into which they were embedded were delivered to the operational forces.

In order to overcome these constraints, three significant transition processes were introduced during the 1990s. First, in the early 1990s, Advanced Technology Demonstrations (ATDs) were established and managed by the individual services in order to identify and demonstrate technologies that might not yet be fully mature, but showed great promise to effectively serve urgent operational needs. In 1994, a second approach, the Advanced Concept Technology Demonstrations (ACTD) program, was introduced by the Department of Defense to "allow users to gain an understanding of proposed new capabilities for which there is no user experience base."[3] Finally, toward the end of the decade (in 1998), the Joint Staff established Joint Experimentation Programs to allow operational forces to experiment with novel technological advances in order to compress the time required to field advanced capabilities. This process provided a means for rapidly getting technological advances into the hands of the fighting forces even before initiation of formal procurement actions.

At the policy level, three broad issues tended to dominate the decade: reconstitution, develop and hold, and acquisition reform. At first, the implementation and ramifications of a broad reconstitution policy set the research agenda. How could the research infrastructure be shaped so that future military systems would retain an enduring technological edge, even as the force structure and its supporting elements were being reduced? An

answer to this question was a policy recommendation that the United States continue to develop advanced military systems, bringing them completely through the concept and development phase—in fact, all the way up until the actual full-scale procurement phase. Once ready for full-scale procurement, the program would be shelved and the system procurement package would wait until some point in the future when pressing operational requirements would necessitate actual procurement. This proposed policy was the source of numerous debates. Neither the operational forces nor the research communities felt it was an optimum solution.

From these debates, a second policy issue emerged: How could the research infrastructure, the kernel of some future reconstitution phase, be preserved if current requirements and budgets couldn't support its continuing operations? The formal policy of not only encouraging but actually mandating technology transfer emerged as the most promising solution to this issue. Over time, however, it appeared that depending on nondefense organizations to support the defense research infrastructure was not going to be a viable policy. Toward the end of the decade, acquisition reform took hold as the formal process for rapidly linking advanced research developments and emerging operational requirements. Under acquisition reform, the acquisition process was transformed from a linear sequence of developing, procuring, creating operational doctrine, and training forces to use system to a nonlinear concurrent process of developing system and doctrine together, procuring and training together. This approach decreased the time from concept identification to actual field operation.

To understand how the transition processes (akin to a weaver's weft) and the policy issues (weaver's warp) were woven together to create the research fabric of the 1990s, it is useful to first look at each of them individually and then show how they were integrated.

The Weft: Technology Transition Processes

Advanced Technology Demonstrations (ATDs)

In the early 1990s, the defense research community faced a difficult and unforeseen challenge. Basic and early applied research programs were being reduced in scope or eliminated just as they were reaching maturity. During the mid–1980s, many new research programs were started or old ones enhanced as a result of the strong defense buildup of the time. By the early 1990s, many of these programs were just reaching the point of fruition but had not yet fully matured, when their fiscal support was

degraded or eliminated. As promising as new and emerging technologies might be, it was becoming more difficult for program managers to show how the fully developed technologies could transition into ongoing procurement programs. Without the ability to show a clear transition path, it was feared that even great research programs would be canceled. The ATD process was established to preserve these programs in the face of this risk.

Every service allocated a percentage of its annual research budget to fund a few of the most promising ATDs. The larger purpose of the ATD process was to identify the most promising technological advancements being made among the ongoing service research programs and fully fund those programs for three years in order to promote their rapid development. Each service devised its own method for selecting which programs would be funded as ATDs. All of the services required a firm link be established between the researchers and potential users of the technology in order for a program to qualify for ATD funding. It was often the case that a program would only be funded as an ATD if a manager of an ongoing acquisition program was willing to commit to use the technology at the end of the ATD program, provided it lived up to its expectations.

An approved ATD typically lasted about three years and received funding of around $15 million. Since the ATD approach was introduced, there have been many successful transitions from ATDs to system procurements. Because of the instability of the overall defense procurement budgets, however, some of the ATDs that proved successful as research programs were never fully integrated into procurement programs. Researchers were encouraged to meet with acquisition program sponsors and operating forces to examine how advancements in technology could serve the needs of the operating forces. This kind of dialog went a long way to helping reshape many ongoing research programs to be more responsive to emerging operational requirements even if the proposed ATDs were not approved for funding.

The ATD process was quite successful in achieving its original objectives; however, over time, it became difficult for the process to keep up with the rapidly escalating pace of commercial technology development. Although $15 million is a large sum of money for some research programs, as computer technology, communications and data fusion and processing technologies grew during the 1990s, it became clear that the ATD process could not fully support advances in these areas. Also, as commercial enterprises matured these technologies without government sponsorship, the Defense Department began looking for way to capture these new concepts and demonstrate their utility for defense-related requirements.

Advanced Concept Technology Development (ACTD)

The Advanced Concept Technology Demonstration (ACTD) program was introduced in early 1994 by the Department of Defense in order to help encourage and expedite the rapid transition of emerging matured technologies from the research and development community to the operational user. Technologies proposed for incorporation into an ACTD were required to be sufficiently matured that they could be readily evaluated at in operational environments. Therefore, they "should not be in the 6.1 (basic research) or 6.2 (applied research) budget categories. Furthermore, the technologies must have been successfully demonstrated at the subsystem or component level and at the required performance level prior to the start of the ACTD."[4] Since the ACTD process focused on matured technologies, it emphasized technology assessment and integration over technology development. Nonetheless, it served as an interim step from the research lab to the operational field.

A typical ACTD lasts for around four years and operates on a budget of approximately $100 million. A significant feature of an ACTD is that it has some level of jointness built into it. The concept an ACTD is demonstrating must contribute to the mission of more than one service. In fact, each of the participating services is required to provide support to the program with its own funds.

The goal of an ACTD is to provide operational commanders with actual prototypes of advanced systems that demonstrate unique military capabilities. With an example of a new technology to review and test, operational commanders were thus provided with the means to fully evaluate and, if necessary, shape the new system. Because the emphasis of these programs is on meeting clearly defined operational requirements, the ACTD also provides the operational commander an opportunity to develop and refine the concept of operations that will be used to guide the application of the new system. As the operating forces gain experience and understanding of the capability through realistic military demonstrations of prototype systems, they are better able to make an assessment of the military efficacy of the proposed capability.

A number of successful capabilities have been evaluated and shaped through the use of the ACTD process. The Medium Altitude Endurance Unmanned Aerial Vehicle, also known as the Predator, was one of the earliest ACTDs to be funded. It was flown and operated in Bosnia even before the ACTD was over. It has since transitioned into a mainstream acquisition program, and the Predator system continues to evolve as new and emerging missions define its role in modern warfare.

Although the ACTD process has proven quite effective for identifying emerging technological capabilities with high potential operational application while giving the services an important "fly before buy" opportunity, in the environment of rapid technological change, the ACTD approach can still seem very slow. It is the nature of the process that one must first build a prototype system, deploy it to the field, develop concepts of operation for its use, conduct operations with the system, and then evaluate its military effectiveness. By the time a system has passed through all of these stages, it may prove difficult and expensive to modify the system in order to take advantage of the knowledge gained during the demonstration phase. Therefore, the Joint Experimentation Program was introduced in order to create a direct link between technology demonstrations and warfighting.

Joint Experimentation Program

Toward the end of the decade, the Joint Staff introduced a joint experimentation program. The purpose of joint experimentation is to examine new technologies, operational concepts and force structure (organization) options together rather than independently in order to discover true advances in warfighting capabilities. Joint experimentation allows warfighters to access new technologies before the systems utilizing them are fully developed. In this way, operational commanders can assess the value of emerging technologies and make suggestions to modify a system's technological development program early in the development process. Presumably, these changes will make the emerging system more useful to the operating forces.

When the United States Joint Forces Command was created in 1999, its Joint Experimentation Directorate (J–9) was established in Norfolk, Virginia, to manage the program. By using the J–9 office as a coordinating body, the research community has a new process for working closely with the operational forces. Concepts identified in the research lab can now be introduced into the joint experimentation process long before the technology is fully developed. This allows the researcher to reach an understanding with the military end-user and make a determination as to whether a program or system is even worth pursuing from a military perspective. And, if it is, the research community can determine what aspects or features should be emphasized in a new system. In addition, the joint experimentation process allows the operating forces to see "what's cooking" in the research lab. This gives the operational community the chance to begin developing doctrine and training programs while the concept or system is still being developed.

The liaison aspect of the joint experimentation approach also allows the operational forces to have more direct input into the direction taken by research programs. This kind of arrangement has proven to be very productive for both the research and development community and the warfighters.

All three of these technology transition processes have helped the researchers and the operational forces reach a common understanding of how technology and doctrine are interlinked, relationships that became especially important for setting priorities for the use of scarce research monies. They are only really effective at advancing operational capabilities if they are closely linked to the acquisition and procurement process. If new technologies and capabilities are identified and developed but not procured and fielded, the operational forces cannot anticipate, respond to, or take advantage of their capabilities.

The Warp: Acquisition Policy Issues as Related to Research

Reconstitution

In his 1991 National Security Strategy statement, President George H.W. Bush included the following points:

"The four fundamental demands of a new era are already clear: to ensure strategic deterrence, to exercise forward presence in key area, to respond effectively to crises and to retain the national capacity to reconstitute forces shout this ever be needed. . . . This difficult task [reconstitution] will require us to invest in hedging options whose future dividends may not always be measurable now. It will require careful attention to the vital elements of our military potential: the industrial base, science and technology and manpower. . . . We will now have to work much more deliberately to preserve them."[5]

Following this guidance, the 1992 National Military Strategy noted: "Reconstitution also involves maintaining technology, doctrine training, experienced military personnel, and innovation necessary to retain the competitive edge in decisive areas of potential military competition."[6]

The term "reconstitution" was introduced into the National Security Strategy in 1991 and used in numerous supporting documents at the time. It was not, however, used long enough to acquire a formal definition in any of the Joint Publications or the Department of Defense Dictionary. As it was used at the time, reconstitution can be defined as "the act of rebuilding the nation's power base, which was reduced as a result of diminished current demands and future expectations, to a level necessary to meet emerging increased demands."[7]

Although the word "reconstitution" was essentially dropped from the defense policy lexicon in 1993 when President Clinton issued his first National Security Strategy document, the concepts prevail and are

debated to this day. It was under the philosophy of reconstitution that two predominant policy issues were debated throughout the 1990s.

The thrust of the debate was this: If the United States was to reduce its standing military forces while remaining on the leading edge of technological military capability when next called upon to fight, the research infrastructure not only had to be preserved, but had to be actively sustained in order to pursue the latest technology development opportunities. Despite the logic of this position, it would be highly unusual for an institution to promote or maintain such a research capability if the results of that research provide no direct or immediate support for the institution's mission. As the budget of the Defense Department shrank, policymakers were compelled to decide how to allocate scarce resources. Should monies go to support long-term research efforts, or sustain ongoing procurements and modernization programs? If the funds were used to continue ongoing procurement programs at their current pace, there would be no funds left with which to conduct research. This would have long-term ramifications for the entire defense establishment, since near-term shortfalls and program terminations would stymie the development of future systems. If funds were used to continue research at its current pace, acquisition programs would have to be cut, thereby eliminating future system procurements and reducing the need for the research in the first place. These difficult choices forced an intense debate within the defense community.

What emerged from this debate was a proposal to reduce acquisition activities while continuing research activities. One suggestion, calling for research programs to be carried until they reach the procurement stage, meant developing the complete procurement package, including specifications, manufacturing instructions and in many cases even building prototypes. With this kind of strategy, once a system was prototyped, development would be halted and the program "placed on the shelf" as a hedge against future threats. The argument was that it would be a quick and straightforward process to get these shelved systems into production while, at the same time, the research would continue, allowing the R&D community to develop the next generation of weapons systems. If ever the time came that one of these systems actually had to be built, it would be the leading-edge system that was ready for full-scale production and fielding. Whatever the merits of this approach to technology management, the debate is not yet over, and this proposal has yet to be adopted.

Technology Transfer

The policy to continue research up to the procurement stage was not adopted, and the question arose as to how the research infrastructure would

be sustained in an active mode, thus ensuring leading-edge capabilities would always be available to the operating forces. What emerged was a policy of encouraging technology transfer from the defense research community to non-defense industry. A number of laws were enacted to ensure that the spirit and intent of this technology transfer policy were carried out. To this day, major research facilities have technology transfer offices monitoring and performing legally mandated technology transfer activities. For example, detection technology developed at the Naval Research Laboratory in Washington, D.C., has been licensed to a private company for integration into a commercially available Explosives Detection Device,[8] a monitor capable of detecting explosives in mail and parcel packages.

Of course, technology transfer is not a new idea, and there was an important legal precedent for the laws and policies adopted during the 1990s. In 1980, for example, the Stevenson-Wydler Technology Innovation Act was passed into law. This bill encouraged and provided legal mechanisms for government research laboratories and facilities to work with private organizations in a cooperative manner. Before this bill was passed, the traditional method of cooperation was unilateral in character: the government would sponsor and pay for research performed by private facilities. With this kind of arrangement, the government owned the rights to the intellectual property and patents derived from this research. This fact tended to discourage nongovernment enterprises (such as pharmaceutical companies) from entering into joint research programs with the government, even if government laboratories were conducting leading-edge research. The Stevenson-Wydler Act allowed the private company or university, in certain circumstances to retain ownership to intellectual property developed under the joint research program. For example, utilizing a Cooperative Research and Development Agreement, the Naval Research Laboratory and the University of Texas Health Science Center at Houston (UTH) entered into a research partnership to develop a portable satellite-networked system to allow two-way audio, video, and data communication between an ambulance in the field and a hospital trauma center.[9] The Stevenson-Wydler Act also allowed the government facility to sell patent rights it held to nongovernment organizations and to retain royalties for internal operations at the laboratory. In 1996, the National Technology Transfer and Advancement Act amended the Stevenson-Wydler to strengthen the government's ability to participate in cooperative research programs.

Under the amended act, not only could the government facility sell its intellectual property rights, the government workers who developed novel technologies would receive a share in royalties collected by the government. It was also possible now for nongovernment enterprises to pay

to have government research laboratories perform research for them on a cooperative basis, and the results of this sponsored research was not held as public knowledge, but was rather held as proprietary by the sponsoring enterprise. In theory, at least, this afforded government research facilities the potential of offering its services on a "not to compete with industry" basis to nongovernment enterprises. The funds received from such operations could be used to sustain the facilities when government funds were inadequate for research and operating costs.

There were many discussions and debates about this issue during the late 1990s, but the concept of selling the use of government facilities as a way of sustaining them for future government use never really materialized. Thus, defense research facilities were still required to depend on the Defense Department for the funds necessary to sustain their operation. It was the policy of acquisition reform that ultimately brought the research community closer to operational community and provided the programmatic link that currently sustains the research activities within the Defense Department.

Acquisition Reform

Throughout the decade, acquisition reform was changing the way the Department of Defense procured and fielded new systems. Technology was improving so rapidly that the traditional acquisition process could not keep up with it. New platforms and systems were being delivered with technology that was obsolete, expensive to operate, and difficult to maintain. Utilization of commercial off-the-shelf components made defense systems more reliant on commercial spare parts inventories. When commercial companies changed their products, defense systems were no longer supportable. In order to compress the time from approval of an acquisition program to fielding of the operational system and thus speed the time for development, new initiatives were introduced into the acquisition process.

Under the traditional acquisition process, systems were procured sequentially. First research was done, then the engineering completed, then the system went into production, and finally the system was evaluated by the operating forces and integrated into operational capabilities. This process is very useful when the technology being integrated into new systems is not yet matured. It ensures that only mature technologies are embedded into new systems. As ATDs and ACTDs, as well as commercial technological advancements, began to yield new concepts faster than the traditional process could accommodate them, a new process of concurrent development was introduced.

Utilizing concurrent development, integrated engineering (supported by ongoing research) and production occurred simultaneously. Like the traditional process, the introduction into operational doctrine and training programs took place after the system was placed in the field. Although this sped up the process, there were few feedback loops from the operational forces to the developers to help shape the systems to the operators needs during development. This process did, however, allow the integration of ATDs and ACTDs into the acquisition process in a very efficient manner.

After the joint experimentation program was introduced, the acquisition process was modified to allow for direct transition from ATDs and ACTDs into production coupled closely with user inputs throughout the process. Utilizing an experimentation/demonstration acquisition process, integrated engineering (supported by ongoing research) and operational evaluation occur simultaneously. Only after the system is refined through the interaction of both the users and the developers is it put into production. Also, under this process, production runs are scheduled and the system is designed so that the latest technology can be integrated into the system during each succeeding production run. This methodology links the researchers, developers, and users as never before. Process action teams have been established as a matter of formal policy to enable these close links.

Conclusion

As the 1990s drew to a close and a new century dawned, the defense research community became more closely linked to the operational units and the system developers than ever before. One visible result of these new relationships is the relatively shorter amount of time required to field new systems. ATDs, ACTDs, and JEPs have proven effective for getting cutting-edge technologies into the field; the value of the operational community's role in research and development cannot be ignored. Similarly, technology transfer programs and acquisition reform initiatives have strengthened key relationships between the commercial world and the defense community, and the benefits of these new and emerging relationships have yet to be fully realized.

Although these approaches and policies have proven largely beneficial for the defense community, it is important to remember that improved R&D techniques and shorter system development times have often come at the cost of other diversified research efforts. Research and development programs have often been sustained at the expense of procurement and sustainability for contemporary forces. Making this kind of trade-off is an

ongoing tension within the DoD and the subject of a debate that continues to this day. Do we sacrifice future systems to preserve legacy equipment, or defer maintenance on field systems to seek out new technologies and capabilities? This is a difficult quandary, and the picture is complicated by other policy discussions.

The Department of Defense is also debating not only *how big* the peacetime research infrastructure should be, but also *who should manage it*. Many major acquisition programs have established strategies that require a single prime contractor to manage the program from the earliest research stage, through the systems life cycle and on to decommissioning and destruction. The size and scope of the peacetime research community is also being debated as part of the ongoing Base Realignment and Closure (BRAC) discussions. Throughout all these debates, it is easy for the weft and the warp to tangle and fray. To keep the fabric of national security tight, it is important to stay focused on identifying what is necessary to ensure the U.S. maintains leading-edge technological military systems in perpetuity.

NOTES

[1] George H. W. Bush, "Remarks by the President to the Aspen Institute Symposium" (as delivered) (Aspen, Colo.: The White House, 2 August 1990).

[2] Department of Defense, Deputy Undersecretary of Defense (Research and Technology), "Defense Science and Technology Strategy," Washington, D.C., May 2000.

[3] Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "Introduction to ACTDs," http://www.acq.osd.mil/actd/intro.htm.

[4] Department of Defense, Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "ACTD Guidelines: Formulation, Selection, and Initiation," http://www.acq.osd.mil/actd/guidelns/fomulat.htm.

[5] The White House, "The National Security Strategy," Washington, D.C., 1991.

[6] The Pentagon, "The National Military Strategy," Washington, D.C., 1992.

[7] Mark L. Montroll, "Reconstitution, Research, and Development: From Swords to Plowshares and Back Again," Report Number ICAF 93-S100; Industrial College of the Armed Forces (ICAF), Washington, D.C., 1993.

[8] See the listing for the explosive detection system at Naval Research Laboratory, Office of Technology Transfer, "Licensed Products," http://techtransfer.nrl.navy.mil/lic_products.php.

[9] Naval Research Laboratory, Office of Technology Transfer, "CRADAs," http://techtransfer.nrl.navy.mil/cradas.php.

Symposium Closing Remarks

B. F. Cooling

DR. JEFFREY CLARKE: Dr. Benjamin Franklin Cooling has agreed to present us with some closing remarks and observations. Professor Cooling was given many of the papers in advance of our sessions, and, during the past three days, he has had the opportunity to attend a great many of our sessions. Dr. Cooling holds a Ph.D. from the University of Pennsylvania. He currently holds the position of professor of Grand Strategy and Mobilization at the Industrial College of the Armed Forces here in Washington, D.C.

During his career, he has been associated with the historical programs of the Army, the Air Force, the Department of Energy, and the National Park Service. He has also had numerous teaching assignments, both within the defense educational system and in the civilian academic community. He has been a prominent member of many historical professional organizations and associations. He has authored, co-authored, or edited well over a dozen books on military history, many of them having to do with the military, business, and technology. He's just the person to give us a balanced assessment of our conference.

Dr. Cooling, the podium is yours, sir.

DR. B. F. COOLING: Thank you, Dr. Clarke, and thank you, ladies and gentlemen, for hanging in here during what has turned out to be a very difficult week. None of us could have anticipated at the beginning the events that transpired yesterday morning [11 September 2001].

Regrettably, those who were with us at the beginning of the symposium are not here with us at the end. They have missed a whole lot, and I personally have missed a lot by being called back and forth for what I thought were going to be teaching duties. It turns out, of course, that the institutions were closed because of the horrible events that unfolded yesterday. So I share in the dislocation that you all have experienced during these three days.

Because of what happened, a cynical person might suggest that all of the detailed coverage and the provocative analysis presented during these symposium sessions now might be entirely irrelevant. It remains to be seen how yesterday's events will influence the acquisition of the tools of war in this decade or in the years to come. Given the magnitude of the tragedy that just unfolded, this is probably not an unreasonable conclusion. All of our questions about the acquisition of complicated and expensive weapon systems, the management of the defense industrial base, and all of the things we associate with post-World War II acquisition seem to pale before the challenges we face in our very unsettled world.

I do not want to suggest that this sentiment will be the focus of my remarks this afternoon. I certainly have been educated and entertained by those of you who were present, whether you were on a discussion panel or in the audience.

I would rather not make profound statements about the future of warfare. Instead, I want to focus on three questions relative to the symposium: What was this all about? Why was it important? And what has been covered and what has not been covered? Then, I would like to make some very specific historical comments and random thoughts on acquisition that I threw together this morning. Yesterday, I made the mistake of leaving all of my notes in my office—an office that is probably quarantined now as a result of yesterday's events. So these random thoughts on acquisition history and context are by no means comprehensive or encyclopedic, but are instead a series of comments and observations that I'd like to make to wrap-up this symposium.

What was this symposium all about? Why is it important? Principally, it showcased the Defense Acquisition History Project, a chronicle in the making about DoD acquisition since the end of the Second World War. In addition to showcasing the project, it has occasioned our gathering. Our numbers have included some current and former DoD acquisition officials, a number of distinguished scholars, and the acquisition history project team, among others. The last three days have been an important first stage of this critical historical undertaking, a work in progress.

Our keynote speaker, Professor J. Ronald Fox of the Harvard Business School, underscored some critical themes for our discussions here. These included authority, responsibility, program management, work force training issues, the inadequacy of management techniques, and the need for an inventory of acquisition lessons learned—applied history, if you will.

Our distinguished roundtable discussion panel included three important administrators: Paul Ignatius, Paul Kaminski, and Jacques Gansler. They provided personal perspective, sagacious prescription, and the articulation

of their respective agendas, because every one of them had an agenda to promote. That is the nature of their work as representatives, administrators, and intellectual practitioners. They touched on many of the same issues identified by Professor Fox in his keynote speech. Their contributions were also entertaining and immensely helpful for students of contemporary and recent acquisition history.

In addition to a keynote speaker, yesterday's distinguished practitioner discussion panel, and my capstone remarks, there were five other sessions, each grouped very neatly around a specific chronological period. The panels featured the project volume writers discussing their respective eras, providing us with an overview that served as a point of departure for the follow-on paper presentations and ensuing discussion. These overview papers were accompanied by a total of ten specialized topical or programmatic investigations, all of which probed and poked via an approach that we used to call—somewhat derisively, I suppose—"post-hole-digging" history.

Do not get me wrong; there's nothing wrong with post-hole history. In fact, if you look at most scholarly history books published today, they are of the post-hole-digging variety. Indeed, detailed monographs are an important and valuable contribution to our collective knowledge about the world.

Every one of the participants, including the audience, represents a dedicated, informed, and involved student of acquisition. Here in this room, all of us are anxious to talk about our research discoveries and transmit new insights and understanding of the acquisition experience. We remain aware, however, that we merely stand on the threshold of knowledge about that experience – *veni*, *vedi*, but not *vici* as yet! Certainly *coming* and *seeing* at this symposium are part of the process. But, in the end, publication of the proceedings will begin to *conquer* understanding the complexity and diversity of the subject field. Of course, I wish we had the published proceedings right now at the Industrial College of the Armed Forces. They would be indispensable for our courses on acquisition, mobilization, and defense industrial base and strategic planning and logistics. As a customer, we need this volume right now. We need it for the classroom and boardroom. We need copies in every conference room and for distribution among practitioners of acquisition and logistics both at executive and operator levels. Make no mistake, there is an audience for this subject. It will not be a popular audience, perhaps, but as students of experience, an audience in the policymaking arena.

So I ask again: why is this symposium—and the ongoing acquisition history project—so important? The importance of the subject is patently obvious. Without material or materiel, our national defenses are hollow.

Without knowledge of and an appreciation for prior experience in acquisition—within *context*—the stories of weapons system development remains incomplete. It is important to promote an understanding of how our national defenses are built, and acquisition is, in many ways, the foundation of our military strength. This symposium and the larger acquisition history project will explore the key relationships that are the building blocks of that foundation.

Acquisition history is interdisciplinary and integrative. It embraces political, economic, and sociocultural elements, as well as the technology that has long captured our imaginations. The "drum and trumpet" story—the operational history—is the stuff of which movies are made and legends are born; it is the thing that best draws the attention of the public. But the operational part of the story is only half a loaf, because it's missing this acquisition ingredient. It misses procurement of the "sinews of war." Thus this symposium has been important because it served as a forum for the first erratic steps that will eventually form an acquisition history overview. Because of the very specialized case study approach taken by the presenters, these steps were punctuated by facts, stories, and insights that can be used to build pillars of acquisition wisdom.

Far too many acquisition histories have been buried in program history office files. The critical details are hidden in the random reminiscences and war stories that appear in oral history interviews that are scattered around the country. Our distinguished panelists had a number of interesting stories to share, and it is imperative that we try to capture those stories, because they are the fabric of history and the fabric of the subject at hand. Without these stories, the raiments of acquisition history have to be made from a rough weave of bureaucratic decision papers, directive binders, and contract specifications. Working with that limited material, the facts may be present, but the insights, struggles, and human drama that are conveyed in story form cannot be passed on to the next generation of acquisition professionals.

Being the "first chop" at the interpretation of the documents has always been the hallmark of official history. That point was stressed by one of my mentors, the Army's chief historian of years ago, Dr. Maurice Matloff. Those of us who trained under his tutelage will never forget his views on the value of history and historical study, and I believe he would be one of the first to applaud this acquisition history project if were he alive today.

On the matter of what has been covered and what has not been covered, Dr. Matloff would surely have seen this symposium as one giant step on a much longer path. He would have appreciated what has been discussed by each panelist, and no doubt impressed with what Dr. Kaminski so aptly captured yesterday by his remarks on the "four P's": process, people,

partnership, and persistence. Likewise, Matloff would have applauded Dr. Gansler's ten fundamental areas that formed the core of his presentation, ably articulated not only as part of a memoir, but also as a credo for his continuing work and thinking in this particular field.

Given that Dr. Matloff was a product of the World War II defense environment rather than the post-Cold War transitional period, he might have related strongly to Mr. Ignatius's discussion of purchasing and procurement. Mr. Ignatius's remarks about terminology struck a chord with me since, in the acquisition business and in the larger defense community, we are constrained by our vocabulary and our definitions. For instance, somehow we must go beyond calling the contemporary era the "post-Cold War" period. As of yesterday, September 11, 2001, we are surely in something besides the post-Cold War era. We don't know what to call it yet, so we refer to it as the "late Cold War transition," transition being the time at the moment perhaps.

Terminology notwithstanding, Matloff would have seen the influence of internal and external politics, federal as well as institutional, on the acquisition process. Similarly, he would have recognized the interservice jockeying and squabbling that is only partially abated at the top levels of command. He would have understood and acknowledged the ever-present role of dollars and budget, organizational structures, and cultural constraints that have been alluded to in your presentations and in the comments made by our audience.

Technology was not so much Maury Matloff's forte. He preferred to think in terms of overarching strategic formulations. Seeing the world through the strategic lens would not have prevented him from grasping the symbiotic relationship between technology and strategy, a kind of marriage, somehow never consummated under the vows of the acquisition process. Many of you alluded to this theme in your papers.

Although we have covered a lot during the past three days, I am sure each of us has thoughts about what wasn't mentioned and what should have been discussed. We could probably use Dr. Gansler's roundtable remarks to explore what could have been covered. The overview papers and the more topical papers incorporated aspects of the changing nature of warfare (a theme Gansler identified as one of his ten points of inquiry) and, at least tangentially, new threats (area two), although we might think in terms that are very different today than we would have if asked to think about new threats before yesterday morning. Dr. Gansler's remarks about modernization (area four in yesterday's presentation), high cost over life cycle (area five), and science technology research and development (area seven) were all addressed in some detail in the symposium sessions.

I am less certain that I heard much about equally important points that Dr. Gansler mentioned yesterday. Service jointness and multinational "combinedness" (area three), as the Pentagonese would have it today, deserve more attention. Likewise, the integration of acquisition as part of a larger framework of logistics processes (area six) should be studied closely. Infrastructure (Gansler's area nine) and work force (area ten) were subjects that got some attention, but they must be examined in more detail in this project's final product, the chronological volumes.

Above all, I believe the acquisition history must explore the other side of the acquisition coin: Dr. Gansler's area eight, the defense industrial base (or what we used to call the "military-industrial complex"). Important are the connectivity of ideas, the management of personnel, the transition of people back and forth between the private corporate sector into the acquisition sector, the influence of management styles from the private sector on managers working within the government community, et cetera. These aspects of defense-industry collaboration and cooperation—implied yesterday by our three distinguished round-table participants—need to be incorporated into the DoD acquisition story.

Defense acquisition history should also address another important contextual question: Where does DoD acquisition fit into the overall pattern of government acquisition? This is not to suggest that the broad subject of federal acquisition should be explored in some fashion, perhaps as the backdrop for the DoD acquisition decision-making process. The legal, procurement, and contracting experiences and practices in government generally should inform for exploring continuity and diversity in the purely defense area. Moreover, together, they can enlighten us about war and the state in late twentieth and early twenty-first century America.

Let me share with you now some random thoughts on acquisition in a historical context. We could probably talk for a week about this topic. My ICAF colleague Dr. Robert Scheina has posited what he calls the "golden rules of acquisition history." They have governed our acquisition activities since we first started government and defense acquisition in the colonial period, or at least militarily since my namesake came down to Frederick, Maryland, from Philadelphia to work with English general Edward Braddock on securing wagons for his ill-fated 1755 expedition to Fort Duquesne. Many of these golden rules seem to have been featured in this symposium.

First of all, it's clear that there's been a constant power struggle between those who favor a centralized process and those who prefer decentralized acquisition. Virtually all the papers, comments, and remarks at this symposium have featured that tension.

Second, this struggle seems to have its origins in the ideological differences of our earliest political parties, the Federalists and the so-called Republicans or Jeffersonians. Over time, the struggle became less ideological and more driven by political pragmatism; in other words, political power was derived from having control of the resource-distribution process, and struggles sometimes played out between the branches of our government over who was going to control the distribution of money and contracts. The nucleus of the struggle shifted to the military services, where disagreements over missions, doctrine, interservice cooperation, and resource management all became part of the acquisition process. The more modern forms of this struggle were reiterated throughout the papers presented at this symposium.

Third, and I did not detect this from the presentations, is that most acquisition laws prior to the 1960s were reactive to scandal, seldom proactive. In the 1960s, control of the acquisition process became more of a power struggle between the branches of government as Congress initiated more laws to govern the process. It was during this competition in the 1960s that the number of acquisition laws increased considerably; perhaps this is attributable to post-Eisenhower fears about the military-industrial complex, the Vietnam-era aura of things, high-profile acquisition scandals, or perhaps something else. Whatever the reasons, there seemed to be a tremendous increase in ethics laws and regulations. I don't think this was because Americans were more corrupt or devious, but because the communication revolution made malfeasance more transparent and, under the right circumstances, more dramatic, drawing attention from not only Capitol Hill, but also constituents from around the country. Mounting public pressure may have influenced the struggle between Congress and the Department of Defense.

The values and ethical principles that the acquisition community always talks about have, in fact, shifted or evolved during the period of time covered by this acquisition history project. The literature that periodically highlights scandal, whether the "shoddocracy" of the American Civil War, the later "merchants of death" that received congressional attention in the 1930s, or the more recent "military-industrial complex" trumpeted by Eisenhower's farewell address, continuously underscored the question of official trust with public funds. Again, an ancillary focus in the acquisition history volume might address a somewhat traditional *leitmotiv* or fourth golden rule for acquisition: rising expectations of impeccable morality for those entrusted with national security programs to the point of a career service Acquisition Corps or professionals in the late 1980s, who would function above and beyond the political cauldron of dispensing federal monies for huge weapons programs or logistical support.

Something that should be mentioned as another golden rule might be that a peacetime acquisition emphasis on promoting efficiency of fiscal consumption gives way to wartime mobilization that emphasizes effectiveness of the warfighting capabilities. How well the policies, programs and human mindset of the bureaucrats or responsible officials transform forward and backward from state of peace to state of war to peace again is surely part of acquisition study. Of course, in broadest terms, the spectrum should be seen as preparedness, surge, mobilization, war, demobilization, and reconstitution. We have recently passed through a demobilization in the 1990s, although we soon sensed it was "transition," and the events of 9/11 suggest that once again the upsweep of remobilization is in tow with all sorts of yet unanticipated consequences of acquisition in the new century. In point of fact, by the time that the Defense Acquisition History appears in print, the nature and competition of separate portions of the Global War on Terrorism, Homeland Security/Defense, and Operation IRAQI FREEDOM will have transformed (another favorite Pentagon reformation term in current vogue) acquisition for the future. The New Mobilization of 2002/2003 will have departed from benefits only for traditional industrial-business partners of the American military to sharing with new national security contractors of the Information and Service Age cutting across other government agencies. Globalization itself will transform the manner of acquisition for national ministries of defense such as the Pentagon. "Lessons learned" from response to events and the new preemptive official National Security Strategy will have their effect on defense acquisition and its contemporary historical record.

At the risk of going on too long, I do want to share a couple of other thoughts with you. Some of my observations flow from the work of a lawyer/professor at nearby George Washington University. James F. Nagle wrote a book that is very relevant to what we are doing here. His book, *The History of Government Contracting*, was published by the George Washington University in 1992. It was very nicely done and is very useful for both general reference purposes and professional research.

Nagle opined in his epilogue that if someone had been asked to devise a contracting system for the U.S. government, "it is inconceivable that one reasonable person or a committee of responsible people could come up with our current system." That system stems from thousands of decisions made by thousands of individuals, within and outside government. It reflects "the collision and collaboration of special interests, the impact of innumerable scandals and successes, and the tensions imposed by conflicting ideologies and personalities." If you think about it, there are little flashes of light

throughout all the papers that we heard here that reflect or allude to Nagle's conclusions.

Since the 1750s, the period in which his narrative begins, "the basis of wealth has gradually changed." He goes on to discuss the late eighteenth century, when wealth was based on land, and how this merged in the twentieth century: "Capital has become less hardware-oriented and more dependent on talent and ingenuity." Then, Nagle writes, beginning about 1955, white-collar service workers overtook blue-collar workers numerically for the first time. Since then, some of the most financially successful companies in today's world do not own large factories with billowing smokestacks or raging furnaces. They may only occupy floors in office buildings or maybe they own the whole office building, where people skilled in computer science or other technical fields can develop new software or new processes. In the process, "some of the industrial giants that once dominated the economy could not adapt and became dinosaurs," a hallmark of the defense industry in the 1990s.

Nagle wrote from the perspective of the final decade of the twentieth century. Even then, some defense contractors were in the process of fulfilling his observations. So it was that he concluded that throughout our history, "the upheaval of new ideas" was exploited by entrepreneurs who took full advantage of the shifts in economic and social power. Citing farmers in eighteenth-century partnerships, industrialists and corporations in the next century and multinational conglomerates in the twentieth century, ten years after writing, Nagle and we, too, may wonder how government acquisition may respond to entrepreneurial flexibility under the laws of Darwinian survival.

More to the symposium's theme, however, since DoD acquisition is a government or public responsibility and mandate, Nagle referenced futurist Alvin Toffler's notion that in this process, government is always "the great accelerator." Possessing "coercive power, its voracious appetite for supplies and services and its tax revenues," government traditionally could undertake that which was unaffordable to private enterprise. Government could accelerate the industrialization process by creating a need for vast quantities of goods and by intervening to fill gaps in the economic system. Without such government intervention, industrialization would have occurred more slowly, if at all, he concludes. In his view, while economic change has opened many new paths to power over our history, the "one constant path has been the government contract." Certainly the government contract forms the hallmark of the five Defense Acquisition History volumes now in preparation.

A recent study of the defense industry, Ann R. Markusen and Sean Costigan's *Arming the Future: A Defense Industry for the 21st Century*

(1999), suggests several defense policy choices, all built around themes that will sound quite familiar. In their final chapter, they had subtitles to various sections: "What and How Much to Buy?" "How to Buy It?" "From Whom to Buy?" "The Make or Buy Decision, or How Much to Privatize?" "Who Should Merge/Collaborate with Whom?" "What to Export and to Whom?" These broad questions might not be as important for writing the first volume in the acquisition history series, but these issues will most certainly have to be addressed in the last volume. *Arming the Future* asks other challenging questions. What was the role of off-shore procurement and the larger arms export business, and how did these aspects of the defense business change the acquisition process? What form does acquisition competition now take and what influence does it have on our economy, our expectations, and our armed forces? By implication, is it recession-proof? Certainly, if we are going to look at the history of defense acquisition as a whole, we will have to understand the long-term evolution of a process that compelled Markusen and Costigan to ask these questions in 1999—and not just about a domestic defense industry, but one internationalizing in size and scope. *Arms 'R Us* might not be so facetious a title for the Defense Acquisition History as first seemed.

The conclusions and prescriptions of Markusen and Costigan are informative. They contend that the "defense-industrial challenge for the United States is to achieve the following goals simultaneously: One, maintain a sophisticated, flexible and tried and true defense-industrial base." This is just as vital in 2002 as it was in 1948–1949, or even one hundred years ago. Second, they advance, "ensure cost and quality discipline using market forces where possible and effective oversight where not." Effective oversight was an important component of the acquisition process, and it still is. Third, Markusen and Costigan continue, "constrain the distorting effects of industry political influence." Number four, they suggest: "Link procurement to the most appropriate defense strategy for the coming decade." Weighing all the evidence, they decided, "we conclude that a concerted international consortium among allies led by the United States, to rationalize defense-industrial capacity and slow the pace of arms innovation and diffusion is a most promising route, one that maximizes our security which economizing on defense preparedness and harnessing the industry to security ends, rather than by vice versa."

The word "economizing" immediately invokes the image of a dollar sign in my mind, since cost has always been a factor as one of the major themes in the acquisition history, whether it's back in the American Revolution or more recently. But, Markusen and Costigan, as private citizens, view it more as arms control, I think.

"This path is also the one most likely to maximize prospects for world peace and restrain the development, possession, use, and potentially destabilizing effects of sophisticated weaponry." Well, I am never one to miss a chance to somehow sound the cause of world peace, which is admirable, although that is a little extraneous to what we are concerned with in this gathering.

A final thought before I conclude. In early 1982, Dr. Gansler and I corresponded about his participation in a planned anthology that I had in mind at the time called *Making War: the Military Mobilization in American Business in World War II*. Well, the volume never transpired. He took the essay that he had given to me and made it the first chapter in his book, *The Defense Industry*. The other day, while trying to put together some thoughts for my remarks, I found his letter in reply, and I want to quote a couple of key passages because they are relevant to what we're talking about in this symposium.

Referring to our project in 1982, Gansler wrote, "I think it is badly needed now and, thus, there is a sense of time urgency to try to get it out in order to help with the current emphasis on mobilization in the Reagan Administration," adding, "and to take advantage of the market demand for the book." Even today, we cannot be sure about the commercial appeal or marketability of defense acquisition history. Gansler also warned in 1982 that he worried "that the book will become too heavy to carry or read." Such an enjoinder surely obtains for the current five-volume projected Defense Acquisition History project—the curse of official government history, although the work seems as badly needed now as Gansler and I obviously thought our work would be in 1982.

Finally, Gansler made some other insightful remarks in 1982 that bear repeating in this forum. "Let me emphasize the importance of such a book and the desire to do it in the next few years to catch the few remaining individuals who still have personal experience," he wrote in 1982. He had referred to the WW II generation when writing to me, but he would emphasize it, I am sure, in reference to this current acquisition history project, "because that asset will soon be lost."

Similarly, a few years ago the Department of Energy had concern at Oak Ridge about the need to conduct oral history interviews with the workers making nuclear weapons. Otherwise, the scientific and technical data would be lost, along with their know-how and the tacit knowledge that comes with having hands-on experience. Unfortunately, the 1990s were a period of political correctness, and in that charged environment, the Clinton administration refused to support anything even remotely related to building nuclear bombs. So that idea was shelved.

Still, Gansler is correct. Historians must contend with this problematic; if you don't get on it now, the individuals, the people who were involved in these things, those assets will soon be lost. Gansler invoked that danger in 1982 in his letter to me. I think all of his remarks in that correspondence are worth repeating again here and now.

This acquisition history project is timely and important. Let's get it done. Let's get it out there. Let's put it out so that a customer can use it, but in a size that anyone can use. This history will be invaluable to students of acquisition, and I look forward to being able to assign it to my own students at ICAF so that they might develop an appreciation for what has come before them, in terms of policy, people, and the other factors that contribute to the struggle that is the defense acquisition endeavor.

Let me glibly conclude by returning to a project that I worked on nearly a quarter-century ago, an effort to explore the acquisition and development of the new American steel Navy in the late nineteenth century. There is the famous Squadron of Evolution. A bunch of "pop-top" ships, we would call them today, but the squadron was a fleet prototype that made its way out of New York Harbor in November 1889. A brisk leave-taking occurred off Sandy Hook. No gun salutes, no tooting of whistles. The secretary of the Navy at the time, Benjamin Tracy, was on an escort boat, and he merely hoisted a signal, announcing, "Goodbye, good luck." The squadron flagship, *Chicago*, answered with a simple "Thanks." With that, the nucleus of a modern permanent American combatant fleet made its way to sea.

So today I would say goodbye, good luck to the project team members, and good luck to all of you working in acquisition history. Thanks to Science Applications International Corporation and the U.S. Army Center of Military History for sending the nucleus of the acquisition history project to sea with what I think we all would agree was an absolutely illuminating, educational, provocative, stimulating, and challenging symposium.

PART VI

11 September 2001
Round Table Discussion on Defense Acquisition

11 September 2001: Round Table Discussion on Defense Acquisition

Linda Brandt
Jacques S. Gansler
Paul Ignatius
Paul G. Kaminski

Editor's Note: This round table discussion was advertised as the highlight of the three-day Providing the Means of War *conference held in Tyson's Corner, Virginia, and scheduled for the morning of the second day of the symposium: 11 September 2001.*

Although disrupted by the tragedies of that morning, the round table session continued as planned. The transcript that follows captures the feelings of shock, confusion, and anxiety that were shared by those in attendance, as well as an awareness that the day's unprecedented terrorist attacks were going to have serious implications for the acquisition community and the larger national defense establishment. Remarks made by the participants about events unfolding in New York, Washington, D.C., and elsewhere, have been preserved here because of their value as historical documentation.

DR. JEFFREY CLARKE: Our panel today will be led by Professor Linda Brandt from the Industrial College of the Armed Forces. Linda, would you like to use the podium to make introductions?

DR. LINDA BRANDT: Yes, thank you. First of all, I'm Linda Brandt from the Industrial College of the Armed Forces, National Defense University.

I want to thank you all for being here. We are meeting on a day as very critical events are now unfolding outside. We really don't yet know what's quite happened, but it certainly does look like it's turning out to be a day

where the discussion of how we can equip our men and women in uniform is appropriate and important.

One of the things that I always say about acquisition is that, while it's interesting, while the actual process is fascinating, and while the technology is really wonderful, the only thing that really matters about acquisition is what equipment you can get into the hands of the people who can use it.

I'm very honored today to introduce three individuals who have spent a very long time getting equipment into the hands of people who can use it, and they continue to work very hard to produce even more of that equipment.

One of the nice things about a session like this is that you can take a pause to reflect back on the past, look at where you are now, and think about where you're going in the future. The three people who are sitting here at the front table have had a great deal of influence on how we think about acquisition, how we frame the acquisition debate, what we have done in terms of the intellectual discussion of acquisition, and also how we implement the acquisition process so that we do get things into the hands of the men and women of our armed forces.

I will introduce all three speakers at the beginning of the program, starting with Mr. Paul Ignatius. He is a critical thinker and a pioneer in acquisition and has, since his tenure in the Pentagon, been thinking and writing about acquisition in a historical framework. Paul Ignatius is a former secretary of the Navy. He graduated from the University of California, received a master's degree in business administration from Harvard, and served on the staff of the Harvard Business School from 1947 through 1950 as a research associate. Along with two Harvard Business School colleagues, he was the founder of Harbridge House, Inc., and those of you who have been in the acquisition business for a while have no doubt had dealings with Harbridge House in a management consulting capacity or in a variety of other professional capacities. He then served for eight years in the administrations of Presidents Kennedy and Johnson, first as the assistant secretary of the Army for Installations and Logistics, then under secretary of the Army, and, in 1966, he was appointed assistant secretary of Defense for Installations and Logistics, a position that pre-dated and foreshadowed the position that our other two participants served in. In 1967, he was named secretary of the Navy and served in that position until 1969. Following his government service, he became president of the *Washington Post* and also served as the president of the Air Transport Association until his retirement in 1986.

He served in the military in World War II as a lieutenant in the U.S. Navy. He's had a variety of distinguished civilian and military awards

and serves on a variety of boards and other activities. He will lead off our discussion this morning by providing us with a framework and historical perspective on the acquisition process.

He will be followed by Dr. Paul Kaminski, who is now chairman and CEO of Technovation, a consulting company dedicated to the development and application of advanced technology. Dr. Kaminski is also a senior partner at Global Technology Partners.

I first met Dr. Kaminski when he served as the under secretary of Defense for Acquisition and Technology, a position he held from 3 October 1994 to 16 May 1997. In that position, he was responsible for all matters relating to the Department of Defense acquisition and technology, including research and development, procurement, acquisition reform, environmental security, international programs, dual-use technology, logistics, the defense technology and industrial base, and military construction.

That is such an enormous job that when they established that position—and I go back long enough in Washington to remember the creation—I always thought that the people who took that job were either unbelievably optimistic, or perhaps didn't understand what was involved in that job.

[Laughter.]

DR. BRANDT: But I think both of them do have an understanding of the job and all that it entails.

I had heard of Dr. Kaminski prior to meeting him because of his background and experience in the development of stealth technology. He is one of the most successful program managers to have ever served in the government, and he left behind a legacy that our military still uses to its advantage.

He has a variety, too, of honors and boards that he serves on, an enormously impressive educational background. But he left one thing out of his resume. He's also an ICAF graduate, and we were always very happy to see him back at ICAF.

[Applause.]

DR. BRANDT: I turn now to Dr. Jacques Gansler. Now, I actually met Dr. Gansler when I first came to Washington. In 1982, I was invited by a friend to attend a defense industrial base conference at Brookings, and he was the speaker. I was very impressed with Dr. Gansler because he applied an academic approach to a subject that I had never seen presented in intellectual or academic terms. Dr. Gansler is now a professor on the faculty at the University of Maryland's School of Public Affairs, where he holds the Roger C. Lipitz Chair in Public Policy and Private Enterprise. He teaches graduate school courses and leads the school's new Center for Public Policy and Private Enterprise, which fosters collaboration among public, private,

and non-profit sectors in order to promote mutually beneficial public and private interests.

Before joining the faculty of the University of Maryland, Dr. Gansler served as under secretary of Defense for Acquisition, Technology, and Logistics from 1997 until 2001. In this position, again, he, too, was responsible for all those things I mentioned before. And, lest he remind us, he had an annual budget of $180 billion and a work force of over 300,000.

Prior to serving in that capacity, Dr. Gansler was very closely associated with TASC, Inc.—in fact, I always thought of him as TASC's face to the government—and he served wonderfully in that capacity. He's also held a variety of other positions in the public sector, including deputy assistant secretary of Defense for Materiel Acquisition in the early- to mid- and into the late 1970s. He also worked at I.T.T, Singer, and Raytheon. In addition to his extensive corporate experience, he has a varied academic background, and has taught and written about acquisition throughout the years.

Again, I have to say that one of the things that I, too, will always remember about Jacques is he has been coming to ICAF—I've been at ICAF for eleven years—and Jacques reminded me when I said he'd been coming for about twenty-five years, he said, "No, it's been twenty-seven years." Maybe it's twenty-eight this year. So he, too, has a long affiliation with the school.

I am pleased to turn this session over to three individuals who have made such a mark on a field that is so patently important, and with that, I will turn it over to you,

Mr. Ignatius.

MR. PAUL IGNATIUS: Thank you, Linda. Paul, Jacques, ladies, and gentlemen. We have to discipline ourselves a little bit today in order to concentrate on the subject of this symposium while the world outside is full of breaking news with very serious implications, but it's our duty to do so. And we, from this side, and, I take it, you, on the other, will do the best we can to address the subject at hand.

I am going to go back in time to about 1950, the time of the Korean War, and then move forward perhaps to 1970, thereabouts, through the Vietnam War. And just to show you how ancient I am, we used to refer to acquisition as "purchasing."

The first contact I ever had with this endeavor was with the National Association of Purchasing Agents. Now some years later they upgraded themselves to business class and started called themselves the National Association of Purchasing Management, but it was still purchasing.

At some later point "procurement" came in, a little fancier word, but pretty much the same thing. There is a secondary definition for procurement that I think we needn't put much emphasis on at this particular meeting.

At some point, "purchasing" and "procurement" became acquisition, and I expect that before this session is over, we will have some idea about how purchasing and procurement became acquisition. I've got some thoughts of my own, but Jacques and Paul will have more to say about that.

Shortly after the Korean War started in June 1950, there was a general named Phil Smith at Wright Field in Dayton, Ohio, who headed procurement for the Air Force. It was quite a creative group at Wright Field at that time. The head of it was Ed Rawlings, who left to become a chief executive at one of the large cereal companies. Within the procurement section were some really understanding people. Barry Shillito, known to many of you, Jack Schaeffer, who later became head of the FAA, and many others.

Phil Smith became concerned that fifty cents or more of every contract dollar was being spent by the purchasing departments of what were then called "air frame" prime contractors in the Los Angeles area and in Seattle, and he wasn't sure of how competent these people were who were handling buying and major subcontracting.

So, with General Smith's encouragement, I got involved in helping to set up a program for the aircraft industry to bring together buyers and purchasing agents from aviation firms like Lockheed, Douglas, North American, Hughes, and so forth. We wrote case studies—that is, Harvard Business School-type case studies—that dealt with the kinds of problems that one encountered in a period of major expansion. These were big fighter plane programs at the time with an awful lot of electronics on them.

Hughes Aircraft had corralled some of the world's most outstanding electronics engineers. Among them were Si Ramo and Dean Woolridge, who both left to form Ramo Woolridge, which later became Thompson, Ramo, Woolridge. If you were writing the Book of Genesis about the electronics industry, you could get an awful lot of begat, begat, begat, through a number of generations, beginning with Hughes Aircraft. For example, Charles "Tex" Thornton, the head of Hughes, was having trouble getting magnetrons from companies like Raytheon and General Electric and from a little outfit up in San Carlos, near San Francisco, called the C.F. Litton Company. Thornton was smart enough to acquire that outfit and, in time, to build a giant company, Litton Industries, around this very successful producer of a component of the fighter fire control systems. It was a very exciting time.

I think that in a symposium like this, it's important not only to look at innovations in the process of acquiring equipment and major weapons, but also to look at the organizations created to do it. As an historical footnote, it's important to remember that the Army had a series of arsenals. Throughout our history, the arts of war were kept alive at these arsenals. We'd be in a war and then we'd demobilize, and pretty soon everybody

would forget about warfare. But the arts of war were kept alive in those arsenals.

The Air Force, being a brand new service, and not coming into being until after the Second World War, didn't have this kind of institutional legacy to draw on, so it created some very interesting new forms.

The Ramo Woolridge company, involved in systems engineering for the big missile programs, was one of the first. Later, the Aerospace Corporation, which was a quasi-public corporation, came into being to oversee a lot of the Air Force's work.

It was a time of intense technological change and challenge because of the missile. As World War II was coming to an end, the U.S. Army had a massive intelligence program to capture the German rocket scientists from Europe and the information that was available there. During the war, maybe a thousand or so V–2 weapons had been launched on London. This was a ballistic missile developed by Werner von Braun and his associates at Peenemünde. Von Braun and a number of his key people left Peenemünde several days before the war ended and surrendered to U.S. forces. The Soviets arrived a few days later and also got some people.

The German team came to the United States, as all of you know, and the Army placed its missile program at Redstone Arsenal, which was helped substantially by the arrival of these pioneers of German rocketry. Our army missile program was also given a boost by a very brilliant general there named Bruce Medaris from the Ordnance Corps who commanded Redstone.

Meanwhile, on the West Coast, the Air Force was developing missiles under another brilliant general, Bernard Schriever. Complicating the picture was a growing ideological conflict between the services over who should control this important new technology. The Army said, "We ought to control this new technology because the laws of ballistics apply, and of course, we're the leaders of that field." And the Air Force said, "Oh, no. The laws of aerodynamics apply, and we're the leaders in that field; therefore, we should have the lead."

The Navy was right in the middle. It had a Bureau of Ordnance with all of the experts on ballistics and a Bureau of Aeronautics with all of the experts on aerodynamics. They finally had to come up with some kind of solution. So they said, "if the missile has a wing on it, it belongs to the Bureau of Aeronautics, and if it doesn't, it belongs to the Bureau of Ordnance." In time, the impracticality of the Navy's arrangement became apparent to everyone, and the two organizations were merged into the Bureau of Naval Weapons.

During this period, the Air Force was intensely interested in assuring proper pricing, and decided to do something about it. It set up a three-month

long, full-time advanced management program, an Air Force pricing school, located in Los Angeles in order to facilitate direct interaction between the senior Air Force people responsible for procurement and pricing and the aerospace company people. This program was quite an important investment, in terms of time and the commitment of people. The curriculum was based on case studies written primarily for this program, and a number of people, including Professor Howard Lewis of the Harvard Business School, were involved.

While the Air Force pricing school was being held, the Navy's Polaris program was getting underway. Polaris was of enormous strategic importance. One of the things that its director, Admiral Raborn, wanted looked at—in addition to all of the extremely complex and difficult technical problems—was how best to manage the contracts for the program. He believed that incentive contracts, which rewarded success and penalized failure, might be useful. At Aerojet and Lockheed Missiles and Space Division, I was studying how one would structure incentives for the Polaris program.

I want to switch now to the 1960s, the McNamara period in the Pentagon. I touched earlier on the issue of organization for procurement and acquisition. Especially in the Army, there was a great focus on organizational questions. The Army's technical services had served the United States well throughout U.S. history. Our country, in some ways, was built by the technical services. The Ordnance Corps made great contributions to manufacturing by their perfection of blueprints and techniques for the serial production of guns. The Signal Corps, through its aviation section, helped to give birth to military aviation. The first contract with the Wright Brothers was with the Army Signal Corps. The Corps of Engineers was also responsible for many things we take for granted, like dams and waterways. An army engineer built the Panama Canal. So the Technical Services had a long, proud record.

But their jurisdictional claims became muddy as electronics became more widely used. The introduction of missiles further complicated the picture. What we had were virtual fiefdoms with jurisdictional scopes that were no longer pure. What the Army *needed* was integrated logistics and integrated procurement, but it had neither. McNamara pushed the integration issue, and out of it came the formation of the Army Materiel Command, with a four-star general in charge. It became a very important focus not only on procurement, but also on state-side CONUS logistics.

We were all encouraged at that time to look for innovations in buying and purchasing. At the Army level, where I got started, one of the things that bothered me were annual contracts for items with predictable requirements,

like a truck or a jeep. It's easy to figure how many jeeps you need to buy. You've got some idea of the useful life of a jeep, and you know pretty much how many you need in the total inventory. So you can look ahead and say, "I need to buy 10,000 a year." The contracts were being let on an annual basis, and often one company would win in one year, and another in the following year. So if, let's say, Ford had the jeep contract and lost it to Willys, the government yanked the tooling out of Ford and sent it up to Willys. You had a hiatus in production for a long time and then another annual increment of jeeps.

Well, it didn't seem to make sense, and I asked some of my people, "Why do we do this?" They said we have to because Congress appropriates money on an annual basis. One Congress can't commit another. I said there ought to be some way to work this out. So a lawyer on my staff, a procurement expert, went to work, and he came up with a clever idea. He said, "Let's buy three years' worth of jeeps. Let's ask for bids based on a quantity of 30,000. The starting costs would be amortized over a lot of 30,000 rather than 10,000, and the unit price will be lower. If the Congress decides, for any reason, not to appropriate funds for years two and three, then the government would owe the contractor the unamortized portion of his start-up cost."

We went up to the Hill and talked to George Mahon, a great American who was the head of the Appropriations Committee. He said he liked the idea, and gave it his approval. General Frank Besson, head of the Army Materiel Command, issued multiyear contracts that saved money and also improved our military readiness.

I'm not going to get into acquisition during the Vietnam War except to make a couple of points. When Tom Morris, who was the assistant secretary of Installations and Logistics, left, I succeeded him, and it was at about the time that the major escalations of the Vietnam War were taking place. I was in that position for about three years.

During the middle and late 1960s, the emphasis shifted from finding new ways to do procurement to getting out contracts and assuring delivery. Procurement quantities were sizable, especially of ammunition, at levels higher than during World War II. The Air Force never expected to drop another iron bomb; in fact, it got rid of the tooling for making iron bombs. But we were dropping iron bombs in quantities that outmatched the World War II experience. Getting contracts placed and delivery on time was a major priority.

Another priority was the Army's aircraft programs, especially for helicopters. We doubled the production rate of the Army's Hueys from seventy-five per month to 150 per month. Production of the other Army

helicopter, the Chinook, a twin rotor, was tripled from five to fifteen per month. With the increased production rates, we were also fighting shortages. The aluminum forgings needed for the helicopters were of the same type that were needed for our fixed-wing aircraft programs.

So my focus, as chief of procurement at the defense level, was getting all this produced and doing it in the best and most efficient way we could. But unlike World War II, we did not have the ability to commandeer resources. For example, Douglas needed forgings for a new jet airplane for commercial passenger use at the same time that we needed them for military production. We had to come up with strategies to deal with our commercial-military conflicts. It was a busy period.

I think I've used up most of my time. Let me end by giving you my own thoughts on the difference between purchasing and procurement, on the one hand, and acquisition, on the other. It's useful for me to divide the world into two groups here and not think of a "one size fits all" approach.

There are some items that are bought by the military that have commercial counterparts. The government buys in huge quantities virtually the same stuff that my wife buys when she goes to the supermarket: mayonnaise, ketchup, paper towels, whatever. For items of that kind, where there's a commercial counterpart or equivalent, we ought to buy the items by formal advertising or competitive negotiations.

But we also buy items that don't exist in the commercial market. These are items that have to be created in whole or in substantial part, and here we are *acquiring* something, if you will, that doesn't exist. We can't go down to the supermarket and say, "I want a bottle of ketchup." We are creating something new.

So the cultures of procurement and acquisition are different. I think the oversight system has to be different, too. With these commercial items, there must be a strict arms-length approach that consists of formally placed contracts, low bidder awards, and so forth. On the acquisition side, where you're creating something new, buyer and seller have to work together. Yes, there's still got to be an arm's-length arrangement; it is, after all, a contract. But it's a different sort of situation. When I think about the ethical issues surrounding acquisition programs and how we organize to manage them, and how we look at the people involved, it's useful for me to think that there are different needs that perhaps require different governance.

I thank you for your attention, and I'll now turn it back to Linda.

DR. BRANDT: Thank you, Paul. Paul?

MR. PAUL KAMINSKI: Thank you, Paul. You've provided us with a wonderful framework with which to continue. Let me ask those of you in the back of the room, can you hear me without the microphone? If you

can't, raise your hand. I'll not use the microphone, but if at any time I'm kind of fading and you're not hearing me, please raise your hand and then I'll use it.

I want to start with a framework to discuss acquisition that includes four P's, and I'm not going to talk about each of these in depth, but I will weave them into what follows.

Discussions of acquisition usually focus on the first of the P's. It's a *process* based on legislation and a large body of arcane rules and regulations. In my experience, the other three P's are of greater importance than just the process.

Besides process, the first of the other P's stands for *people*—capability, training, motivation of the people involved in the process. The second one is *partnerships*—the partnerships that have to be put together to make the system work, partnerships within the government, partnerships with industry, partnerships between government and industry, and several other kinds of partnerships. And the last one that I've personally found to be very important is *persistence*—grabbing onto something and staying with it for a period of time to make it happen.

I'm picking up where Paul Ignatius left off. I came on active duty as an Air Force officer in 1964. I was sent back for a little more education before getting out to the field, so I really started out in 1966 after getting a master's degree in engineering. I started my career by testing the advanced inertial guidance components for our ballistic missile systems and working on the very first precision television-guided munitions that were finding their way to Vietnam.

After finishing that assignment, which was really not an acquisition assignment—it was a test and evaluation assignment—I did a little more schooling and then ended up in an organization that, at the time, I couldn't tell anybody about. In fact, my wife and I were at dinner a few years ago; at the end of the dinner, she was very quiet in the car driving home, and finally she spoke up in kind of a gruff voice and said, "You never told me you worked with the National Reconnaissance Office." It turned out that her dinner partner had been the director of the NRO. Of course, at the time that I worked in the organization, that organization wasn't acknowledged officially—it's very existence was classified. But it's important to the acquisition story because when I came to that organization, I was introduced to the way the National Reconnaissance Organization did procurement, and it was done in a very streamlined way. It was an organization that had a high tolerance for risk. The methods we used at NRO provide a good example of the kind of special relationships you need when you're pushing the frontiers.

There was a program, since declassified, called CORONA, which was our country's first space reconnaissance system. I think it had eleven consecutive failures before we got the first vehicle to work.

There were some very clever people who set up the entire acquisition system in the NRO. One was a General Martin. In fact, there were two Martins, brothers. One was in the ballistic missile business; the other was in the national reconnaissance business. Martin was very clever; he created some of the incentive schemes that were used at NRO, and it's unfortunate, but we've seen a few of these schemes go away. We had a great deal of freedom and authority. NRO was an organization that wanted to incentivize the performance of these satellite reconnaissance systems in orbit. To make it happen, Martin came up with this wonderful scheme. Today, it's called the Martin Incentive Formula. It was essentially a cost-plus-award fee contract. The fee was 15 percent.

Martin insisted that the fee be paid to the contractor the day the contract was signed. The reasoning behind his giving up that cash flow was very simple. Every time the contractor failed to meet one of the performance objectives on orbit, the CEO was writing a check to the government for a piece of the fee that the company lost. Think about the incentives to the organization with that kind of arrangement. Every time the system failed to meet performance objectives, the CEO certainly knew about the problem.

While I was starting work on one of our new national reconnaissance systems at the National Reconnaissance Organization, I was asked about taking on a task that had dual-use applications, something that was useful for both NRO and our conventional space community. That dual-use effort hit me like a ton of bricks because I wrote up the procurement package, submitted it for review, and I found out we had this whole body doing what I call "conventional acquisition requirements review" for the space business, which, from my perspective, had all these oddball requirements, including a whole set of Contract Data Requirements List (CDRL) reports, a whole set of military specifications and standards, and other requirements that, as the program manager, I felt were unnecessary. The program manager could certainly remove any of the requirements that were imposed by the review organizations, but doing so would put the program manager at great risk. So the issue was, how far out on the limb did you want to go against bureaucracy to sidestep things that you felt you really didn't need? That procurement was a very eye-opening experience for me. It was something I pocketed but later planned to come back and look at.

I was able to put those procurement experiences to good use a little later in my career when I was working with Under Secretary of Defense Bill Perry to lay the procurement and acquisition foundation for the

stealth program. That program also started out very lean. In fact, what we applied were most of the principles that we first used in the National Reconnaissance Organization procurement system.

It comes back, first of all, to the first of the P's, people. In both organizations, very careful attention was given to getting the best and brightest, equipping them with tools they needed to do their jobs. With those people on staff, it was very key, then, to allow the process to have a lot of tolerance for those bright folks who were dedicated to solving problems with innovative approaches.

Those organizations were also strengthened by partnerships, especially in terms of coupling together those who were eventually going to be using the equipment with those who were buying it. Because of my belief about the importance of these kinds of partnerships, I had always resisted the idea of a stand-alone procurement corps whose only mission in life was to acquire things. This was because I'd always felt you had to have some sense of how what you were buying was going to be used, what was important in that process, and we had to have some mixing of buyers and users to make that occur in the appropriate way.

We used this partnership approach in the stealth program. In 1979, we were using the idea of integrated product and process teams; we weren't fancy enough then to call it IPPT at that time. We didn't really have a name for it, but in practice, we had a monthly management meeting on every one of those key programs, and in the monthly management meeting, decisions were made about what to do during the next month and beyond. The price of admission to those meetings was that you had to be prepared to make decisions. Because we made decisions at the meetings, there was no chance to go home to check with the boss about whether we wanted to go left or right. It was a very wholesome process, and the people who couldn't make decisions ended up getting separated out in a meeting or two so that the people who were showing up at those meetings were the decision makers and they were prepared for us to see where to go.

It was this kind of partnership that directly involved folks like the government program manager, representatives of the command that was going to acquire the capability, the head of the test force, the Lockheed program manager, the GE engine program manager, the logistics support element, etc. With this team, crisp decisions were made, and I will tell you that in my experience, looking back at that program, I did see bad decisions that were made, but never did I see a bad decision last for two meetings.

[Laughter.]

MR. KAMINSKI: It was a very streamlined system made up of a small number of people, all of whom were very responsive. When I

came back into government service as the under secretary in 1997, one of the things I tried to do was to see if we could pick up some of the best features of that management process and begin to apply it to our overall defense procurement system. When I came into the government, we were springloaded because an excellent foundation had been prepared. There was the so-called Section 800 panel that had already convened and had pretty much produced its results. It laid the foundation for what became the Federal Acquisition Streamlining Act of 1994. In fact, that act was approved the day I came into my under secretary's position, so I had very little to do with that. That whole foundation was there, although I kibitzed a bit before coming to government service.

It was my view that the success of the larger procurements had to do a lot more with the people and the partnership rather than the process. The right people and right partnerships had to be in place for the process to work properly. When I considered some of the major acquisition programs, I thought about old friends in the Air Force—an officer who had gone through a series of forty briefings just to get to a major acquisition milestone. Almost anybody in one of those forty briefings could say no, but no one person could say yes.

I also felt that the Defense Acquisition Board—or the DSARC—process had gotten to the point of theater by preparing for this big meeting in which someone might be recognized for their intelligence by simply raising a hand in a meeting and pointing out some problem that would slow up the program under discussion.

[Laughter.]

MR. KAMINSKI: And I felt the process had completely departed from its objectives because the objective of this process was not to hold big meetings; the objective was to acquire military equipment. And I think many people had lost sight of that.

So one of the important accomplishments I think of the past administration was the push to move to a true integrated product and process environment. I made it clear to the people there…

DR. BRANDT: Do you want to…

MR. KAMINSKI: Could I take a break?

DR. BRANDT: Yes. Can we just let Dr. Kaminski answer a phone call, and what I might ask, Jacques, is if you pick up and…

MR. KAMINSKI: Sure, right in the middle of the full sentence.

[Laughter.]

[Mr. Kaminski leaves the room.]

DR. JACQUES GANSLER: Right. One of the important things that I think all three of us recognize is that even over a forty-year time period, the

issues are largely the same, and there is always the challenge of keeping the momentum of a project going so that you can, in fact, make what amount to continuous improvements to the process.

One of the things that I'll never forget from trying to make changes was when I was really pushing a lot of the acquisition reform stuff, and I was giving a talk at—I won't say where—one of our schools, and one of the professors there said, "Well, you know, as soon as you stop making all those changes, we'll implement that and put them into the curriculum." That professor just absolutely missed the whole point.

[Laughter.]

DR. BRANDT: Are you sure it wasn't us?

DR. GANSLER: No. What both Pauls have described—and what I will describe—is a process of continuous improvement. The challenge that Pete Aldridge has now and is doing is to continue making changes in the areas that are critical.

I think part of the thing that makes it so interesting about the three of us is that we came to our senior acquisition positions with both government and industry perspectives. In my case, I had worked in the defense industry when I first got out of college because it was the most intellectually challenging part of designing guidance and control systems for missiles in the second half of the 1950s. I continued to do that kind of work through the 1960s. It was in the 1960s that I got much more heavily involved in selling things to the government, working to meet its specifications and requirements, and recognizing significant problems in how it was conducting business.

In 1972, I wrote a paper saying that I thought the government could do its business better. I was the vice president of ITT at the time, working in their defense electronics section, and Johnny Foster, who was then running DDR&E called. Foster was in the position that later evolved into the job taken by Paul Kaminski. Anyhow, Johnny Foster called me up and said, "If you think you can do it better, I'll give you all the electronics programs. You try it." So that was my first experience in the government, from 1972 to 1977, working first in DDR&E and then later in Installation and Logistics.

At the end of that, in 1977, I went back to the defense industry and worked for almost twenty years. While I was on the commercial side, I spent a lot of time trying to figure how we could improve acquisition, including spending some time on the Packard Commission in the mid–1980s and then finally come back to the government in 1997.

I mention that because one of the things that really depresses me is how much of our legislation today discourages or, in some cases, almost prohibits people with experience from taking jobs in the government. I

think that's just counterproductive. It strikes me that experience is what is essential for success in these senior positions. A little earlier, Linda was describing the difficult nature of the job and the wide variety of things that it has to cover. The idea that a person could come into it and learn the job on the job—which is the assumption that most of our laws make because the goal is to find someone who has no conflict and, therefore, no background—is just inexcusable. I think what we need to recognize is the ethical character of people selected to take these positions. Quite frankly, I've always found that the people serving in senior government positions have much more concern about their ethical behavior than their counterparts in industry. So I think this is one of the key observations I'd like to make today: it really does take bringing experienced people into the government to take these positions.

The other side of it I would say . . . again, maybe it sounds like I'm talking about my own background, but my academic training was in both engineering (I earned undergraduate and advanced degrees in engineering) and economics (another advanced degree). I mention this combination of engineering and economics because there is a tendency in the acquisition community to figure out how to make the best system (the engineering challenge) or how to audit (the economist or auditor's approach), but the real challenge is how to use engineering to reduce cost. We need to get the people who are in the acquisition engineering community to start thinking about cost as part of the larger engineering challenge, rather than relegating cost to the world of the accountant. This is a cultural issue, a cultural schism that may take many years to reconcile.

Let me pick up from 1997. At my confirmation hearing in 1997, I made the point that one of the most important things we had to recognize was the dramatic period of change that we were in. Now, Paul Ignatius said there was a dramatic period of change before Vietnam. Historically, I suppose we're always living through dramatic periods of change. But in the defense community, we do go through cycles in which the issues at hand are more matters of leadership and vision, while other periods are marked by change-management struggles, during which process and systems are the focus of attention.

One of these change-management periods occurred during the introduction of missiles; Paul briefly described this. Another was during the period of rapid technological change in the 1990s, when systems and technologies seemed to be evolving on an eighteen-month cycle. During this same period, new threats; dramatic changes in geopolitics, such as our increased dependence on allies in many parts of the world; basic changes in the nature of warfare, coupled with growing concerns about what kinds

of battle we were going to be fighting in the future (going from planning for the Fulda Gap in Western Europe to trying to anticipate the kinds of things we see today); becoming embroiled in regional peacekeeping; facing dramatic changes in our industrial structure, namely the consolidations that were taking place; all of these external issues combined with the dramatic changes in the character of the DoD workforce, meant that the acquisition business was in a period of transition, and the transition had to be managed properly.

With these dramatic changes underway, it was absolutely essential that the Department of Defense respond rapidly to bring about change in the four areas that Paul mentioned: process, people, partnerships, and persistence.

I also have four areas of focus that I use to conceptualize acquisition, but mine are slightly different than Paul's. My four points—questions, really—are: What do we buy? How do we buy? From whom do we buy? And who does the buying? I see these four questions as the heart of the acquisition dilemma. Now, we could easily have an entire discussion that would take up the rest of our time here if we focused on the first of those questions; a better articulation of that first question would be: "Should the acquisition community be involved in the question of what we buy?"

Paul and I have both emphasized the importance of involving the acquisition community, even though some of our predecessors, who came into office with the purchasing and procurement perspective Paul Ignatius, argued against it, preferring to think of their roles in terms of budgeting and management. I think it was very clearly established by the Goldwater-Nichols Act of 1986 that the role of the acquisition community is to become involved in the decision-making process. This process has to involve collaboration between the warfighters, including the vice chairman of the Joint Chiefs, and the acquisition community in order to get an effective combination of perspectives that match warfighting requirements with affordability.

In other words, you need to make decisions; not "Here's what I'd like to have"— we'd all have Ferraris if we could take it from that perspective—but "Here's what we can afford to have in order to do that military mission." And that trade-off, I think, is very much a function of the acquisition people playing a role in that decision process.

[Mr. Kaminski returns to the room.]

Paul, do you want to pick up from where you were, and I'll come back and finish?

MR. KAMINSKI: Let me sort of close if I can, Jacques. Also, I want to let you all know that I was just called out because of some matters that may affect other people in this room.

It turns out that a 767 has crashed at the Pittsburgh airport. We don't know whether it's related or not. Most federal buildings in Washington are being evacuated. I understand that a section of the Pentagon has collapsed and there are fires at State and Congress as well. So this seems to be a little more activity than was initially indicated. All flights in the country are now shut down.

MR. IGNATIUS: A 767 crashed in -- ?

MR. KAMINSKI: They don't know if it's related, Paul. The crash just happened.

[Pause.]

MR. KAMINSKI: I don't know if it's possible to get us focused back on the subject, but I'll try. I thought you should at least all be aware of what's going on out there right now.

On the issue of what we buy, I think Jacques and I are in very strong agreement about the need for—I come back to one of my P's again—partnership. Partnerships are an important part of the process associated with what we buy and also sometimes how we go about buying. Partnerships are sometimes about creating the right incentives. That's why I used that example of the Martin Incentive. When you're looking to develop a specific capability or operational characteristic, incentivizing the team can be very important, but it's important that the entire acquisition process support the incentive approach.

I think we still have a ways to go in the partnership arena to make this work better. I still see, I believe, a great deal of horse-trading taking place in the Joint Requirements Oversight Council. Maybe log-rolling might be a more appropriate term for it. I also don't see enough real engagement on the issue of cost as an independent variable to make the trade-offs needed to understand where we're starting to get beyond the knee in the cost growth curves. In some cases, it's important to go beyond the knee of a curve because it makes a very large operating difference, and we ought to be willing to pay for that or at least understand the consequences of paying for that in terms of the size of the buy.

I do think we need more and more discussion and give-and-take on those issues, bringing the data to bear, and while most talk about this is associated with hardware that we buy, there's probably a lot more discussion needed on the software and the variable trade-offs in the services and the support of the equipment over the life cycle. Also, we need to develop an approach to create the right incentives. That does come back again to the people aspect of this issue, which is creating the right incentives for the best and the brightest to become involved in this activity and providing the right training and experience opportunities for people to do this well.

I believe this is going to be a growing problem. The entire institutional base that we built during World War II and reinforced during the Korean Conflict and in Vietnam is in transition. If you look at the demographics of the acquisition workforce and the larger defense industry, we're set for a period of time in which somewhere between the next five and fifteen years, we're going to see about 90 percent of that experienced workforce out the door. And there is not, in my opinion, a suitable replacement program in place the capability to provide people like we had in the past. And no doubt, these chickens are going to home to roost. It's only a matter of how fast can we gear up to try to do something more about it.

One point that I want to make is that we've made some very substantial progress through the use and collection of past performance data. That's one of the initiatives I worked on, and Jacques continued to push on that. Past performance information is an important part of the proposal evaluation process, and I am really beginning to see how that initiative has influenced acquisition. Companies have come to realize that if they don't perform well on the current contract, they're going to have a little more trouble acquiring the next one because past performance is going to be reviewed.

The other thing I wanted to mention briefly—and maybe this will be a good hand-off to Jacques, and I can come back to some later points in the wrap-up—is that there were two major rewrites done of the 5000 series acquisition regulations. There was one done in 1996 when I was was in DoD, and Jacques also undertook a very major rewrite.

I think one of the most important things for this new administration to do is to take advantage of that base that Jacques established and make use of the flexibility that was written into that system in order to telescope the acquisition system. This is because there remain two appalling acquisition problems (and I'll perhaps come back to these in the summary session): the slow pace of the process and the inability to provide funding and program stability.

We've got a lot of flexibility that we ought to be using, and I was directly involved in programs in which flexibility was used very appropriately and effectively, in both the stealth program and in our national reconnaissance program. Our first F–117 was fielded in 1983. Not many people realize that because awareness of the stealth program didn't happen until many years later. It was a high-risk program. We started development in 1979, wrote the contract in 1980, and the capability was fielded in 1983.

The second major problem that exists—and very interestingly enough, Paul, you started out in describing the problem. It still exists today in a very major way, and that's program instability. In most cases, we have a very good feel for what we need to buy over a period of time, but our

annual budgeting process restacks the deck with the effect of destabilizing programs. I saw this firsthand on two occasions: the first when I was working with Bill Perry, then the under secretary of Defense (Research and Engineering) during the Carter administration.

It was during this time that, in my view, we were getting about fifty cents' value out of our procurement dollar because every year we were restructuring programs. The result of this was that the average major program was slipping six to nine months every year as a result of this kind of restructuring.

I also saw this happening during the last administration, when every year, when putting together our entire acquisition budget, we were coming back and taking about 10 percent out of it for contingencies and other uses. You can imagine the havoc that a 10 percent reduction in your investment program can wreak. It doesn't seem like much, but, in my experience, if you take 10 percent of the investment program and you face these reductions on an annual basis, the inefficiencies compound to about 30 percent.

Those are, in my opinion, still the two biggest acquisition problems that remain: the slowness of the system and the instability of the system. Thank you.

DR. GANSLER: As I said earlier, when I was up for my confirmation in 1997, I identified what I thought were ten critical areas that I ought to try to focus once I was in the position and had four years to tackle acquisition problems. I emphasize that because it is almost impossible to do all the things you'd like to do. One could argue that ten points of focus is too many; there simply isn't enough time to address everything. On the other hand, with the breadth of organization and the high quality of people that we had in the organization, many of whom I inherited from Paul (which was fortunate), I thought we could address these ten areas.

Some of my points of interest had already been examined and reforms initiated. Bill Perry and Paul Kaminski, among others, had done important work along these lines. But despite this foundation, I expected very strong resistance to change. I was looking to make lasting institutional changes. Some of my initiatives involved changing the culture of the department. Because of the institutional resistance the persistence that Paul mentioned earlier was absolutely essential.

I'm especially pleased by the fact that Pete Aldridge is continuing to address these same areas of focus, and because of this continuity, I think we have some reason to believe that, over time, we can make the necessary cultural changes. And looking back, we will see there were significant shifts.

Let me just briefly highlight these ten areas. The first one: What systems do we actually need? As I said earlier, there's no point in trying to

figure out how to develop the perfect way to buy the wrong thing. I think the key to addressing this question in a meaningful fashion is to recognize the dramatic changes in the nature of warfare that have taken place. Bill Perry coined the term "reconnaissance strike warfare." Others have used "network-centric." Whatever you want to call it, the reality is that, compared to fifty years ago, warfare is very different today, and warfare will be very different in the twenty-first century.

Our technological capabilities have grown by leaps and bounds. Think about it in terms of real-time distributed sensors networked to distributed shooters; that's the kind of thing we'll be doing. This sort of warfighting approach requires smart sensors, advanced manned control communications, etc., a foundation of smart systems that exists to support the decisionmakers or make decisions automatically. These systems can, in turn, be supported by precision weapons. With advanced communications, sensing, and information distribution capabilities, precision weapons can be quickly redirected to fight against mobile targets. To realize this vision, there has to be a clear shift in the Defense Department's historic focus on such traditional platforms, as ships, planes, and tanks. Resources will have to be diverted into these other, more radical areas to develop the technologies and systems that we've been discussing since the end of the Cold War.

That doesn't mean you neglect ships, planes, and tanks. I'm confident that there is enough institutional inertia to make sure we don't neglect those systems. But we have to recognize that a shift in resource allocation will be played out as a zero-sum game. This means that in order to support the continuing development of those older systems, we're going to have to significantly increase the resources allocated to acquisition. This is one of the challenges that we faced, and I know it's one that Donald Rumsfeld is facing now, especially with the tax cut. This shift of resources to modern warfare acquisition efforts is absolutely critical.

A second area that I believe is extremely important is the recognition of the new threats. This includes recognizing new dangers and identifying the new forms of technology that can be used to counter those dangers. New forms of warfare are often a response to the development of new military technologies—so-called asymmetric threats, for example—including, I think, what we're seeing unfold today. There are other technology-based threats that have been with us for some time, but the changing nature of the world has increased the danger posed by these weapons. We've all heard about them: biological, chemical, nuclear, devices, as well as ballistic missiles that can reach the United States. Information warfare is another new threat—born of technology—which I'm sure we're going to see a lot

more of in the future. We certainly see forms of information warfare in use today, where much of the emphasis is on homeland defense.

But, again, realizing or responding to these and other new technologies will require more resources, and those resources have to come from someplace. *That* is part of the the acquisition challenge. How do you generate these resources?

This brings me to the third area, jointness and coalition operations, which is an important part of how we fight our wars. Interoperability is obviously the key to jointness. Interoperability means designing, testing, and fielding systems that can be integrated—or are at least compatible—with the platforms and systems adopted by our armed forces. The vice chairman and I actually signed a directive that declared that interoperability is one of the few critical performance parameters of every single weapon system. We're really trying to get people to focus on the interoperability issue. We set up an office for interoperability. We set up a think tank at the Institute for Defense Analyses to try to push it. For obvious reasons, the Joint Forces Command is focused in this issue. The Joint Staff is now focused on it. The C3 Guide people are focused on it. I think interoperability is absolutely essential.

With our focus on interoperability, we've started to provide the basic tools for jointness; we still need to worry about the training and doctrine issues associated with joint operations. Ultimately, developing jointness is about developing trust, and I think it's fair to say that reliable distributed sensors will go a long way to promote trust among the services. Developing systems that balance interoperability with reliability will be crucial. This burden is going to fall on the acquisition community.

Jointness, however, isn't enough. I would argue that just about any conflict we find ourselves involved is going to be a multinational effort. This is not just for military reasons. We involve allies for a variety of geopolitical reasons. We will have coalitions in every conflict. And we've seen what happens when our allies—for example, the Kosovars—don't have secure communications. We become very vulnerable in those situations. So if we're going to have to have interoperability with our allies, we may have to make some very significant changes to our technology transfer and export control policies.

We've tried to make some of the necessary changes in export controls. We've also been applying enormous pressure on our allies to get them to more closely regulate their technology exports. They can do it; what remains to be seen is if they want to do it. Those countries will have to make choices. Will they opt to become interoperable and take part in the U.S. market, or sell a few things to China or Iran or wherever they want to? That's their

option, but only the corporations and countries that show a willingness to control the distribution of their technologies are the ones that I think we should be working with. But interoperability and export controls are two sides of the same coin, so to speak. If they agree to monitor their exports, then we have to be willing to work them and share our technologies. This means that, over time, the defense industry is going to become even more global that it is today—this is a point I'll come back to in a moment.

The fourth area is one that Paul mentioned: modernization. Obtaining resources to modernize is a challenge. Old and aging systems are at the heart of the challenge we face as acquisition managers. Let me give you an example. How many of you drive a sixty-seven-year-old truck? Now try to figure out how to maintain something that old. This is a common problem for the Army. They have to make predictions and forecasts based on a set of assumptions about the life cycle of their systems. They have to assume that, in the future, that they will have trucks that are sixty-seven years old.

As Paul mentioned earlier, every year we factor billions of dollars into our operations and maintenance costs in order to sustain these older systems. Where does that money come from? It comes out of the modernization account. These kinds of expenditures become a death spiral because we're taking money from modernization to pay for logistics and maintenance, which means that our logistics and maintenance expenses are going to keep going up which, in turn, means that we can't pay for modernization. It's a trap.

We need to approach this problem from two angles. The first is to figure out how to get rid of that old equipment or make it much more reliable. Doing so might mean adopting proven commercial equipment. The second solution is to increase dramatically the funds for modernization. Over the past four years, we did exactly that. Hopefully, the increases will continue into the future.

The fifth area encompasses the very high cost and the very long cycles associated with weapons systems. I can't overstate the importance of the cycles. In other words, while our acquisition reform efforts have tackled problems associated with cost as an independent variable, I think with contemporary technology development cycles of eighteen months (or less!), such as the technologies that are involved in reconnaissance strike warfare, we need to take a *schedule* as an independent variable approach. In other words, the typical commercial practice that says technology development—or product development, for that matter—is an evolutionary process that consists of blocks. These blocks are modular, allowing the developers to make enhancements and improvements as the system or product is being crafted. This block-oriented approach is now built into the 5000 series

acquisition regulations. It's also built into the new directive on requirements that Vice Chairman General Joe Ralston signed in 2000. So now that the regulations and policies are in place, we have to make sure that we do, in fact, use the commercial practices of evolutionary or spiral development so that we can continue to upgrade the systems that we create.

Here's an illustration of the problem that we have to solve. We have systems like the F–22, which is not yet in production, and we're spending $350 million to replace obsolete parts before the plane is even fielded. A different model is to have a "block one, a block two, a block three" approach—build a flexible enough platform and get out there quickly as they did with the F–117 program, which was five years from initiation to deployment. The operational F–117 was block one; it will be followed by improvements and enhancements, i.e. block two and block three. Before we get there—in fact, before some of the enhancement technologies that we are anticipating have even been realized—we've got a deployable platform for use in military operations. If we adopt this approach, we can build and use that "block one" system and get it out into the field in five years.

Pete Aldridge just signed out a directive that says we ought to aim for a system development time of five to seven years. I think if we aim for five, we might make seven. But it's a lot better than fifteen to twenty. Some cynics like to joke that the reason the F–22 is named that is because it's taken twenty-two years so far to develop the thing. It's ridiculous to propose a development process for a really great system that we need in the field only to spend more than twenty years to get it there when the technology is changing every eighteen months.

There's no question that one of the best ways to promote these changes and focus on higher performance at lower cost with faster development times is through the use of competition. If you say you're going to do something in five years, you take available technology to start with and use it more in capability-based requirement for block one and then continue to improve it as you find what you need from the field, using a spiral development process.

The sixth area is the modern logistics. I think there needs to be more attention given to information-based supply chain management. Taking advantage of information technology to enhance out logistics capabilities will require a total transformation of our logistics system. The fact that our current system works is going to make it that much more difficult to make a transformation. We do have a logistics system that works. If we pile up enough metal and put enough people and spend enough money, we can force the system to work, but it is not world class. It doesn't measure up to commercial capabilities. If, for example, you put something in a FedEx

drop box, you know with 99.99 probability that it will get there in twenty-four hours domestically and forty-eight hours worldwide. Other companies, including Caterpillar and General Electric, can make similar claims about the performance and reliability of their logistics systems. In contrast, for our system, we have now reduced the time from order-to-receipt for items from thirty-six days to twenty-two days with a confidence level of around 60 percent and a spread that goes out to two years sometimes. That's simply not world-class performance, and it costs us much too much. We spend over $80 billion a year on our logistics system. We have an inventory of over $60 billion, of which probably half of it is even useful. Logistics cost reductions and efficiency improvements would have a huge impact on our readiness. Although Paul Ignatius started us down the path of readiness enhancement with his alternative procurement contracting methods, we're still struggling to take full advantage of the available technology.

Let me quickly run through the last four of these. The maintenance of long-term investment in science and technology is my seventh area of concern. I really do worry that we're eating our seed corn because the Defense Department needs to continue to invest in science and technology, and one of the areas that the services continue to try to steal from in order to pay for today's modernization is tomorrow's modernization. We can't afford to do that. So in some ways, that is one of the fronts that OSD has to keep fighting on.

The eighth one is the defense industry. Here the government, when it used to have nine or eight suppliers of airplanes, could simply sit back and say, "We'll hold a competition and we'll get some bids. We'll get four or five bids, and that will make competition, and the government doesn't have to really create a market or worry about the structure of the market because the conduct and performance of the market will follow from its structure." Today that structure is dramatically different. Now the government is the monopoly buyer, the sole buyer, when you have maybe two suppliers and in some cases, even up to three at maximum, and in many cases, even one, the government now—responsibility changes dramatically. The government has to assure an innovative, competitive, healthy defense industrial base, and that means worrying about the structure of the industry. If you have two companies that represent most of the expertise in one defense manufacturing area, and one of them wins contracts two or three times in a row, what happens to the loser?

Splitting the buy or dividing the contract is not the way to maintain the industrial base. That's grossly inefficient. The way to do it is to make sure that the loser has some kind of sustaining R&D contract to develop the next generation of technology so you can preserve competition. The point here is

that the government has to remain concerned about the state of the industrial base, and take steps to preserve it.

I think there are two ways to solve the problem. The first is to promote more civil-military integration, to find more defense uses of commercial product lines. We've found that when we tried this approach, we got 30 percent to 50 percent savings just from the overhead absorption. Another way to address this problem is to make better use of the international market. Promote competition between U.S. firms and foreign firms. We're doing that with the sale of landing gears right now. We have one U.S. firm; we have one foreign firm. The foreign firm happens to be French-owned and builds the landing gears in Canada. Both companies are competing on the Joint Strike Fighter. That's good competition, taking advantage of a world market.

The ninth area of concern is the excess infrastructure. I believe that we can get billions of dollars out of that infrastructure. Base closures are obviously one of the essential steps. Even where you don't have base closures, we ought to be able to competitively source any work that isn't, by its nature, the exclusive domain of the government. We literally have thousands of people working in capacities that should be competitively sourced. I'm not interested in whether the government wins the work or the private sector wins work. The data are overwhelming that when you have competition, you get better performance at lower cost. Sole source in industry or government doesn't make a lot of sense, and so we should be doing much more competitive sourcing.

That means changing the A–76 regulation so the sourcing conversion process can be done in less than two years and still be fair and transparent. But we can have enormous impact here, and this is another area of the initiatives of the president. It would extend all the way into things like privatized housing, a lot of other areas where you can gain some huge benefits. And you probably are aware there's something like to $20 billion to $30 billion in backlog in housing alone in the DoD that's substandard, and it's not budgeted. The only way you can correct that is through privatized housing, and that's a readiness, morale issue that's a very serious problem.

And my last area and the one that everyone is focused on and needs to be focused on is the acquisition workforce itself. Now here I think the role of the government is changing dramatically from the doer to the manager of the doers, and the more we do privatization and partnering and contracting out, competitive sourcing, whatever, I think we need different types of workforce.

I think this can be more shifting from government and industry back and forth so they see both perspectives. I think you need a different skill

mix definitely. Significant changes in the universities has taken place, Defense Acquisition University, Defense Systems Management College, more case-based and web-based education.

There's a whole training and development program that's required to keep up with these changes that are taking place monthly in terms of technology, in terms of warfighting, in terms of geopolitics and so forth, that we have to get into our educational system. So it's not a matter of sending twenty people to a class at the Defense Systems Management College; it's a matter of bringing the 300,000 people who are involved in the acquisition process up to date every year. This means providing at least forty hours of advanced education for every one of them. We have to be willing to supply that.

I feel very strongly that these ten areas, when addressed in an integrated fashion, will really make a huge difference in the way we do business. These ten points have been examined by a variety of people in the last few years, and addressing those points will be our challenge in the next few years. Fortunately, the leadership of the institution recognizes the importance of these issues and understands the need to make changes. Continuity of the leadership will continue to promote change within the acquisition community. Unfortunately, the leadership is going to have to face institutional inertia—another kind of continuity—to change the culture of the institution.

Change is going to take leadership. Change management is the real challenge for the future. If we don't make changes in these ten areas, I think we will have some very serious national security problems in the future.

Contributors

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