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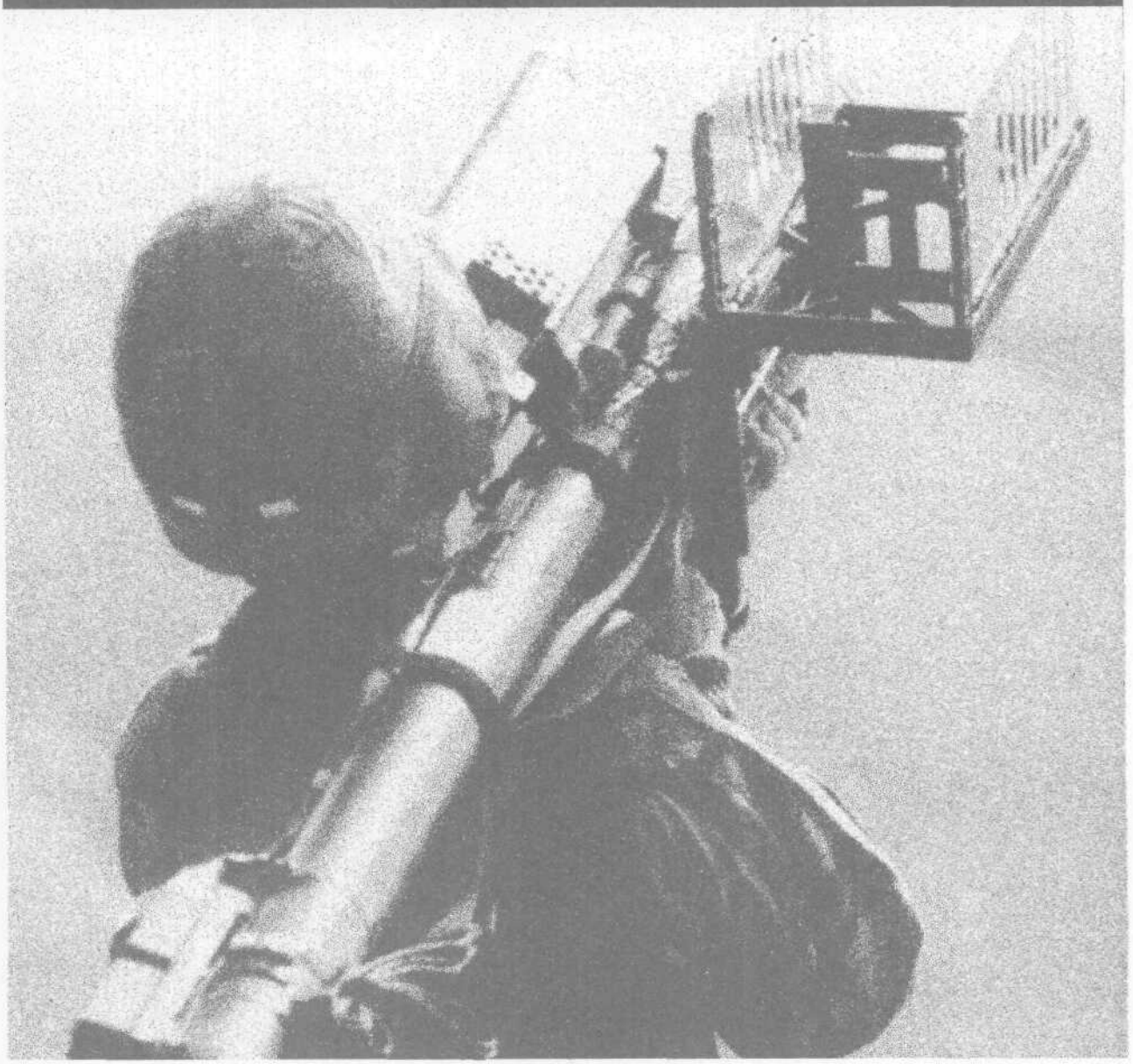
Options for Improving Munitions Sustainability: A Summary



A SPECIAL STUDY

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OPTIONS FOR IMPROVING MUNITIONS SUSTAINABILITY

Annual funding for munitions in the defense budget rose by nearly 250 percent in the 1980s. Despite this increase, senior U.S. military commanders still maintain that their supplies of advanced munitions are inadequate to sustain combat. At the request of the Senate Committee on Armed Services, CBO prepared a special study, *Options for Improving Munitions Sustainability*, that focused on 30 modern munitions. Current stocks of these munitions seem to justify the commanders' concerns. At the end of fiscal year 1988, war reserve stocks for 21 of the 30 munitions items met half or less of the requirement set by the military. The situation will improve when weapons currently on order are delivered. By the time all weapons authorized through fiscal year 1989 are delivered, only 11 of the 30 munitions would have inventories that failed to meet 50 percent of the services' requirements for sustainability.

The Department of Defense's Five-Year Defense Program would build stocks to higher levels, but would still leave significant shortages of many munitions. To meet requirements for all 30 munitions would require nearly $11.4 billion in additional funds. CBO examined three alternative munitions plans that would avoid adding funding to the defense budget.

One option would be to attempt to balance sustainability at 80 percent of requirements by reallocating funds. Eleven munitions acquisition programs would be increased, while seven others, which currently are scheduled to exceed 80 percent of their requirement by 1994, would be reduced. This option would yield a modest net saving of $0.6 billion over the 1990-1994 period.

A second alternative would curtail procurement of weapons platforms in order to meet 100 percent of requirements for all 30 munitions. Because DoD spends nearly three times as much on platforms as it does on munitions, there are many ways to accommodate such a transfer of funds without adding to overall budget totals.

The third option would be to cancel development programs designed to create the next generation of munitions, and apply the funds to meeting the services' goals for current munitions items. This option would be most appropriate if the Congress believed that the threat of war was greater in the near term.

CBO's study is based on requirements and budget plans reported by the Department of Defense in early 1989. The political changes taking place in Eastern Europe, together with arms control negotiations currently under way, are likely to affect both plans and requirements significantly. Many of the problems identified in this study are likely to persist, however, even under revised perceptions of the threats to U.S. security.

Questions regarding the analysis should be directed to the author, R. William Thomas of CBO's National Security Division, at (202) 226-2900. The Office of Intergovernmental Relations is CBO's Congressional liaison office and can be reached at 226-2600. For additional copies of the summary, please call CBO's Publications Office at 226-2809.

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OPTIONS FOR IMPROVING MUNITIONS SUSTAINABILITY: A SUMMARY

The Congress of the United States
Congressional Budget Office

NOTE

The main text of this study is classified as secret. Those with appropriate clearance wishing copies of the study should contact the National Security Division of the Congressional Budget Office (202) 226-2900.

NOTES

All years are fiscal years, unless otherwise noted.

Details in the text and tables of this study may not add to totals because of rounding.

Negative numbers in tables indicate savings.

PREFACE

In recent years, the U.S. military has developed a number of advanced, precision-guided munitions. These munitions offer increased lethality against enemy forces; many also reduce the risk of loss to the U.S. forces that employ them. Senior U.S. military commanders, however, often complain that these advanced munitions are not available in sufficient numbers to sustain combat operations longer than a few weeks (or, in some cases, a few days). Although older conventional munitions are available in larger quantities, they offer few technical advantages to offset the numerical superiority of U.S. potential adversaries.

This study examines current stocks for selected advanced munitions and compares them with current military requirements. It then examines the Administration's April 1989 plan for procurement of these munitions and assesses how well that plan improves existing shortfalls. Options are presented that would increase munitions stocks without adding to the overall defense budget totals for the 1990-1994 period. The study was performed at the request of the Chairman of the Subcommittee on Conventional Forces and Alliance Defense of the Senate Committee on Armed Services. This volume contains a summary of results. The full study is classified as secret.

The study is based on requirements and budget plans reported by the Department of Defense in early 1989. Press reports suggest that budget plans currently being considered by the Department of Defense may greatly reduce planned purchases of weapons; requirements for weapons may also be modified significantly. These changes are motivated by arms control negotiations and by the far-reaching political changes taking place in the Soviet Union and Eastern Europe. DoD's revised plans were not available at the time of publication and so are not considered in this study. Nevertheless, many of the problems identified in this study--such as the tendency of the services to buy fewer munitions than they say they need--are long-standing problems that may well persist even under revised budget plans.

R. William Thomas of CBO's National Security Division prepared the report under the general supervision of Robert F. Hale and John D. Mayer. Raymond J. Hall and Ben Wolters of CBO's Budget Analysis Division performed all of the analyses of costs and budgetary impacts. William Kostak (formerly of CBO) and Robert Ahearne of CBO assisted in preparing the study. The author gratefully acknowledges the assistance of his CBO colleagues Michael Berger, Frances M. Lussier, and V. Lane Pierrot. Peter Brooks of the Institute for Defense Analyses contributed to the analysis of the effectiveness of alternative munitions programs. CBO appreciates the cooperation of the Department of Defense in making available the IDA results. Leonard Sullivan provided valuable comments on an earlier draft of this study, as did Royce Kneece and Jay Mandelbaum. CBO, of course, bears full responsibility for the final product. Paul L. Houts edited the manuscript. Kathryn Quattrone prepared the report for publication.

Robert D. Reischauer
Director

December 1989

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OPTIONS FOR IMPROVING MUNITIONS SUSTAINABILITY: A SUMMARY

Senior U.S. military commanders have repeatedly expressed serious concern about their stocks of munitions. In 1988, the Commander in Chief of the U.S. Central Command testified that "although munitions sustainability has shown some improvement over the last year. . . the posture. . . continues to be a genuine concern." In addition, the U.S. military commander in the Pacific similarly testified that "our sustainability posture is not as good [as the Pacific Command's readiness posture], even though there has been marked improvement in recent years." Other commanders echo these concerns.

When military commanders speak of sustainability, they are referring to the ability of the Department of Defense (DoD) to supply U.S. military forces with the materiel that they need to fight effectively for an extended period. While many different items would be needed to assure sustainability, this study deals only with munitions--the bombs, bullets, and missiles that would be used to defeat an enemy attack. In particular, the study focuses on 21 advanced munitions--the types that military commanders often mention as being key to defeating enemy forces that are superior in number. These modern munitions are expensive, consuming roughly two-thirds of the $8.9 billion that the Administration has requested for all conventional (nonnuclear) munitions in 1990.

How well would current U.S. munition stocks sustain combat today? To what extent would the Administration's budget plan improve sustainability for U.S. munitions? What alternatives might the Congress consider to improve further sustainability for munitions in this period of restrained defense budgets? This study addresses these key questions.

REQUIREMENTS FOR MUNITIONS

Assessing sustainability typically begins with estimating the requirements for munitions--a process on which the Joint Chiefs of Staff and civilian officials offer guidance. They specify the nature and extent of the anticipated enemy threat, U.S. objectives and expected enemy goals, and a scenario for the outbreak of hostilities and the subsequent course of the conflict. They also provide specific objectives for sustainability, such as how many days' supply of munitions the military departments should attempt to stockpile.

Methods for Estimating Requirements

Based on these guidelines and objectives, the military services then calculate the quantities of munitions they require. Although they do so using a variety of mathematical methods and elaborate computer models, these methods all follow one of two basic approaches--either the "level-of-effort" or "threat-oriented" method.

Level-of-Effort Method. The level-of-effort method bases requirements for a munition on the number of friendly weapons and the rounds each fires. To estimate these values, the services use various computer models designed to simulate combat outcomes. To determine requirements for each day of battle, the number of surviving friendly weapons of each type is multiplied by the number of rounds that weapon is expected to fire; daily totals are summed over the number of days the forces are to be sustained. This method is used for most Army munitions. Similar methods are applied by the other military services to estimate requirements for munitions that are designed to be fired from the air at surface targets (referred to as air-to-surface munitions).

One advantage of this level-of-effort approach to determining requirements is its ability to capture battlefield conditions in detail. This method reflects the outcome of combat in determining losses of both friendly and enemy forces over a period of time. Another advantage is that its outcome--a prediction of how many munitions and other important supplies will be used over a period of time--can easily be compared with existing stocks to determine the number of days of supply that exists. This latter measure is a convenient and easily understood yardstick for sustainability.

The level-of-effort method also has important disadvantages. Because of the complexity of its models, the Army cannot determine easily the sensitivity of its results to the many assumptions that are required to support the process. A further disadvantage of this method--particularly from the viewpoint of policymakers in the Office of the Secretary of Defense--is that it cannot be used quickly to analyze the effects of alternative munitions programs.

Threat-Oriented Method. In contrast, the threat-oriented method relates requirements for a munition to the number of enemy targets the munition is intended to attack and the probability that the munition will destroy the target. Thus, to use a simple example, if a munition were intended to destroy 1,000 enemy weapons and had a single-shot kill probability of one-half, then 2,000 munitions would be needed. (The mathematics actually used is considerably more complicated than portrayed here, since it incorporates considerations of probability and cases involving multiple targets and multiple shooters.) The threat-oriented methodology is used for most air-to-air and surface-to-air munitions and for most of the Navy's surface-to-surface munitions.

The threat-oriented method has also been criticized. Some applications of it ignore attrition suffered by friendly forces. If U.S. forces are eliminated before the enemy threat is destroyed, then remaining stocks of munitions are irrelevant to the outcome. Also, the threat model, in its pure form, sheds no light on when, during the course of a conflict, munitions are required. Thus, it is difficult to incorporate such factors as logistics and production capability in an assessment of sustainability. (Some threat-oriented models used by the services do seek to incorporate dynamic elements and estimates of attrition, but usually as assumptions rather than as outcomes of the model.)

Both methods estimate requirements without reference to any budgetary limits on munitions spending. Nor do estimates of requirements consider physical limits on production capacity for munitions. Yet, both these considerations impinge on the ability of the military departments to meet their requirements.

Uncertainties in Estimates of Requirements

Regardless of the method used, significant uncertainties are inherent in any estimates of munitions requirements. First, there is the issue of how long a conflict would last. The longer defense planners assume the conflict will go on, the greater will be the total requirements. Requirements also depend on the specific ways that planners assume a war is fought. For example, decisions as to which forces are committed to which theaters, the intensity of fighting, how large a threat U.S. forces would face, and how much warning U.S. commanders would receive of approaching hostilities all affect the calculation of munitions requirements. So, too, do estimates of the lethality of U.S. munitions and the sophistication of enemy countermeasures.

Perhaps because of these uncertainties, estimates by the services of their requirements often change radically from year to year. For example, the U.S. Army recently nearly doubled its objective for acquiring rockets for the Multiple Launch Rocket System. While this is an extreme example of a year-to-year change, this munition system is not the only one that has experienced dramatic changes in requirements. In the last eight years, the requirements for half of the munitions items varied by more than 23 percent of their average level.

This volatility and uncertainty, coupled with the lack of explicit budgetary limitations, have led some critics to contend that the military services systematically overstate their requirements for munitions. Generally, these critics do not offer an alternative means for determining requirements. Nonetheless, their criticisms raise concerns about whether estimates of requirements by the services are a valid basis for assessing the ability of the United States to provide adequate munitions.

Service estimates of requirements for munitions can be tested by comparing them with the numbers of weapon platforms that fire or launch the munition. The Congressional Budget Office (CBO) performed this calculation based on service projections of requirements and weapons platforms for 1994. CBO calculated "available loads"--defined as the requirement for that munition divided by the product of the number of platforms designed to carry that munition and the standard or basic load each platform would carry of that munition.

Platforms are defined as the aircraft, ships, or combat vehicles needed to equip active and reserve combat forces in 1994, and exclude such items as backup aircraft, trainers, and equipment held as war reserves. This measure of available loads suggests how often these platforms could return to combat. Thus, if a military service's requirement for an air-to-air missile were twice the number needed to supply all its aircraft designed to carry the missile, it means that each aircraft could be fully supplied with its initial load of munitions and would have one reload in reserve.

Looked at in this way, requirements do not appear markedly exaggerated. Even if 1994 requirements were fully met, stocks for many weapons would provide from one to three loads per platform. For some types of munitions, one to three loads may be adequate. Ships, for example, may be designed to carry a large initial load of munitions, but only those subjected to intense attack would need reloads. Similarly, while many air-to-air missiles are needed to equip all aircraft for self-defense, most aircraft might not be expected to expend their missiles.

But for many other munitions examined in this study, especially the air-to-surface and surface-to-surface weapons launched by aircraft and combat vehicles, expenditures are likely to be high and frequent reloads necessary. Overall, CBO's load calculations suggest that requirements are not systematically overstated.

Regardless of the concerns about the services' estimates of their requirements, they are the most common yardstick for assessing sustainability. Thus, the analysis in this study used the percentage of requirements met by current and future munitions inventories as the primary indicator of sustainability.

MUNITIONS SUSTAINABILITY TODAY

How close do the services come to meeting the requirements they establish? This study focused on 21 modern munitions that military commanders have cited as critical to their capability to fight a war (see the box on pages 6 and 7 for a brief description of each munition). Nine

MODERN MUNITIONS SELECTED FOR DETAILED STUDY

The *Advanced Medium Range Air-to-Air Missile* (AMRAAM) is a radar-guided missile for use by most Air Force and Navy tactical fighter aircraft.

The *Chaparral* is a heat-seeking surface-to-air missile system developed in the mid-1960s. It is now being equipped with an improved Rosette Scan Seeker.

The *HARM* stands for High-Speed Anti-Radiation Missile. Its role is to suppress enemy surface-to-air missile systems by destroying their radars.

Harpoon is a high-subsonic speed antiship tactical cruise missile currently used by the U.S. Navy as well as many foreign navies.

The *Hawk* is a radar-guided surface-to-air missile that provides medium- and high-altitude air defense for Army and Marine Corps units.

The *Hellfire* is a laser-guided air-to-surface missile fired from the AH-64 Apache attack helicopter. It is designed to attack enemy armored vehicles.

The *Imaging Infrared (IIR) Maverick* is an air-to-ground missile for attacking enemy armored vehicles as well as fixed installations, such as Surface-to-Air Missiles, bunkers, and depots.

The *Modular Glide Bomb (GBU-15)* denotes a family of air-to-ground weapons. A GBU-15 kit converts a 2,000-pound iron bomb into a sophisticated munition that is directed to its target by an electro-optical (TV) imaging device. Variants include replacing the 2,000-pound bomb with a submunitions dispenser.

The *MK 48* torpedo is the standard heavy submarine-launched torpedo. It is now being produced in an advanced capability (ADCAP) version.

The *MK 46* torpedo is the Navy's current lightweight torpedo for launch by helicopters, aircraft, and surface ships.

The *MK 50* torpedo, which is just entering production, is the successor to the MK 46 torpedo. It will have a larger warhead, longer range, faster speed, and improved resistance to enemy countermeasures.

The *Multiple Launch Rocket System (MLRS)* is a tracked vehicle-mounted system that can fire 12 free-flight rockets armed with a variety of submunitions to ranges over 30 kilometers in less than one minute.

The *Patriot* missile is a long-range, high-speed, highly maneuverable air defense weapon used by the Army to protect high-value installations and defend the rear areas of the battlefield.

The *Phoenix* missile is the Navy's primary long-range air-to-air missile for the defense of carrier battle groups.

The current *Sidewinder* missile is a much improved descendent of the original air-to-air infrared missile first developed by the U.S. Navy in the early 1950s.

The *Sparrow* missile is a medium-range, semi-active radar-guided air-to-air missile currently used by the Air Force and the Navy.

The NATO *Sea Sparrow* missile is a surface-to-air missile adapted from the Sparrow for ship defense against air attack.

The *Standard 2* missile is a surface-to-air missile used to defend naval vessels. It is available in both a medium-range and extended-range version.

Stinger is a man-portable, shoulder-fired missile that can be used to destroy aircraft flying at low altitude. Some U.S. Army Stingers are now being mounted on vehicles.

The *Tomahawk* sea-launched cruise missile is used for attacking enemy surface ships at long distances. Nuclear- and conventionally-armed versions for attacking land targets are also being produced.

TOW is an acronym for a tube-launched, optically-tracked, wire-guided antitank guided missile. The current model, the TOW 2A, has an improved-lethality warhead, digital electronics, and an explosive probe for detonating reactive armor before impact. The TOW 2B, now in development, will attack the more vulnerable top on armored vehicles.

of the 21 are used by two military services; thus inventories and requirements must be compared not just for 21 but rather for 30 munitions items used by individual services.

Current Sustainability is Limited

As of the end of 1988, stocks for 21 of the 30 munitions met half or less of their requirements. Looked at another way, the 1988 stockpile for the median system among the 30 munitions met only 34 percent of its requirements. (That is, half of the 30 munitions had inventories that met 34 percent or more of their requirements, while stocks for the other half met less than 34 percent.) Clearly, the services were not close to meeting their requirements for the munitions CBO included in its sample.

In many cases, the percentage of requirements met for specific munitions is classified. Army data are unrestricted, however, and limited results are publicly available for other munitions. As of September 1988, the Army's inventory of the TOW 2 missile met only 9 percent of its objective. Army inventories met only 10 percent of requirements for the Stinger missile and 24 percent of requirements for the Hellfire missile. By September 1988, deliveries of Phoenix missiles were barely enough to meet 18 percent of the Navy's objective. The Air Force had just accepted its first AMRAAM missile (ignoring those produced during development), while the Navy was still waiting for its first IIR Maverick missile.

Calculations of available loads provide further proof of the inability of the United States to supply substantial numbers of these advanced munitions to its forces today. More than half of the munitions were not available in sufficient numbers to provide even one full load for today's forces; for only 3 of all 21 munitions examined in this study were 2 or more loads per platform available.

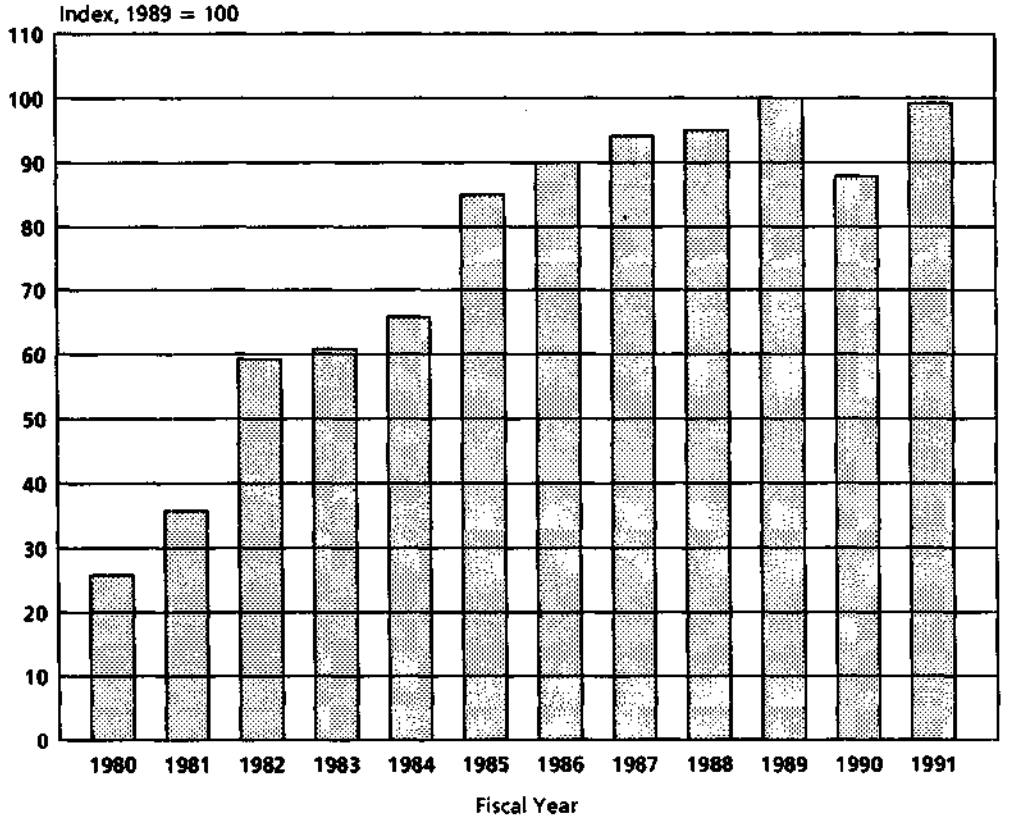
Munitions on Order Will Improve Sustainability

Sustainability will improve when munitions currently on order are delivered. Modern munitions typically require from 12 months to 24 months between the placement of an order and its delivery. Thus,

many of the weapons bought with funds from fiscal years 1987 and 1988, and nearly all those that have been ordered with funds appropriated in fiscal year 1989, are yet to be delivered. To assess the effects of these future deliveries, CBO calculated munitions inventories at the end of the 1989 funded delivery period (FDP)--that is, the period after all weapons ordered through 1989 have been delivered--and compared them with requirements for 1990.

By the end of the 1989 FDP, available stocks for the median system of the 30 systems examined by CBO will meet 63 percent of requirements, compared with a median of 34 percent in 1988. Only 11 of

Summary Figure.
Munitions Funding



SOURCE: Congressional Budget Office based on Department of Defense data.

the 30 munitions will have inventories meeting 50 percent or less of their requirements compared with 21 systems in 1988.

Results for specific systems corroborate this overall improvement. Army Hellfire stocks will increase to 67 percent of the requirement, compared with 24 percent in 1988, while Army Stinger stocks will climb to 38 percent of the requirement, up from 10 percent.

One reason for this sharp improvement by the end of the 1989 funded delivery period is the increased munitions funding provided in recent budgets. Funding for buying munitions rose by 246 percent from 1980 to 1986 (see Summary Figure). This is a higher percentage than that recorded in almost any other major category of defense spending over that period. In subsequent budgets, munitions funding has been maintained at about the 1986 level in real terms. By the 1989 funded delivery period, many of the munitions bought with these larger budgets will have entered the inventories.

THE ADMINISTRATION'S MUNITIONS PROPOSALS FOR 1990 AND BEYOND

Will these improvements continue under the Administration's current plans for munitions funding? Every other year, the Administration submits a detailed budget for the next two years and a budget plan for five years. The latest Administration Five-Year Defense Program (FYDP), submitted to the Congress in April 1989, covers the 1990-1994 period.

The 1990 Munitions Budget Request

The 1990 budget request calls for a reduction in spending for munitions. Overall funding for conventional munitions would decline by 10 percent. A number of systems would experience significant declines in production rates compared with current levels. For example, the Administration proposed to cut production of the MLRS rocket from 48,000 to 24,000 per year, the Army Hellfire missile from 6,000 to 3,102 per year, the Army Stinger missile from 6,750 to 2,375 per year, and the HARM missile from 2,200 to a combined total of 1,488 a year for the Navy and the Air Force.

In addition to these reductions in production, the Administration proposed to terminate procurement of the Phoenix missile after 1990 and the IIR Maverick missile after 1992, leaving inventories of both systems considerably short of their requirements.

Improvements Over the Five-Year Program

In contrast to the decline in 1990, the Administration's projected procurement of munitions over the later years of the Five-Year Defense Program would result in considerable budgetary growth. Spending in the years beyond 1990 would increase--from the reduced 1990 base--at a real rate of about 7 percent a year.

Of course, this five-year plan may well go astray. The current five-year plan calls for growth in overall defense spending of about 2 percent a year in real terms in the years beyond 1990. Federal fiscal problems may, however, prevent such increases and could result in further declines in total dollars available for defense. Moreover, based on past practices, funding for munitions could be cut by disproportionately large amounts. The actual amount requested for 1990 for the accounts that pay for munitions (as well as other items) was reduced by 42 percent from the previous Administration's 1990 estimate (reported in the five-year plan DoD developed in September 1986). This cut was significantly larger than the reduction of 28 percent imposed on all procurement funding and more than twice the 18 percent cut applied to total defense funding.

Assuming it is funded at planned levels, however, DoD's five-year program for the fiscal year 1990-1994 period would improve sustainability for the 30 munitions items for specific services. By the end of the fiscal year 1994 funded delivery period (which for some munitions might extend into 1996), stocks of the median system of the 30 items CBO examined would meet 73 percent of the system's 1994 requirement. This portion compares with 63 percent at the end of the 1989 funded delivery period and 34 percent in 1988. Based on 1994 FDP inventories, only 7 of the 30 munitions would have inventories that met less than half of their requirements compared with 11 munitions at the end of the 1989 funded delivery period and 21 munitions at the end of 1988.

Problems Over the Five-Year Program

While sustainability would improve, problems would remain. Several of the systems--notably those the Administration proposes to terminate (IIR Maverick, Phoenix, Sidewinder, and Sparrow), as well as the TOW 2 and Chaparral missiles--will still have inventories that meet only a small percentage of their requirements. At the other extreme, stocks for 6 of the 30 munitions would actually exceed their requirements by 1994. This increase suggests that the Administration's program is somewhat unbalanced or accords some munitions programs much higher priority than others.

Furthermore, the Administration's program fails to meet all munitions requirements. Fully 24 of the 30 munitions examined in this study would have inventories that remain short of meeting their goals for sustainability. As a result, even by the end of the 1994 funded delivery period, the median system would have only 1.8 available loads. To fight a potential global war that features intense combat in all theaters, this is a modest goal for advanced munitions.

ALTERNATIVE APPROACHES TO IMPROVING THE SUSTAINABILITY OF MUNITIONS

Adding defense funds is one approach to improving sustainability. In this period of restrained defense budgets, however, any additions would probably have to be offset by reductions in other areas of defense spending. After estimating the costs to meet all requirements, this study examines several options that improve sustainability while making offsetting reductions in other parts of the defense budget. (Summary Table 1 describes the options and their costs.)

Add Funds to Meet All Requirements

Over the next five years, CBO estimates that the Administration would have to increase its munitions budget by a net of nearly $11.4 billion to meet all requirements for the 21 munitions examined in this study. (In four cases, existing production capacity would not permit requirements to be fully met by 1994.) Of the 21, only 16 would require increased production to meet requirements. Under current Adminis-

tration plans, 5 of the 21 munitions examined in this study would have inventories that exceed requirements by 1994. The estimate of $11.4 billion assumes that production of these munitions would be slowed to avoid creating inventories that exceed 100 percent of requirements, with savings used to offset the added costs of higher procurement for other munitions.

Option I: Balance Sustainability at 80 Percent of Requirements

Adding to the defense budget to improve sustainability may not be realistic in this period of limited funding. One approach to improving

SUMMARY TABLE 1. OPTIONS AND COSTS OF MUNITIONS SUSTAINABILITY (In billions of current dollars of budget authority)

Option	Cost/Saving Relative to Administration Plan	Percent of Requirements Met
Administration Plan	n.a.	Varies from 22 percent to 126 percent
Option I. Balance Munitions Buys	-0.6	80 percent
Option II. Meet All Requirements; Cut Platforms	0	100 percent
Option III. Meet All Requirements; Cancel New Starts	2.3[a]	100 percent

SOURCE: Congressional Budget Office based on Department of Defense data.

NOTES: Negative number indicates savings.

n.a. = not applicable.

a. Assumes all new starts are canceled. Were fewer programs canceled or deferred, the costs would increase to as much as $11.4 billion.

sustainability for selected munitions without adding to costs is to pursue a balanced approach. Of the 21 munitions examined in this study, the Administration's five-year plan would leave 12 with inventories that fall below 80 percent of requirements by the end of the 1994 funded delivery period. The other nine would have inventories that exceed 80 percent of requirements. Wherever feasible, this option would transfer funds among munitions programs in order to balance sustainability at 80 percent of requirements.

Under this option, additional funds totaling about $6.9 billion would be allocated to increase production for 11 of the 12 munitions for which stocks at the end of the 1994 funded delivery period fall below 80 percent of requirements. (The twelfth system is reportedly already scheduled to be produced at capacity and so could not be increased without additional investment.) Among the systems receiving funds are a number of missiles--the IIR Maverick, TOW 2, Stinger, Sidewinder, and Phoenix--as well as MLRS rockets and the MK 50 torpedo. Seven of the nine programs that would exceed 80 percent of requirements would experience reductions from the Administration's planned quantities (two others are not currently being procured; hence, no reduction is possible). Systems with reduced funding again include a number of missiles--AMRAAM, Patriot, Standard 2, and HARM--and the MK 48 ADCAP torpedo. These reductions would save a total of $7.5 billion over the 1990-1994 period. Thus, this option would result in a modest net savings of $0.6 billion over the 1990-1994 period, or about 1 percent of total planned funding for the munitions.

Advantages. The principal advantage Option I offers is balance. By evening out stocks of advanced munitions, the option minimizes the likelihood of running short of particular munitions, which would force military units that employ those munitions either to rely on inferior substitutes or to retire from the conflict entirely if no substitute was available. If calculations of requirements are meaningful, it would seem reasonable that a better balance of munitions stocks against requirements should improve overall military capability.

In particular, Option I would significantly reduce current shortfalls of munitions--such as the TOW 2 and Maverick missiles--designed to destroy enemy tanks. Retired General Donn Starry, who chaired a DoD study group examining the armor/antiarmor balance, termed these shortfalls "a matter of considerable national urgency" in his

testimony before the Conventional Forces and Alliance Defense Subcommittee of the Senate Committee on Armed Services.

The potential for improving combat capability under this balanced approach is corroborated by a model that simulates combat in Central Europe in the mid-1990s. The Theater Land/Air Model (TLAM) was developed by the Institute for Defense Analyses for the Office of the Secretary of Defense as part of a study to improve methods of analyzing sustainability. The current study effort only considers the effects of air and ground forces and thus cannot show the effects of altering naval munitions. Moreover, its detailed results are classified and can only be discussed in detail in the main body of this report.

Overall, however, analyses using TLAM showed that balancing air and ground munitions stocks--that is, increasing procurement of some and decreasing procurement of others in ways that avoid an increase in total costs--would improve outcomes of combat in Central Europe. Improvements are suggested by TLAM projections that show increases in the numbers of enemy vehicles destroyed during combat and increases in the numbers of friendly forces that survive. (The Office of the Secretary of Defense does not endorse or necessarily agree with CBO's interpretation of these specific results or the broader conclusions of this study.)

Disadvantages. Option I does have disadvantages. Balance may not be appropriate if some munitions are deemed more important than others, either by DoD planners or by the Congress. Presumably, the Administration's plan reflects its priorities. The Senate, however, authorized increased funding for a number of systems, including the TOW 2, Hellfire, Stinger, HARM, Standard Missile, and MLRS rockets.

Furthermore, Option I does not take into account the degree to which acceptable substitutes are available for some munitions but not for others. In particular, while suggesting the need for buying many more TOW 2 and Maverick missiles to destroy enemy armor, this option does not consider the alternative of increasing stocks of advanced kinetic energy tank rounds or other antiarmor munitions now in development, such as the SADARM (Sense and Destroy Armor) projectile.

Also, Option I might worsen the imbalance between the sustainability of U.S. munitions and that of our NATO allies. Data suggest that the United States already has greater ability to provide its forces with munitions than most of its European allies. Option I would improve U.S. capability in some cases. But this improvement might have little effect on the overall outcome of the conflict if allied armies defending other portions of Europe suffer reverses because of a lack of munitions. (To the extent that U.S. munitions are interchangeable, improved U.S. stocks might be made available to allies should the military situation demand it. Often, however, U.S. munitions cannot be used by the allies.)

Carrying out this option would penalize the Navy, the service that has done the best job of meeting its goals for sustainability. Under Option I, procurement of several naval munitions would be reduced to help pay for increases in procurement for the other services, particularly the Air Force. If the Congress adopted this balancing approach in reviewing munitions budgets, service planners might adopt the strategy of not fully funding their total requirements for sustainability, lest they lose the monies involved through Congressional transfers to more needy programs in other services.

Moreover, the modest savings achieved under this option might not accommodate fiscal limitations. In the years beyond 1990, Option I would still require significant real increases in funding for munitions. But the overall defense budget might be limited to no real growth or might continue to suffer declines. If such limits are imposed on the total budget, munitions funding might well be cut back.

Finally, even if funds close to those requested by the Administration in its five-year plan are available, Option I does not meet all requirements for sustainability as required in the planning guidance provided to the services. If all of the requirements are to be met without adding to overall defense costs, other approaches would have to be considered.

Option II: Meet All Requirements
By Slowing Procurement of Selected Platforms

One such approach would meet 100 percent of requirements for sustainability wherever feasible. Added costs would be offset by slowing procurement of selected weapons platforms--that is, the aircraft, ships, and combat vehicles that fire the munitions. As was noted earlier, this option would require additional funding for munitions of almost $11.4 billion over the five years from 1990 through 1994--an increase of 21 percent over the Administration's proposed funding.

To offset these increases, Option II would reduce or delay planned procurement of the combat aircraft, ships, or armored vehicles that launch munitions at their targets. There are many ways to reduce procurement of platforms in order to achieve the requisite savings of $11.4 billion. Specific choices would depend on the Congress's priorities, and CBO has not made a detailed analysis of the effects of reducing specific programs. Thus, the potential choices presented below are included only for illustration.

The Congress could slow procurement of selected aircraft programs or terminate them altogether; candidates might include the F-15E, AV-8B, F-16, or AH-64 aircraft programs. Savings could be used to purchase more of the air-to-air or air-to-ground munitions that would be carried on these platforms. Alternatively, the Congress could slow shipbuilding programs, such as the Arleigh Burke class cruisers, or cancel a nuclear attack submarine. Savings from these actions could be used to augment stocks of torpedoes and antiship missiles. Finally, cuts could be made in purchases of Army Bradley Fighting Vehicles and the savings used to buy more TOW 2 missiles to equip these vehicles and other platforms that launch TOW 2 missiles.

Summary Table 2 summarizes the reductions that could be made and shows associated savings. Total savings from these reductions would amount to $18.5 billion. Clearly, it would be feasible to slow procurement of platforms by enough to fund all requirements for munitions, should the Congress elect to do so.

Advantages. The primary advantage of Option II is that, wherever feasible, it would fully meet DoD's acquisition goals for these 21 ad-

vanced munitions within the next five years. This increase in sustainability would ensure that forces had advanced munitions available in the quantities military planners feel would be necessary to meet the enemy threat. This option would also hedge against the risk that service requirements might be understated, either because weapons fail to perform as advertised or because enemy forces are more numerous and more capable than intelligence estimates predict.

SUMMARY TABLE 2. POSSIBLE PLATFORM SAVINGS TO OFFSET INCREASED APPROPRIATIONS FOR MUNITIONS

Option	Service	Five-Year Savings (Billions of dollars)
	Aircraft	
Cancel Remaining Procurement of F-15	Air Force	4.2
Cancel Procurement of AV-8B	Marine Corps	1.2
Slow Procurement of F-16 to 72 Per Year	Air Force	3.5
	Ships	
Cancel Final SSN-688 Submarine	Navy	0.8
Slow Procurement of DDG-51 Destroyers to 3 Per Year	Navy	6.4
	Combat Vehicles	
Terminate the Air Defense Antitank System	Army	1.6
Slow Procurement of Bradley Fighting Vehicle to 420 Per Year	Army	0.8
Total Program Cancellations/Deferrals		18.5

SOURCE: Department of Defense amended budget request for fiscal years 1990 and 1991.

Furthermore, this option would respond fully to concerns expressed by senior theater commanders. These commanders speak with one voice in expressing a preference for smaller forces that are fully trained, ready, and supported rather than larger forces that cannot be adequately sustained. Budget shares suggest one reason for their concern. In 1990, all the military services together propose to spend about 2.7 times as much on weapons platforms designed to carry munitions as they spend on the munitions that would be carried. This option would partially close that gap.

Disadvantages. While these arguments may seem persuasive, there are other considerations. Reducing forces to better sustain the remaining units limits the ability of NATO forces to blunt the initial enemy thrust. After all, the goal is not to prolong the conflict but rather to defeat the enemy. A larger number of forces may contribute more to this goal than does increased sustainability.

Results from the TLAM model suggest caution in assuming that combat outcomes would be improved under this option. The TLAM model was used to explore the effects of one approach to implementing Option II--increasing air and ground munitions while reducing the number of U.S. aircraft. The model suggests that this approach would improve combat effectiveness, but not by as much as the balanced option. By themselves, the added munitions improve outcomes of combat. But the reductions in aircraft cancel most of these improvements. The scenario and assumptions embodied in TLAM postulate intense combat in a major European war, resulting in losses of large numbers of both friendly and enemy aircraft. This places a premium on having large stocks of aircraft. Indeed, in the model, losses of aircraft sometimes meant that the added munitions could not all be delivered, negating their utility.

TLAM, of course, represents only one set of assumptions about the nature of a future war. The model also assumes that all munitions work as well as planned; if they do not, more may well be needed. Nevertheless, the results of the model suggest caution in assuming that added munitions would improve the outcomes of combat if those additional munitions are financed by reductions in platforms.

Option III: Defer Improvements in Munitions to Meet Requirements

Reducing the procurement of weapons platforms is not the only way to pay for boosting stocks of munitions. Instead, the Congress could limit planned improvements in munitions capability by deferring or canceling selected programs that are developing and procuring the next generation of munitions.

Over the next five years, between 1990 and 1994, the Administration plans to spend $9.1 billion on munitions programs that have initial funding (either for procurement or for development) included in the 1990-1991 budget request. Summary Table 3 lists these programs. Some or all of these could be canceled. Alternatively, the Congress might defer the start of some of them, though deferrals would save substantially less than cancellations.

Even if the Congress were willing to cancel all the new starts, which seems highly unlikely, the savings would not be adequate to buy enough munitions to meet all the services' requirements. More likely, selected programs would be canceled or deferred. Thus, if all munitions requirements are to be met without increasing costs, this approach would have to be combined with other steps to reduce defense spending, such as the reduction in platforms described above.

Advantages. The main advantage of this approach is that it would add quickly to the stock of munitions. Funds spent on munitions currently in production would buy a lot more hardware over the next five years than spending the same funds on developing new systems. For instance, the $950 million the Army intends to spend in the next five years developing the Advanced Antitank Weapon System would instead buy 80,000 TOW 2 missiles or 150,000 MLRS rockets. Therefore, combat simulation models like TLAM, which simulate a war that is assumed to occur in the mid-1990s, inevitably favor this approach. New munitions just entering development may not be available in large enough numbers by the mid-1990s to affect the outcomes of war significantly, while additional supplies of the current generation of munitions purchased with the same amount of funds do improve the outcomes of combat.

Disadvantages. Option III has obvious drawbacks, however. Today's new starts of munitions provide improved capability to meet future

increases in enemy capability. Indeed, if no improvements are made, improvements in enemy countermeasures could render the current generation of munitions much less useful, leaving U.S. forces poorly defended. Thus, the desirability of this approach depends on whether planners perceive that near-term or more distant threats are more dangerous to this country's security.

SUMMARY TABLE 3. SELECTED NEW DEVELOPMENT AND PROCUREMENT STARTS IN THE FISCAL YEAR 1990-1991 BUDGET

System	Type of Funding	Five-Year Costs (Billions of dollars)
	Army	
Follow-On to LANCE Missile	RDT&E	0.8
Non-Line-of-Sight Missile	Procurement/RDT&E	1.6
Advanced Antitank Weapon System	Procurement/RDT&E	2.0
Antisatellite System	RDT&E	1.4
Subtotal		5.8
	Navy	
Joint Standoff Weapon Systems	RDT&E	0.2
Sea Lance Missile	Procurement/RDT&E	1.2
Subtotal		1.4
	Air Force	
Joint Standoff Weapon Systems	RDT&E	0.3
Short-Range Attack Missile--Strategic	Procurement/RDT&E	1.3
Short-Range Attack Missile--Tactical	RDT&E	0.3
Subtotal		1.9
Total New Starts Listed		9.1

SOURCE: Congressional Budget Office based on Department of Defense data.

NOTE: RDT&E = Research, Development, Test, and Evaluation.

Today's geopolitical events argue that more distant threats are of greatest concern. The United States, its NATO allies, and the Warsaw Pact countries are embarked on negotiations intended to reduce significantly the military forces in Europe. This effort, in turn, would lead to significant reductions in requirements for munitions. These events may argue against options to improve near-term sustainability at the expense of future military capability.