
BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Budgetary Pressures Created By The Army's Plans To Procure New Major Weapon Systems Are Just Beginning

The Army is now facing the problem of funding the procurement of all 14 of its new major weapon systems. Recent experience has shown that as new Army weapons begin production, procurement costs run considerably higher than anticipated. Since 11 of the 14 weapon systems have not yet gained any significant production experience, their cost estimates are likely to be on the low side.

Fielding all 14 new systems during the next decade is likely to seriously strain the Army's operation and support resources since, compared to present weapons, these systems will require more people with higher skills, as well as increased expenditures for fuel, spares, and ammunition.

GAO recommends improvements in planning for the procurement and eventual support of these weapon systems to alleviate the future budgetary strains they could impose.



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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

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To the President of the Senate and the
Speaker of the House of Representatives

This report portrays the budgetary pressures the Army has felt and which are likely to continue in procuring and supporting its new major weapon systems.

We undertook this review to determine the likely effect on the Army's budget over the next several years, which introducing 14 new major weapon systems poses, and to identify ways for relieving their attendant funding difficulties.

We did not receive official comments from the Secretary of Defense within the maximum 30-day response period permitted by law.

We are sending copies of this report to the Director, Office of Management and Budget, and to the Secretary of Defense.

A handwritten signature in black ink that reads "Charles A. Bowsher".

Comptroller General
of the United States

D I G E S T

The Army has just passed through a budget crisis which, for a time, threatened to impede or delay its introduction of several newly developed weapon systems into the forces. However, the substantial funding increases contained in the fiscal year 1981 supplemental appropriation, and in revisions to the fiscal year 1982 budget, enabled the Army to adhere to its earlier plans for buying the major weapon systems in the time frame it desired. Because recent experience is showing that production costs tend to range considerably higher than the Army's cost estimates once a weapon begins production and because the new systems require great amounts of resources to operate and support them, GAO foresees continuing strains on future budgets unless some changes in planning for their procurement and support are introduced.

GAO undertook this review to (1) determine the likely effect on the budget for the next several years of financing the procurement, operation, and support of the Army's new major weapon systems and (2) identify ways for relieving the pressure which characterized the preparation of the Army's 1982-86 Five-Year Defense Program. GAO's review covered 14 new weapon systems whose cost over the next 5 years will comprise about 50 percent of the Army's procurement budget. (See pp. 1 to 7.)

THE PROCUREMENT FUNDING CRISIS

The 1970s marked the Army's most intensive peacetime effort to modernize its forces with new weapon systems. During this period the Army began developing new armored vehicles, helicopters, missiles, guns, and sophisticated electronic equipment. Because most of the major weapons were to experience a transition from development into production during the late 1970s and early 1980s, the problem of providing sufficient funding to procure all of them had long been anticipated. The "procurement bow wave," as it has been called,

became a reality in preparing the original fiscal year 1982 budget. With less funds available than were needed to procure the new weapons in the quantities desired, together with substantial cost increases in several of them, the Army stretched out the production schedules of nearly all the systems--that is, it proposed buying them in smaller increments over a longer period of time. This would have resulted in higher prices and extended the period for fielding the new weapons. The setback to the Army's modernization effort was largely alleviated by the additional funds provided in the revised fiscal year 1982 budget. (See pp. 3 to 6.)

The transition of three Army systems into production has been characterized by substantial cost growth, stemming mainly from actual production processes being more complex than anticipated. This in turn requires more labor hours and machine time. Cost increases tend to occur during the first few years of production, after the weapon system has been delivered in some numbers to the field. Of the 14 major systems, the 3 that have been in production long enough to deliver units to the field--the Blackhawk helicopter, the Stinger missile, and the M1 tank--have experienced large cost increases as a result of early production problems. The Blackhawk's unit cost has risen from \$2.8 million at the time of production in early 1978 to \$6.2 million in 1981. The M1's unit production cost estimate has gone from \$1.4 million to \$2.5 million since the first production contract was awarded in May 1979. The Stinger's unit production cost estimate has gone from \$36,900 to \$70,600 since the first production contract in April 1978.

Although much of this cost growth is due to inflation, the basic cause has been that more production time per unit was required for producing in large quantities than was projected in estimating program costs. The 11 other major weapon systems have yet to undergo similar production experience. Unless production cost estimates become more realistic, they are likely to report similar cost growth as they are produced. (See pp. 8 to 15.)

The use of optimistic inflation rates in developing cost estimates also accounts for considerable

cost growth. The low rates used to project inflation for the duration of the acquisitions have consistently resulted in underestimated program costs. The revised fiscal year 1982 budget calls for even lower rates than the original budget. (See pp. 15 and 16.)

OPERATING AND SUPPORTING THE
NEW WEAPONS NEEDS MORE CONSIDERATION
IN PROCUREMENT DECISIONS

Operating and supporting the new weapon systems once they are fielded will require very large amounts of resources in the late 1980s and beyond. Operation and support costs are generally greater in total than a weapon's procurement cost and span a much longer period of time. Funds for these types of costs are primarily provided by appropriations for military personnel and for operations and maintenance. Since their budgetary effect will not be felt until after the weapons begin deployment, these costs do not receive as much attention as procurement costs while the new weapons are undergoing development. However, the procurement decisions made or to be made on the major systems, in effect, commit the Army to funding the resultant operation and support costs in future years if they are to be kept in a required state of readiness.

Fielding all 14 new systems during the next decade is likely to seriously strain the Army's available long-term operation and support resources. Most all of these systems will require more people with higher skills at a time when competition for personnel may be more intense. They will also require more fuel and ammunition, imposing an increased logistics burden. These additional resources as well as a greater expenditure for spare parts will require increased funding over the next several years.

Before beginning or continuing the acquisition of individual weapon systems, the Army should assess the systems' aggregate long-term support requirements. Also, it should determine whether sufficient funds can reasonably be expected to be made available to sustain at the required degree of readiness not only those systems that are still to be produced but also those already in inventory. (See pp. 17 to 21.)

RECOMMENDATIONS

GAO recommends that the Secretary of Defense direct the Army to:

- Fully fund those new systems deemed by the Army to be essential to bring its missions most in need of strengthening up to the desired capability, even at the expense of canceling or reducing other acquisition programs, given the likelihood of continuing budget pressures.
- Ascertain, in consultation with the prime contractors, that foreseeable production risks of the 11 systems for which deliveries are still to begin have been identified; revise procurement cost estimates accordingly; and consider the steps necessary to forestall or minimize such risks.
- Identify, in each 5-year plan, the additional resources that will be needed to operate and support all major weapon systems in inventory and to be procured and determine the resources that can reasonably be expected to become available for these purposes so that the results of such assessments can be considered in procurement funding decisions. New major weapon system procurements should not be undertaken unless a positive determination has been made that the systems can be adequately operated and supported.

MATTERS FOR CONSIDERATION BY THE CONGRESS

It is conceivable that the Navy and the Air Force are experiencing difficulties, similar to those experienced by the Army, in financing their major acquisition programs. The Congress should be alert to this possibility and determine that cost estimates provided with Navy and Air Force budget requests, as well as the Army's, reflect all cost to be anticipated when systems transition from development into production. The Congress should also determine, at the time the services request procurement funds, that the services have adequately determined that sufficient resources are likely to be available to operate and support the new systems as well as existing systems in the long term.

(See pp. 22 and 23.)

AGENCY COMMENTS

GAO requested comments on the report from the Secretary of Defense, but did not receive them within the maximum 30-day response period permitted by law.

Subsequent to the preparation of this report, the Department of Defense proposed budget reductions for several major weapons including the Army's Roland, M1, and Patriot systems. These reductions are indicative of mounting pressures on the defense budget.

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ABBREVIATIONS

DIVAD	Division Air Defense Gun
DOD	Department of Defense
GAO	General Accounting Office
MLRS	Multiple Launch Rocket System
SOTAS	Standoff Target Acquisition System

CHAPTER 1

INTRODUCTION

In the early 1970s while phasing down military activities in Southeast Asia, the Army began an intensive research and development effort to field 15 to 20 new major weapon systems. Although many of these weapon programs have had a history of stops, restarts, and restructuring, about two-thirds of them have made the transition into production. The Army considers this investment in new weapons the largest peacetime modernization effort in its history.

The budgetary implications of actually procuring these weapons have been known or suspected for years. The question has always been whether the Army could financially afford all the programs under development. Not only is there some concern regarding the availability of sufficient procurement funds to buy the weapons at economical rates, but there is also growing concern about the accompanying operation and support costs that will be required over the next 10 to 20 years to ensure that these weapons will provide the combat readiness desired. Although the infusion of additional funds into the defense budget should alleviate the funding problem for fiscal year 1982, this may not be a feasible long-range solution. Continuing heavy demands on the Army's budget are a distinct possibility and could soon force difficult funding choices among weapon programs.

THE MAJOR WEAPON PROGRAMS DRIVING THE PROCUREMENT BUDGET

To determine the potential problems the Army may still face, we selected its top 14 major weapon systems for a more detailed examination. During the next 5 years, the cost of these weapons will represent approximately 50 percent of the Army's total procurement budget. These systems listed below encompass the primary Army mission areas and essentially represent the modernization effort started in the 1970s.

Close Combat Mission

M1 tank	The primary ground combat direct fire weapon for armored units.
Fighting Vehicle System	A lightly armored tracked vehicle with an assortment of firepower capability for mechanized infantry and cavalry units.
AH-64 advanced attack helicopter	A mobile antiarmor weapon for aviation units to support ground forces.

Hellfire missile An antiarmor, laser-guided missile for use on the AH-64 attack helicopter.

Fire Support Mission

Multiple Launch Rocket System (MLRS) A tracked, vehicle-mounted rocket launcher for field artillery units.

Copperhead A cannon-launched, laser-guided projectile for field artillery units.

Pershing II A truck-mounted ballistic missile for tactical nuclear forces.

Ground Air Defense Mission

Patriot missile A truck-mounted high and medium altitude antiaircraft missile for air defense units.

Roland missile A tracked, vehicle-mounted, short-range, low altitude antiaircraft missile for air defense units.

Stinger missile A troop-portable, shoulder-fired, low altitude antiaircraft missile for small combat units.

Division Air Defense Gun (DIVAD) A tracked vehicle with low altitude twin guns for air defense units.

Combat Service Support Mission

UH-60A Blackhawk helicopter A utility helicopter for transporting infantry squads, small artillery units, and combat-consumable items.

CH-47D Chinook helicopter An improved version of the CH-47 medium-lift cargo helicopter for transporting logistic items, troops, and special weapons.

Reconnaissance, Surveillance, and Target Acquisition Mission

Standoff Target Acquisition System (SOTAS) A radar mounted on a Blackhawk helicopter with accompanying ground stations for locating and tracking ground and air vehicles.

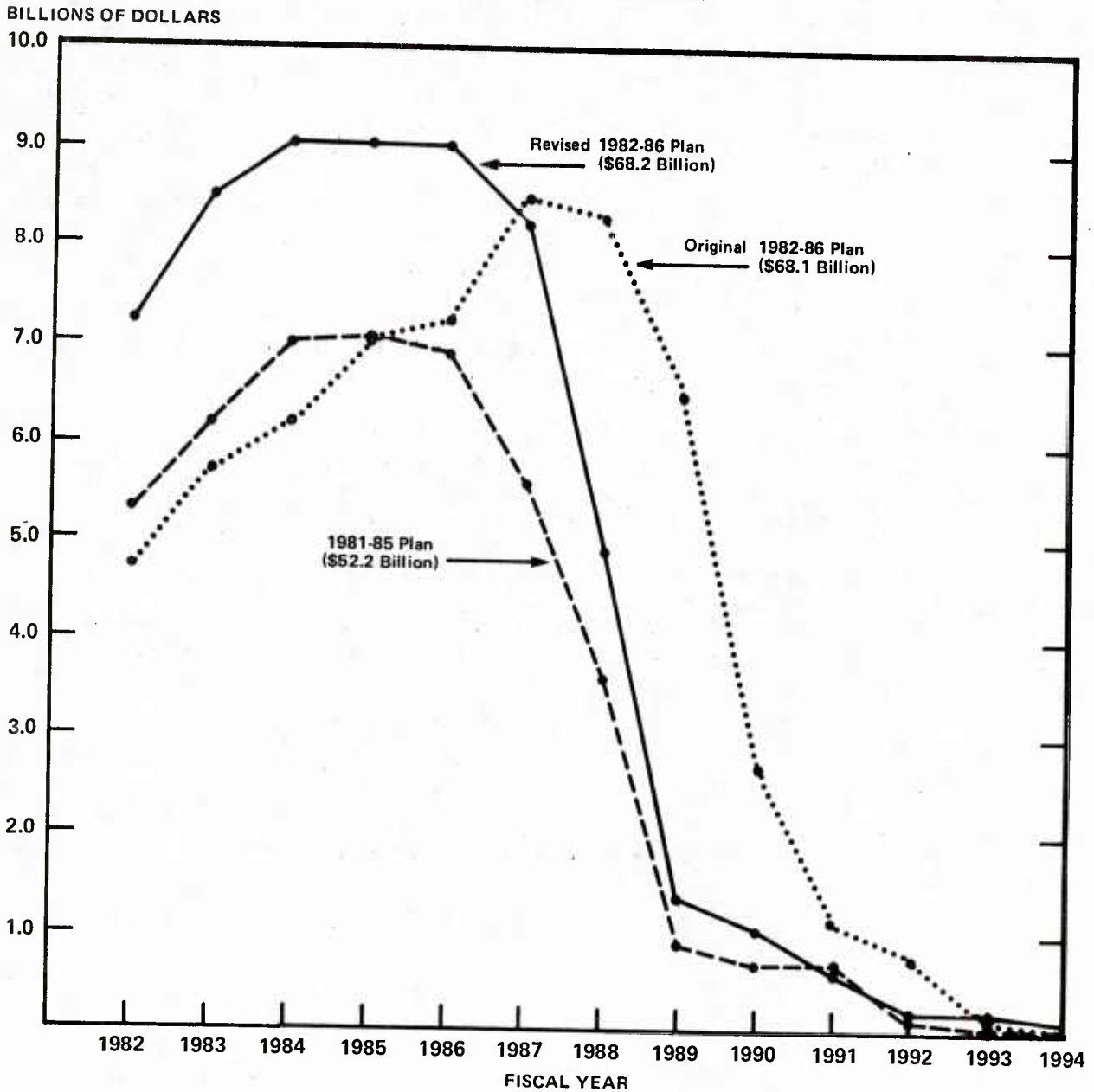
THE EFFECTS OF THE PROCUREMENT
BOW WAVE ARE NOW BEING FELT

In preparing the original fiscal year 1982-86 defense plan, the Army was faced with the reality of the long anticipated procurement "bow wave." With all of the major weapon systems competing for procurement funds during these years, together with large cost growth in some weapons and the need to bolster near-term readiness, the Army did not have enough procurement funding available to buy all of the weapons as planned. As a result, the Army stretched out the procurement schedules of most major weapons.

The current administration plans to restore most of these weapon systems to their original schedules by substantially increasing the Army's request for total obligational authority in fiscal year 1982 and over the next several years. Whether these increases will be enough to offset the increasing costs of the major weapon systems or whether the funds can all be made available remains to be seen.

The fluctuation in the 14 systems' procurement funding plans resulting from these bow wave pressures are illustrated on the following page according to (1) the fiscal year 1981-85 defense plan, (2) the original fiscal year 1982-86 defense plan, and (3) the revised fiscal year 1982-86 defense plan. This graph depicts the three versions of the procurement bow wave, whereby the Army's 14 major systems all require a large investment of procurement dollars over the next decade. The total estimated procurement costs of the 14 systems according to the 1981-85 plan were \$52.2 billion. As these programs were stretched out in the 1982-86 plan, estimated costs rose to \$68.1 billion. The revisions to the 1982-86 plan, in essence, buy the same systems at a more rapid pace, but the overall expenditures remain about the same at \$68.2 billion, as explained on the following pages. These costs are cumulative from the inception of procurement requests for each program to the final year of procurement.

Procurement Funding Plans Of 14 Major Weapon Systems
(includes estimates for inflation)



The original 1982-86
defense plan

In the 1981-85 plan, as shown on the chart above, procurement of the 14 systems was to peak during fiscal years 1984-86 after a quick buildup and then drop off sharply during 1987-89.

The 1982-86 plan differed markedly from this in that a substantial amount of procurement was pushed beyond fiscal year 1986, delaying the peak funding until 1987 and 1988. This funding plan represented a serious setback to the Army's modernization effort in that 10 of the 14 major systems were stretched out--the Stinger missile, M1 tank, Copperhead, Fighting Vehicle System, MLRS, CH-47D cargo helicopter, Hellfire missile, AH-64 attack helicopter, DIVAD, and SOTAS. The Roland air defense weapon program quantities were reduced by more than 50 percent. Procurement costs for the 14 systems increased by 30 percent from \$52.2 billion to \$68.1 billion over the 1981-85 plan. This was due to a combination of factors: (1) the effects of deliberate production stretchout, which include incurring more fixed cost than planned and higher inflation associated with greater annual spending rates in future years, (2) program cost growth due to underestimating, and (3) the use of higher inflation estimates than had been used previously.

Adding to the funding pressures caused by buying all 14 major weapons was an increased emphasis on near-term readiness. In preparing the 1982-86 plan, the Army was directed to increase funding of readiness items, such as war reserve stocks and ammunition, which reduced the funding available for the major new systems.

Revisions to the 1982-86 defense plan

The increases in obligational authority accompanying the revisions to the 1982-86 defense plan will enable many major systems to return to more efficient production schedules and will also increase quantities in some systems. The M1 tank, Fighting Vehicle System, Hellfire missile, and AH-64 attack helicopter are to be restored to the procurement schedules established in the 1981-85 plan. The CH-47D cargo helicopter schedule will also be restored, and the quantity procured will increase by 75 aircraft from 361 to 436. The DIVAD program, which was stretched by 5 years, will regain 4 years of its schedule and will reach economical production rates. The Roland program would be restored to the original program quantities.

Based on current Army cost estimates, more efficient production schedules will reduce the total procurement cost of the 14 systems by about \$2 billion. Further budget reductions of \$4.6 billion are projected, since the revisions use much lower inflation rates for these systems than under the original plan. These inflation reductions, however, depend on the President's economic recovery program's success.

Although these budget reductions are substantial, they have been more than offset by other increases, as reported in the March 1981 Selected Acquisition Reports. The quantity increases would add \$2.7 billion to the Roland and CH-47D programs. Program cost growth, largely in recognition of actual

production experience, has added \$3.8 billion to the estimated procurement costs of the 14 systems. The major contributors to this cost growth are Patriot (\$0.7 billion), Blackhawk (\$1.1 billion), and the M1 tank (\$1 billion). Other contributors are Stinger, AH-64, Copperhead, and DIVAD.

As a result of these increases and decreases, the procurement expenditures for the Army's 14 major systems in the revised 1982-86 defense plan will amount to \$68.2 billion, or about the same as the original 1982-86 plan. These changes are summarized as follows:

	<u>Estimated procurement expenditures</u> (billions)
Original 1982-86 plan	\$ 68.1
Lower cost due to:	
Production efficiencies	-2.0
Lower forecasted inflation rates	-4.6
Higher cost due to:	
Increased quantities	+2.7
Real program cost growth	+3.8
Engineering and other program changes	<u>+ .2</u>
Revised 1982-86 plan	<u>\$68.2</u>

With the likelihood of weapon program cost growth and the increased quantities to be procured, the demand for procurement funds is expected to be very high during the next 5 years. An even greater amount of funds is likely to be demanded for operations and support beyond those 5 years.

OBJECTIVES, SCOPE, AND METHODOLOGY

The actions taken on the Army's major systems in the Carter administration's 1982-86 defense plan and the Reagan administration's revision to that plan are indicative of the funding pressures that buying these weapons pose. We undertook this review to (1) determine the likely effect on the budget for the next several years of financing the Army's major procurement programs and the cost of operating and supporting the systems and (2) identify possible alternatives for relieving the strains on the budget which characterized the preparation of the Army's 1982-86 Five-Year Defense Program.

We approached the review by analyzing Office of the Secretary of Defense and Army budget documents, Selected Acquisition Reports, independent assessments of the individual weapons, and several

internal defense documents. We also interviewed Department of Defense (DOD) and Army officials involved with formulating and analyzing the budget and 5-year plan, as well as those monitoring the procurement and eventual fielding of the major systems.

Our work was conducted entirely within the Washington metropolitan area at DOD. We met with representatives from the Office of the Secretary of Defense, Joint Chiefs of Staff, and Department of the Army Headquarters. We did not visit the individual program offices for each major system. Rather, we concentrated our efforts on where the Army budget and planning decisions were made for all the systems, including their procurement and operation and support. Thus, we addressed the affordability difficulties posed by the major systems in the aggregate rather than making a system by system evaluation.

The quantitative data cited in our report is dated as of March 31, 1981. Due to the fact that the operating and support estimates cover a span of some 20 years, and largely do not reflect the benefit of actual experience with the new systems, these estimates are not as precise as the procurement estimates. However, they do indicate the magnitude of the resources that will be required by the major systems when they are fielded.

Although we requested comments on the report from the Secretary of Defense, we did not receive them within the maximum 30-day response period permitted by law. We did discuss our findings with Department of the Army officials and considered their comments in preparing the report.

After we completed our work and prepared this report, DOD proposed reductions for several major weapons, including the Army's Roland and Patriot air defense missiles and M1 tank. We see these proposed reductions as indicative of the mounting pressures on the defense budget.

CHAPTER 2

CONTINUED COST INCREASES ARE LIKELY

AND COULD CAUSE ANOTHER FUNDING SQUEEZE

IF PATTERN PERSISTS

Funding increases proposed for fiscal years 1982-86 will relieve much of the Army's near-term procurement difficulties. However, continued cost growth of the major systems can be expected. This is likely to revive the affordability concerns of last year and either force difficult procurement decisions or create a demand for more total obligational authority.

Since the 14 systems will account for roughly half of the Army's total procurement budget over the next 5 years, any further significant cost growth in one or more of the systems is likely to lead to another budget squeeze. Based on the Army's experience thus far with systems already in production, such cost growth is likely to occur. Several systems have incurred substantial cost increases, largely due to a higher actual level of effort in production, such as more labor hours or machine time than anticipated, startup difficulties, and quality control problems. This pattern does not appear to be an aberration in the production of major weapons. It has occurred on all 3 systems (of the 14) that have already had some production experience. Since most of the major systems have not yet gained actual production experience, further cost growth can be expected as they move through initial production. In no cases have the Army's cost estimates reflected these production "growing pains" until after they have occurred.

PATTERN OF SUBSTANTIAL COST GROWTH ON MAJOR SYSTEMS AS THEY BEGIN PRODUCTION

Most of the Army's major systems which have started production have incurred major cost increases. The cost increases are occurring mainly because production processes are requiring more time and effort than anticipated during development. They indicate poor earlier assessments of production risk or unrealistic projections of processes contemplated for manufacturing new weapons.

Production schedule information about the 14 major weapon systems is displayed on the following page.

Production Schedule Information
on 14 Major Weapons

<u>Weapon system</u>	<u>Production decision date</u>	<u>Units delivered as of Mar. 1981</u>	<u>Final fiscal year of procurement funding</u>
Blackhawk helicopter	Nov. 1976	130	1991
Stinger missile	Nov. 1977	228	1988
M1 tank	Apr. 1979	76	1988
Roland missile	May 1979	-	1986
Copperhead projectile	Nov. 1979	-	1989
Fighting Vehicle System	Jan. 1980	-	1988
MLRS	May 1980	-	1990
Patriot missile	Sept. 1980	-	1987
CH-47D cargo helicopter	Oct. 1980	-	1994
Hellfire missile	Dec. 1981	-	1986
AH-64 attack helicopter	Dec. 1981	-	1988
DIVAD	Mar. 1982	-	1987
Pershing II missile	June 1982	-	1993
SOTAS	Oct. 1984	-	1988

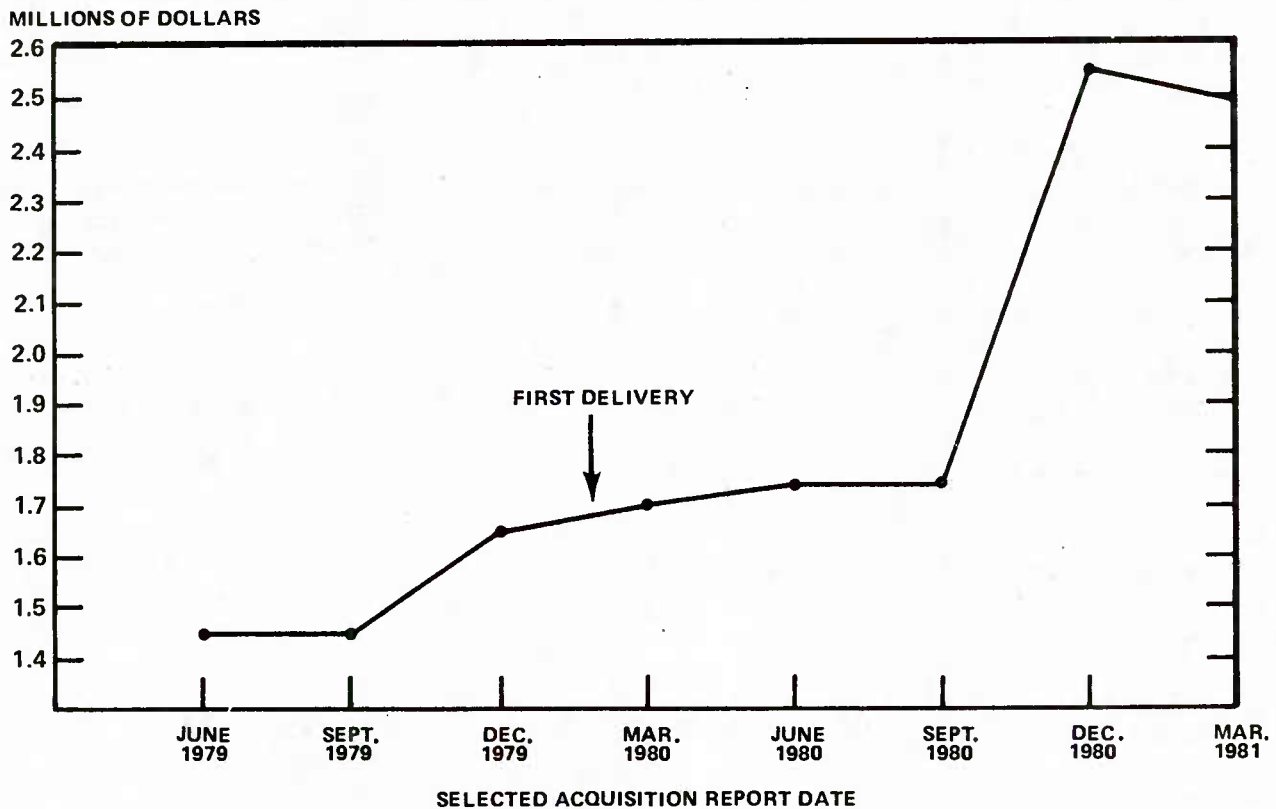
The costs for the M1 tank, Blackhawk helicopter, and Stinger missile have grown substantially since starting production. Of the 14 systems, these have been in production the longest, and deliveries have already been made to units in the field. Cost increases tend to occur when contractors can prepare new production proposals based on actual cost data accumulated on units which have already rolled off the production line. These early production contracts were budgeted using cost estimates that have proven to be optimistic. According to the Army, when actual costs turned out much higher than the funds allocated to the contracts, it had to lower the contract quantities to cover the increase. This pushed more of the program quantities to be produced into later

years and slowed down the contractors' learning rate on production.

M1 tank

Since the first production contract for the M1 was awarded in May 1979, the tank has experienced production problems which have driven its costs up. As illustrated in the chart below, the tank's unit procurement cost grew gradually from \$1.45 million at the time the contract was awarded through September 1980. The Army, in its Selected Acquisition Reports, attributed these increases largely to inflation.

**M1 Average Projected Unit Procurement Costs
(includes estimates for inflation)**



However, in December 1980 the Army reported that total M1 procurement costs had risen by \$5.8 billion as follows:

- \$0.4 billion due to schedule stretchout.
- \$2.1 billion due to a new inflation estimate.
- \$0.3 billion due to increased spare parts requirements and costs.
- \$3 billion due to revised vehicle cost estimate.

These increases drove the M1's unit costs from \$1.73 million in September 1980 to \$2.55 million in December 1980.

The largest cost increase, the \$3 billion revised vehicle estimate, was based on production experience. By that time, the contractor had submitted the proposal for the 3d year of M1 production, which reflected the actual costs experienced on the 1st-year contract. Tanks produced under this contract began arriving during 1980. In March 1981, reflecting the 1982 budget revisions, the Army reported another \$1 billion growth in M1 production costs. This was attributed to increases in the cost of initial production facilities and auxiliary services and a change in the hardware cost estimating methodology that reflected cost trends on the first contract and in the 2d- and 3d-year production proposals. However, this increase was offset by a deliberate reduction in the forecasted inflation rates and by efficiencies expected to result from restoring production to the original schedule. Thus, unit costs decreased slightly to \$2.49 million.

According to the Army, the cause for many of these problems can be traced to the fact that the M1 tank requires a more complicated production process than the existing M60 series tank. Because of this, the Army did not have much relevant experience to draw from in estimating M1 production costs, and subsequently found out that the tank requires more effort to produce than originally thought.

Several factors have affected M1 production:

- Machine cycle times (the time it takes a factory machine to perform its tasks) are running much higher than planned.
- Some subassembly shops are requiring several times the labor hours they were expected to.
- Less than desirable production quality is occurring necessitating rework.
- Unanticipated modifications to the tank to correct deficiencies disclosed in testing are disrupting the production process.

Also, the contractors are experiencing slower than anticipated learning of the high technology production process which, together with the other factors, is causing less improvement in production efficiency than expected.

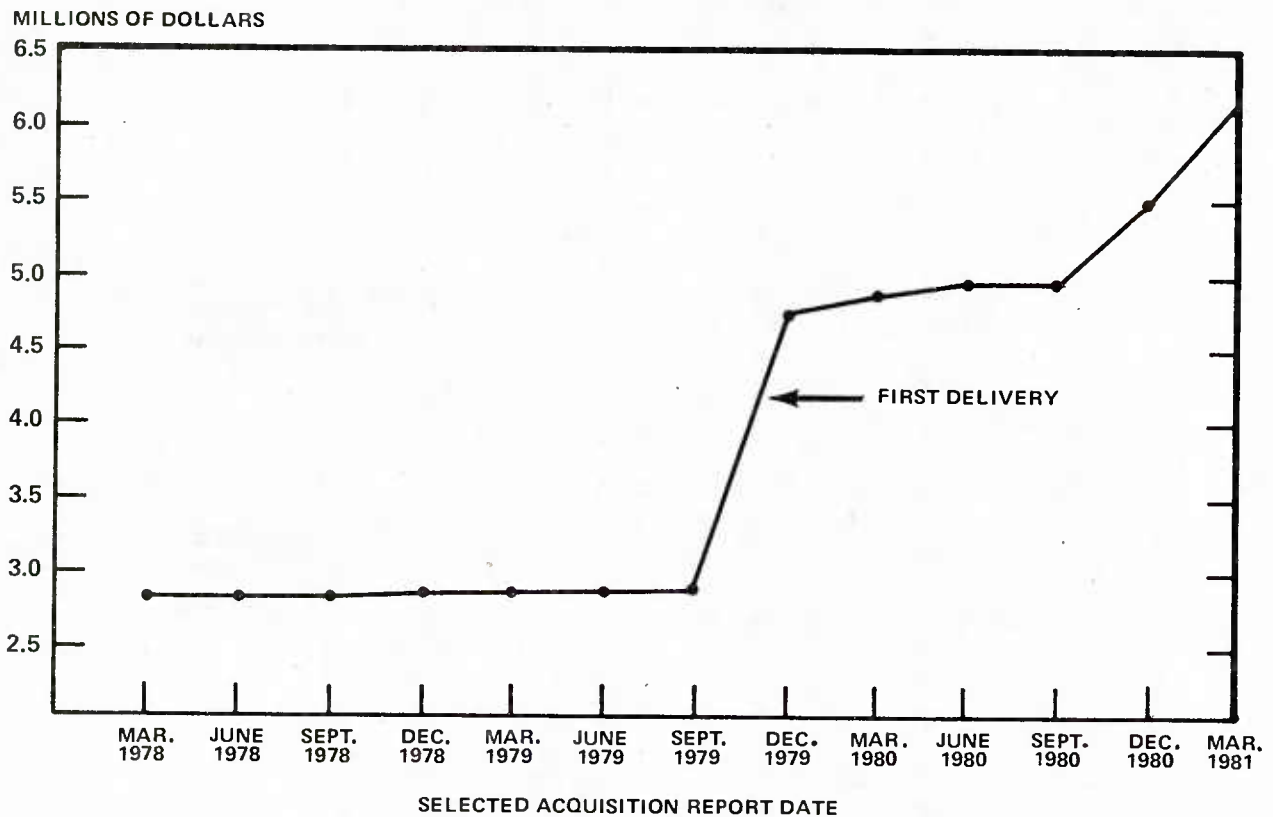
In view of the contractor's 3d-year contract proposal, which reflected the production problems on the first two contracts, the amounts budgeted for the tank in fiscal years 1979 and 1980 proved to be too low. As a result, the budgeted

purchases of 110 and 352 tanks for these 2 years will now buy only 90 and 309 tanks, respectively. Thus, due to its inability to fund cost increases during the first 2 production years, the Army had to defer the production of 63 tanks into later years. This deferral forced program stretchout and slowed the production process learning rate in the early years, compounding the cost increases.

Blackhawk helicopter

The Blackhawk helicopter also encountered large cost increases once it entered production. In fiscal year 1977, the Army awarded the first Blackhawk production contract for 15 aircraft, with options to buy 56, 129, and 145 in fiscal years 1978, 1979, and 1980, respectively. As shown on the chart below, Blackhawk unit procurement cost estimates remained constant through September 1979, and by December 1979 the Army had reported a \$1 billion increase based on production experience. This increase, coupled with a schedule stretchout and inflationary growth, drove unit costs from \$2.8 million to \$4.7 million.

Blackhawk Average Projected Unit Procurement Costs
(includes estimates for inflation)



Costs were driven up because actual production labor hours were significantly higher than estimated and expected production efficiencies from learning experience on the engine did not materialize. Because the Army had already exercised its three production

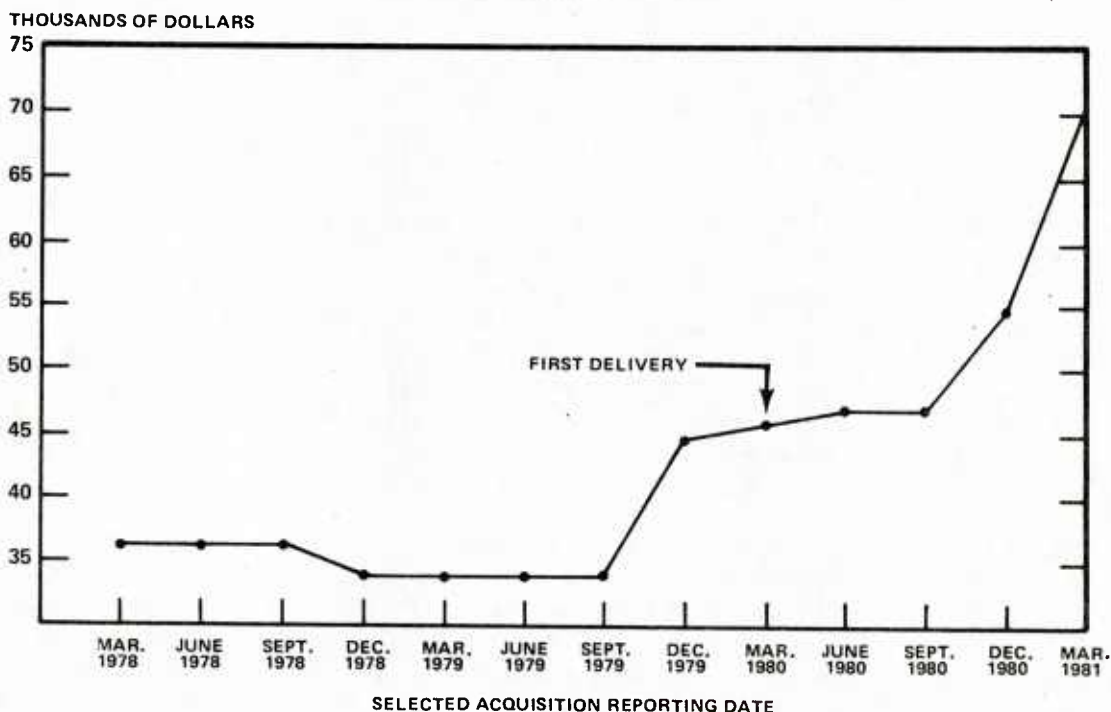
options and had budgeted for them, it was unable to increase Blackhawk funding for those years to cover the cost growth. Thus, the Army reduced the 1979 buy of 129 aircraft to 92 and the 1980 buy of 145 to 94. As in the case of the M1 program, the unfunded quantities (88) were deferred into the future years, resulting in program stretchouts and slowing the production efficiencies expected from learning experience.

In December 1980 the Army cited an \$850 million increase in Blackhawk costs based on the engine and airframe contract proposals for the fiscal year 1981 contract. Again, one of the main causes of the increase was the greater number of labor hours required to produce the aircraft, which were about 20 percent higher than planned. In March 1981 another \$1 billion cost increase was reported following further analysis of the 1981 airframe proposal. As a result, unit costs rose to \$5.5 million in December 1980 and to \$6.2 million in March 1981.

Stinger

The Stinger missile has also experienced production difficulties and resultant cost increases. The first Stinger production contract for 258 missiles was awarded in April 1978 at a unit cost of \$36,900. Subsequent contracts were awarded in fiscal year 1979 for 2,250 missiles and in fiscal year 1980 for 1,874 missiles. Although minor program adjustments reduced costs initially, as indicated on the chart below, unit procurement costs of the Stinger have been increasing steadily since September 1979.

Stinger Average Projected Unit Procurement Costs
(includes estimates for inflation)



In December 1979 the Stinger procurement estimate rose by \$322 million. The Army attributed \$238 million to inflation, increased production leadtimes, and extending the production schedule 1 year. The remaining \$84 million was attributed to reestimating the missile's costs based on contract experience. Unit procurement costs rose from \$34,400 to \$44,900. In December 1980 the Stinger estimate grew by another \$230 million, increasing the unit procurement cost to \$54,800. The Army attributed half of this increase to actual production efficiencies being less than estimated. The other half was due to problems in developing an improved seeker for Stinger (referred to as the Post seeker) which resulted in stretching out the production schedule.

During 1980 the prime contractor began projecting cost growth on the fiscal year 1979 and 1980 contracts again because actual production efficiencies from learning experience were less than planned. The missiles required more time to produce than estimated, mainly because the precise tolerances demanded of the subcomponents required more extensive testing than anticipated. In March 1981 the Army reported that procurement costs for the Stinger grew by nearly \$300 million as a result of this experience, which forced the Army to lower the 1979 and 1980 contract quantities to 1,651 and 1,482 missiles, respectively. Moreover, the Army realized that the money budgeted for the fiscal year 1981 buy of 1,356 missiles was not enough to buy even 1,000. Consequently, the Army decided to combine the 1979 and 1980 contracts and to use the fiscal year 1981 money to purchase 991 missiles deleted from the earlier contracts, deferring the 1,356 missiles planned for purchase in 1981 to later years. The deferral increased Stinger costs by another \$300 million, and together with the cost growth based on production experience, drove the unit cost up to \$70,600.

MANY SYSTEMS HAVE YET TO GAIN PRODUCTION
EXPERIENCE AND OVERCOME TECHNICAL PROBLEMS

Experience with the M1, Blackhawk, and Stinger programs shows that cost estimates prepared during the development phase have not taken into account initial production problems like more time to perform tasks, quality control, and rework. These substantial cost increases tend to occur after systems begin production. Most of the Army's 14 major systems have not yet had the benefit of such experience, and unless production estimates become more realistic, they are likely to encounter similar cost growth as they are produced. It should be noted that many of these are much more sophisticated and costly than the Stinger or Blackhawk.

Naturally, production experience is not the only indication of potential cost growth. Those systems still in development have to undergo further critical testing before they are allowed to go into production. Some have already shown cost growth as they near production. For example, Stinger Post, which is intended to be a more capable and more complex seeker than

that incorporated in the present Stinger, has had several recent development problems which have caused schedule slippage. The seeker will be coupled to the current Stinger's missile sections, which have had production problems as discussed above. Also, the advanced attack helicopter has a very tight schedule for fully testing and evaluating the system before a production decision in December 1981. In December 1980 SOTAS costs doubled to \$2.4 billion and the production decision was delayed 2 years because of greater than anticipated complexity in the radar, antenna, and data link. SOTAS program costs have also increased because the Blackhawk helicopter, used as the platform for carrying the radar system, has experienced enormous cost growth as discussed earlier.

The systems already in production still have potential for further cost growth. Cost estimates of the M1 tank will vary with the rate of production, which is still uncertain, and will be influenced by the success in achieving the 120-mm. gun integration, now scheduled for 1984. Copperhead and Roland are still in low-rate production and must demonstrate higher reliability before being allowed to proceed with full production. MLRS is also in low-rate production and must complete a "maturation" phase before beginning full production. Patriot will remain in low-rate production until it can meet its performance, reliability, and maintainability requirements. Also, it has experienced some production cost increases. Independent cost estimates prepared by DOD showed potential cost growth of up to 40 percent in MLRS and Patriot due to development and production risks remaining in the programs.

LOW INFLATION ESTIMATES WORSEN THE PROBLEM

The forecasted inflation rates applied to weapon system procurement have consistently fallen short of the actual inflation experienced. Thus, actual inflation has proven to be another source of unanticipated cost growth, and all the Army major systems have been hurt by it. When unit costs increase after a production contract has been signed, it can force a reduction in the quantity deliverable for the contract price. Under escalation clauses, unit prices are increased so that in total, less funds remain with which to buy the entire contract quantity.

When procurement costs grow for reasons other than inflation, the estimates for inflation merely magnify the total cost increases. Such inflationary growth has affected production costs in the M1, Blackhawk, and Stinger programs and has contributed to the quantity reductions in the contracts for these weapons.

The Office of Management and Budget establishes the overall rates of inflation for DOD. As a practical matter, the Army is somewhat restrained in estimating separate inflation rates for each weapon program without substantial justification. In

addition to this administrative restraint, the Army had cited difficulties in predicting inflation rates within certain industries. For example, the Army claims that rising costs of scarce minerals and increasing leadtimes for acquiring titanium forgings have resulted in prices from 2 to 10 times the original estimates.

Underestimates of inflation could have a significant effect on the Army's ability to afford the weapons it wants. For example, in the case of the Fighting Vehicle System, the program manager estimated in December 1980 that actual inflation would amount to \$2.3 billion more over the life of the program than that allowed by the guidance provided by the Office of Management and Budget through the Office of the Secretary of Defense. Similarly, the M1 program manager estimated a \$2.1 billion increase for the tank. Such large increases create a demand for procurement funding beyond the amount previously programmed and frustrate the defense planning process. If the 12 other major systems were to incur cost growth for the same reason, the affordability question will become even more serious.

For the time being, inflation rates forecasted under the 1982 budget revisions have been reduced in accordance with the administration's predicted economic recovery. Below is a comparison of the inflation rates used for estimating procurement of Army weapon systems in the December 1980 Selected Acquisition Reports under the original 1982 budget versus the March 1981 reports under the revised 1982 budget.

<u>Fiscal year</u>	<u>Dec. 1980 percentages</u>	<u>Mar. 1981 percentages</u>	<u>Point differences</u>
1981	9.9	7.9	-2.0
1982	9.3	8.7	-0.6
1983	8.2	7.3	-0.9
1984	7.3	6.2	-1.1
1985	6.2	5.5	-0.7
1986	6.2	5.0	-1.2
1987	6.2	5.0	-1.2

CHAPTER 3

THE ARMY'S ABILITY TO OPERATE AND SUPPORT

THE NEW SYSTEMS NEEDS TO BE ASSESSED

EARLY AND CONTINUOUSLY

Although the procurement of the Army's major systems is highly visible because of congressionally mandated reports and committee hearings on the budget, operation and support costs have not received as much attention. This is mainly because these costs are more difficult to estimate than acquisition costs and are not incurred until several years after the Army begins fielding a system. However, operation and support costs can comprise up to two-thirds of a weapon system's life-cycle costs. They cannot be overlooked because a weapon's combat readiness and effectiveness depend on how adequately it is supported and maintained. Although the Army is giving more attention to these costs and has established an organization to monitor the integration of the new systems into the field, their operation and support requirements remain to be fully assessed.

Operation and support costs are primarily provided by appropriations for military personnel and operation and maintenance. Unlike procurement costs, operation and support costs will not taper off quickly after peaking. Rather, they will build up progressively until the new systems are completely fielded and will stay at that level as long as the systems remain in the field. Fielding the Army's major systems will require large increases in operation and support funding. Since it is already difficult for the Army to adequately operate and maintain its existing weapons, to do so for the new systems will very likely continue to strain the Army's resources in the longer term. Supporting the systems may be even more difficult, given their complexity. Further, the personnel requirements are based largely on anticipated weapon reliability. If these weapons require more maintenance and support than planned, the Army's ability to provide qualified personnel will be even further strained. Therefore, these costs and the Army's ability to provide the necessary resources for all the systems must be critically assessed to ensure that those systems purchased now are supportable in the future. This information should be a major factor in making procurement decisions.

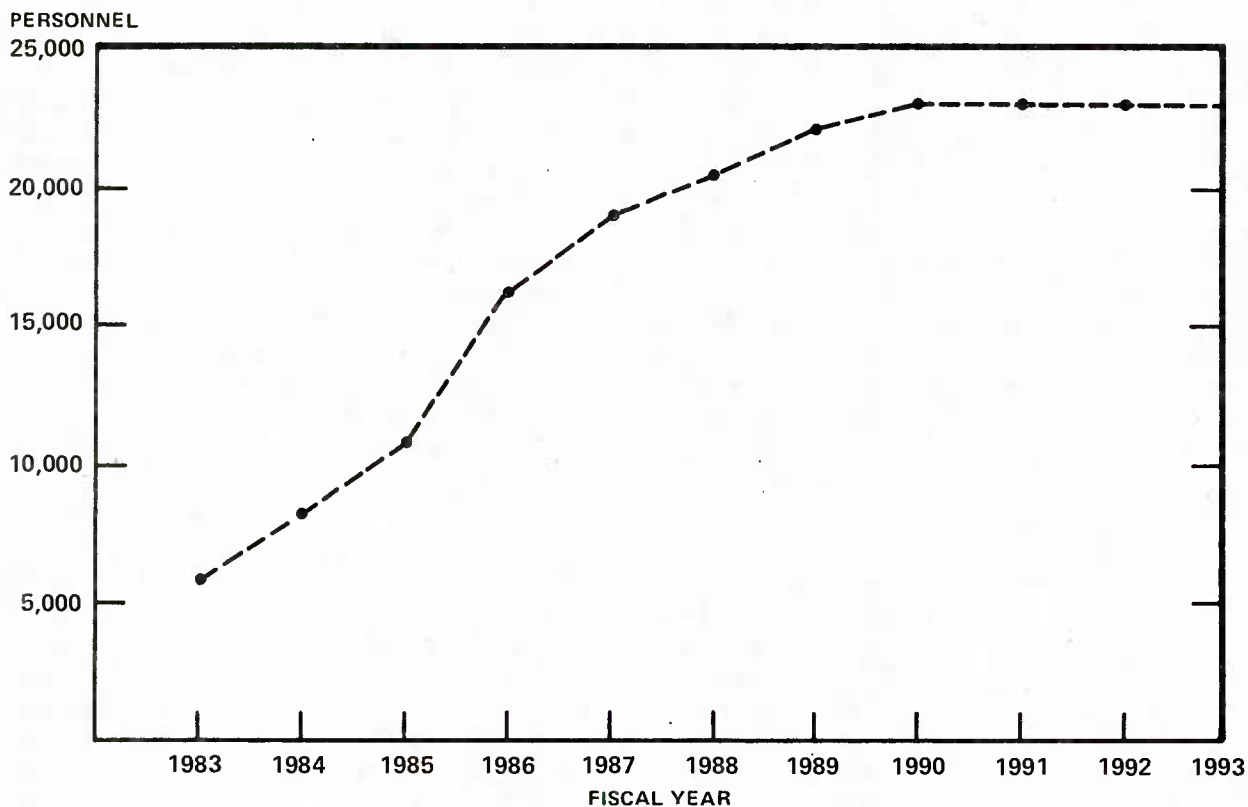
NEW WEAPON SYSTEMS WILL REQUIRE MORE PEOPLE AND HIGHER SKILL LEVELS

According to the Army, fielding the 14 major systems will require about 23,000 more people over the next 10 years. Also, the people needed to maintain and support these systems will have to be more highly skilled because of the weapons' increased complexity. The demand for more people with better skills comes at a time when competition for these people is expected to be

keen. Army projections show that during the period 1980 through 1992, when the personnel increases would be needed, the population of 17 to 22 year olds is expected to decline 25 percent. At this time, the Army feels it can provide these people within existing personnel ceilings. Whether this can be achieved remains to be seen.

As shown below, the 23,000 additional people required for the new systems will build up rapidly as the systems are fielded in large numbers and will level off around 1990.

**Personnel Increases Required By 14
New Major Weapon Systems**



Of the 23,000 personnel increase, about 14,000 are planned to be military and about 9,000 to be civilians. This increase refers to the net number of people required for the new systems over and above those required by similar systems now in the field and does not represent the total number of people needed to operate and support the systems. Several factors account for this increase. First, new systems such as MLRS and SOTAS represent new capabilities for the Army, so that their additional personnel requirements are not offset by phasing out existing systems. Second, several new systems such as the M1 tank and the advanced attack helicopter will initially be added to the inventory of existing systems, rather than replacing them immediately on a one-for-one basis. Finally, the new systems will require more labor at the

higher maintenance levels, such as depots, than existing systems, which according to the Army helps explain the increases in civilians required.

The major systems will require more highly skilled maintenance personnel due to their technical complexity. The demand for electronics expertise is expected to increase because of the widespread use of electrical components on the new weapons as well as more weapons with sophisticated radars. More computer related expertise will be required because most weapons use computerized fire control systems.

The Patriot may be an exception to this overall trend toward increased personnel requirements. The Army maintains that the missile will require fewer personnel and lower skill levels than the systems Patriot is to replace.

NEW WEAPONS WILL USE MORE EXPENDABLE RESOURCES THAN EXISTING WEAPONS

Besides needing more skilled personnel, operating and supporting the Army's new systems will use more expendable resources than existing systems. For example, many new systems require more fuel and ammunition than the older systems, which will increase the burden of handling and storage. These additional resources, together with greater expenditures for spare parts, will surely impose substantially higher funding demands upon the Army. This will become evident particularly in the late 1980s and beyond when all the new systems are expected to be in the field. To the extent that these resources are not provided, vehicle operating times will probably have to be cut back, necessitating reduced training and ultimately less operational availability.

A comparison between the fuel consumption rates of selected old weapons and their new replacements follows:

<u>Old system</u>	<u>Fuel consumption</u>	<u>New system</u>	<u>Fuel consumption</u>	<u>Percent increase</u>
M60A3 tank	1.14 gal/mile	M1 tank	1.85 gal/mile	a/62
M113 personnel carrier	.4 gal/mile	Fighting Vehicle System	1.2 gal/mile	200
AH-1S helicopter	108 gal/hour	AH-64	137 gal/hour	27

a/Based upon a comparison at 25 miles per hour. This increase would be greater for a typical tactical mission which includes lower speeds and engine idle time.

In addition to these systems, SOTAS and MLRS will increase the Army's fuel consumption requirements without any offset arising from phasing out older systems. The additional fuel

consumption of the new systems will not only drive operation and support costs up, but will increase the logistics requirements of getting fuel to the vehicles on the battlefield as well.

The new systems will require greater expenditures for spare parts, because of their complexity, than the older systems. The Army will employ the "fix forward concept" on the new weapons, which calls for using built-in test equipment to diagnose problems. Faulty components are then removed and replaced with new ones. The removed components are sent back to higher maintenance levels mainly because they are too complex for the forward maintenance organizations to repair. Although this support concept is designed to improve the operational availability of the weapons, component reliability will be a key factor in the success of this concept.

In addition, the new systems are also designed to expend higher rates of ammunition than the older systems which will further strain the Army's operation and support resources, as well as the logistical burden on the battlefield.

OPERATION AND SUPPORT COST EFFECTS
WILL OCCUR SEVERAL YEARS AFTER
PROCUREMENT DECISIONS ARE MADE

Although all of the Army's 14 major systems will be in production by 1985, their demands for operation and support resources will not be felt until the late 1980s, when significant numbers of the systems will be fielded. It is not any one system which is cause for concern, but rather the wholesale introduction of many new systems requiring more people, fuel, ammunition, and more expensive spare parts which will greatly tax the Army's operation and support resources.

Depending on the type of system, operation and support costs for major systems can run twice the amount of procurement costs. Also, these costs will be sustained as long as those systems remain in the field, contrasted with procurement costs which are nonrecurring and do not span nearly as many years.

The Army does prepare life-cycle cost estimates on each major weapon to determine its affordability as it proceeds through the acquisition process. However, it has not given enough attention to its ability to provide the aggregate operation and support resources that fielding all major systems will require. The main reason for this is that the mechanism for determining the availability and affordability of resources at the aggregate level, the Five-Year Defense Program, pays close attention only to costs in the current budget year and the 4 years beyond. For example, for systems included in the plan covering the years 1982-86, operation and support costs do not start to rise significantly until the late 1980s, so that they do not represent a major consideration in the plan as yet. Instead, it is procurement costs that will be paramount and will receive the most attention. Even the 1983-87 defense plan will not capture the operation and

support repercussions of the procurement bow wave. Thus, whether the Army will have the resources to adequately operate and support its major systems is uncertain.

CHAPTER 4

CONCLUSIONS, RECOMMENDATIONS, AND

MATTERS FOR CONSIDERATION BY THE CONGRESS

CONCLUSIONS

The funds provided by the revised fiscal year 1982 budget enabled the Army to restore almost all of its major weapon programs to the production schedules contemplated before it prepared the original fiscal year 1982-86 defense plan. The additional funds, however, are likely to provide only temporary relief if burgeoning weapon system costs are not brought under control. Because cost estimates appear not to have taken into account cost growth, which seems to be a byproduct of transitioning from development into production, and because inflation rates projected in program cost estimates have been conservative, it is probable that the estimates for 11 of the 14 principal weapon systems still to be procured remain on the low side.

For this reason we believe that the Army will continue to feel the funding squeeze, in the absence of more total obligational authority, unless it is prepared to cancel or reduce planned procurement quantities of lower priority weapon systems so that the highest priority systems can be fully funded. The alternative option of stretching out procurement is clearly unsatisfactory since it only perpetuates agonizing procurement decisions and has a delaying effect on preparedness.

Fielding all 14 new systems during the next decade is likely to seriously strain the Army's available long term operation and support resources. These systems will require increased funding to obtain more personnel with higher skills at a time when competition for personnel may be more intense. They will also require more fuel and ammunition, imposing an increased logistics burden. Although the Army is concerned with this problem, it has not adequately evaluated its ability to provide operation and support resources for all the new systems in light of the increasing readiness demands of its existing systems. Before beginning or continuing the acquisition of individual weapon systems, the Army should assess its aggregate long-term support requirements and determine whether sufficient funds can reasonably be expected to be made available to sustain at the required degree of readiness not only those systems that are still to be produced but also those already in inventory. Such an assessment is necessary so that aggregate funding decisions on which systems to buy and at what levels will not exceed the Army's operation and support capabilities.

RECOMMENDATIONS

We recommend that the Secretary of Defense direct the Army to:

- Fully fund those new systems deemed by the Army to be essential to bring its missions most in need of strengthening up to the desired capability, even at the expense of canceling or reducing other acquisition programs, given the likelihood of continuing budget pressures.
- Ascertain, in consultation with the prime contractors, that foreseeable production risks of the 11 systems for which deliveries are still to begin have been identified; revise procurement cost estimates accordingly; and consider the steps necessary to forestall or minimize such risks.
- Identify, in each 5-year plan, the additional resources that will be needed to operate and support all major weapon systems in inventory and to be procured and determine resources that can reasonably be expected to become available for these purposes so that the results of such assessments can be considered in procurement funding decisions. New major weapon system procurements should not be undertaken unless a positive determination has been made that the systems can be adequately operated and supported.

MATTERS FOR CONSIDERATION BY THE CONGRESS

It is conceivable that the Navy and the Air Force are experiencing difficulties, similar to those experienced by the Army, in financing their major acquisition programs. The Congress should be alert to this possibility and determine that cost estimates provided with Navy and Air Force budget requests, as well as the Army's, reflect all costs to be anticipated when systems transition from development into production. The Congress should also determine, at the time the services request procurement funds, that the services have adequately determined that sufficient resources are likely to be available to operate and support the new systems as well as existing systems in the long term.

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