West German Military Modernization Goals, Resources, and Conventional Arms Control

Joseph E. Nation

RAND | ARROYO CENTER
PROJECT AIR FORCE

The research described in this report was sponsored jointly by the United States Army, Contract MDA903-86-C-0059 and by the United States Air Force, Contract F49620-86-C-0008.

ISBN: 0-8330-1137-5

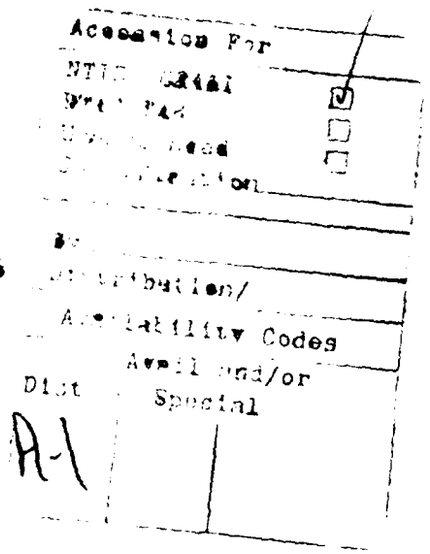
Published 1991 by RAND
1700 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138

R-3841-A/AF

West German Military Modernization Goals, Resources, and Conventional Arms Control

Joseph E. Nation

Prepared for the
United States Army
United States Air Force



RAND

PREFACE

This report was prepared for two RAND projects: "Alternative NATO Futures," sponsored by the U.S. Army's Training and Doctrine Command, and "Enhancing the Allied Contribution to Tactical Airpower in NATO's Central Region," sponsored by the U.S. Air Force's Deputy Chief of Staff for Plans and Operations. These projects were performed jointly under the National Security Studies program entitled "The Future of Allied Tactical Airpower in NATO's Central Region," for the Arroyo Center and Project AIR FORCE, two of RAND's federally funded research and development centers.

The report compares the financial requirements of modernizing West German military forces with a range of budgetary resources both with and in the absence of negotiated conventional force reductions in Europe. The analysis focuses on the evolution of economic and demographic constraints on long-term West German defense planning, projects resource-requirement imbalances, and examines potential reactions to imbalances. It should be of interest to those concerned with developing concepts and force structures for NATO missions in the early 21st century, allied modernization efforts, the emerging West German security debate, and conventional arms reductions in Europe.

The information cutoff for this report was February 1990.

SUMMARY

Over the past several years, West German leaders have unveiled carefully constructed and ambitious plans, commonly called Bundeswehr 2000, to modernize military forces in the next several years. The financial requirements of these modernization efforts are certain to be large, particularly since replacement equipment is almost always more costly than its predecessors. Requirements appear substantial even with conventional force reduction agreements that cut forces.

Several factors further complicate West Germany's modernization efforts. A precipitous drop in the number of male youths will make achieving conscript personnel goals virtually impossible. This demographic trough will also exert strong upward wage pressures for careerists and make careerist personnel objectives, both more difficult to achieve and more costly.

The falling Soviet threat, strengthened by political and economic reforms in Eastern Europe; the debate over NATO strategy and force structure; and the emerging debate about the need for and role of the Bundeswehr complicate modernization efforts. The reunification of Germany also seems certain to alter modernization plans.

West Germany's ability to achieve its military modernization goals is important. For the immediate future Germany will remain the most critical European player in NATO's defense strategy. This will be true as long as Soviet forces are in Eastern Europe and regardless of the outcomes of reforms in the East, Conventional Forces in Europe (CFE) negotiations, and German reunification.

Arms control agreements may result in substantial decreases in modernization requirements and lead to a more optimistic appraisal of West Germany's ability to meet its objectives, but a first-stage CFE agreement that marginally reduces NATO forces may only modestly improve the chances of achieving modernization objectives. The enormous costs of modernizing East Germany's economic infrastructure in a united Germany will also exert downward pressure on defense resources and further complicate modernization efforts.

This report compares the financial requirements of achieving Bundeswehr modernization goals with a range of projected budgetary resources. The financial requirements of major equipment production and projected resources are estimated for two cases: in the absence of conventional arms control in Europe and following a first-stage CFE agreement.

The total production costs of equipment modernization in the absence of arms control are DM 141 billion, based upon current estimates. A range of feasible annual production cost growth, 0 to 8 percent, has been used to estimate future costs, resulting in a range of major equipment requirements from DM 141–230 billion.

To forecast major equipment production in the absence of arms control, aggregate defense budget growth is based on historical data, including defense budget share of gross domestic product (GDP), constant defense spending over time, and the defense budget's share of total government expenditures. Demographic and other budgetary and economic data are analyzed to forecast likely growth in areas of the national budget that compete with the Ministry of Defense (MoD) for funds.

Defense budget expenditures seem unlikely to increase at an annual rate of more than 2.5 percent in a high resource scenario. (Recent expenditure patterns indicate that this rate is very optimistic.) In a low-resource scenario, defense spending may be more tightly constrained by nondefense requirements and may fall at an annual rate of 1 percent from 1990 to 2005. These scenarios probably overstate defense spending since they do not consider the effects of decreases in the perceived Soviet threat or the effects of reunification.

A model for West German defense spending uses historical data to project available funding levels for specific budget categories, including the production of major equipment items.

Conventional arms control agreements will undoubtedly reduce West German modernization requirements and defense resources. Requirements will probably fall about 10 percent. For the purposes of this analysis, aggregate German defense budgets under a first-stage CFE agreement are assumed to remain flat in real terms. (This probably overstates budget levels.)

Finally, requirements are contrasted with resources. **In the absence of arms control, the middle requirement, middle resource case results in a DM 117 billion major equipment shortfall, representing 14 percent of projected defense spending between 1990 and 2005.** A low requirement, high resource scenario results in a DM 50 billion surplus, and a high requirement, low resource scenario results in a DM 225 billion shortfall, or 29 percent of projected defense spending. These figures represent the difference between major equipment production resources and requirements. The sea category (roughly corresponding to the Germany Navy) appears to be the most underfunded based on projected ratios of shortfall to production.

Equipment shortfalls represent the difference between production resources and requirements and understate an additional increase in aggregate defense spending necessary to eliminate production shortfalls. **Defense budget shortfalls are projected to be roughly 38 percent greater than major equipment shortfalls. In the middle case, the shortfall is DM 161 billion, or roughly 19 percent of aggregate spending during the 1990–2005 period.**

Much smaller shortfalls exist under CFE assumptions. A CFE agreement reduces defense budget shortfalls from 19 percent (the estimated middle-case figure in the absence of arms control) to between 9 and 10 percent. (These figures reflect flat defense spending. Real annual decreases, more likely following CFE agreement, result in larger shortfalls.) Further reductions in requirements, such as those planned for subsequent CFE talks, increases in resources, or both, may be necessary to avoid future shortfalls.

Reductions in defense resources after a first-stage CFE agreement may exacerbate shortfalls. For example, **under optimistic first-stage CFE requirements (i.e., a 15 percent reduction in major equipment requirements) and a defense budget decline of 2 percent per year, equipment and defense budget shortfalls increase to DM 118 and 162 billion, respectively. The latter represents a 20 percent defense budget shortfall. To meet CFE requirements in the middle case, the defense budget must increase at an average annual rate of almost 2 percent.**

It is almost certain that conventional arms control agreements and the continued rapid changes in East Germany, including the prospects for unification with the west, will reduce Bundeswehr modernization requirements. Further, the magnitude of pre-CFE shortfalls would probably alarm planners, and they would take steps to modify plans. The 10 percent shortfall following a CFE agreement might not cause planners to make major changes, however; but that shortfall is based on flat budgets that would be unlikely after agreement.

These potentially large shortfalls are also less daunting when placed in a broader economic context. For example, even in the high requirement, low resource case, the projected defense budget shortfall is comparable to a single year of on-budget West German federal expenditures or about one-half of annual federal outlays. This shortfall is even smaller compared with West German GDP, representing less than 1 percent of projected GDP between 1990 and 2005.

Projected shortfalls may have a substantial effect on the West German security debate. In particular, they may accelerate the debate and lead to arguments for large conventional force reductions and correspondingly large budget savings. This will probably intensify the

debate on West Germany's role in NATO, NATO's legitimacy and strategy, and the need for and role of the Bundeswehr.

Projected shortfalls would probably not greatly weaken Germany's commitment to NATO. However, they might increase criticism of the social costs of the Bundeswehr, and that could provide ammunition to advocates of German neutrality. Tighter budgets and projected shortfalls may marginally weaken the German link to NATO.

Bundeswehr restructuring will undoubtedly occur in light of changes in Eastern Europe. However, large shortfalls will probably lead more political leaders to argue for changes in West Germany's grand security strategy.

Reactions by MoD planners will vary largely depending on the emerging security environment and the results of West Germany's security debate. If substantial shortfalls appear likely, planners may be forced to make difficult choices, ranging from stretching out procurement purchases to large personnel reductions and abandoning specific missions. However, MoD plans will probably be influenced more so by changes in Soviet and their Warsaw Pact member defense efforts.

ACKNOWLEDGMENTS

Several RAND colleagues provided helpful comments and encouragement in my researching this report. David Ochmanek, Christopher Bowie, Mark Lorell, and James Wendt commented on earlier drafts. Ronald Asmus and Charles Cooper of RAND gave their formal reviews. Numerous officials and researchers in West Germany and at the U.S. Library of Congress assisted in data collection efforts. Helen Turin assisted greatly in editing this document. An earlier version was submitted to partially satisfy requirements for a Ph.D. at the RAND Graduate School. Dissertation committee members James Thomson, Michael Kennedy, and Kevin Lewis deserve much credit for guidance in the early stages of the research. Any remaining errors are my responsibility.

CONTENTS

FIGURES

TABLES

I. INTRODUCTION

BACKGROUND

West German leaders have recently unveiled carefully constructed and ambitious plans, commonly called Bundeswehr 2000, to modernize military forces in the next several years. Between 1990 and 2005, Bundeswehr 2000 calls for the replacement or upgrading of all main battle tanks, 60 percent of fighter aircraft, and slightly more than one-half of major naval combatants. Substantial modernization efforts for minor equipment, including munitions, are also planned. The financial requirements of these modernization efforts are certain to be large, particularly since replacement equipment is almost always more costly than its predecessors. Requirements appear substantial even with conventional force reduction agreements that cut forces. Planners are currently amending modernization requirements as a result of events in East Germany, the Soviet Union, and Eastern Europe and in anticipation of reductions in Conventional Forces in Europe (CFE); however, in the absence of such reductions, West German leaders appear committed to achieving existing objectives.

Factors Complicating Modernization Efforts

Several factors further complicate West Germany's modernization efforts. A precipitous drop in the number of male youths will make current conscript personnel goals virtually impossible. These factors will also exert strong upward wage pressures for careerists and make careerist personnel objectives both more difficult to achieve and more costly. Increasing personnel costs in turn may reduce defense resources available for investment and jeopardize the acquisition of replacement equipment.

Three political factors in the Federal Republic will also make these modernization objectives more difficult:[1]

- The falling perception of the Soviet threat, strengthened by political and economic reforms in Eastern Europe, especially in the German Democratic Republic (GDR).

[1]For a history of the emerging security debate, see Asmus, 1989. Asmus identifies four changes that have intensified the security debate in the 1980s: the collapse of the security consensus following the Intermediate Nuclear Force (INF) debate, falling perceptions of the Soviet threat, generational change and the move toward more autonomous German foreign and security policies, and a drop in appeal of major parties and the rise of more radical parties.

- The debate over NATO strategy and force structure in light of the falling threat.
- The emerging debate about the need for and role of the Bundeswehr.

The perceived threat from the East has declined consistently in the past ten years and is probably the greatest factor affecting support for modernization plans.[2] In a poll taken just before the dismantling of the Berlin wall, less than one in seven West Germans expressed concern about the threat of a Soviet military attack.[3] Recent events in the GDR, including democratic elections and the relaxation of emigration and travel restrictions, have almost certainly further decreased West German fears. The apparently inevitable reunification of the two Germanys also reduces the threat perception and is certain to alter modernization plans in the long term.[4]

This decrease in threat perception is best understood in a historical context. West German fears of Soviet military action have centered around two very real vulnerabilities. First, of course, was the fear that Soviet control of the GDR and their strong military presence in Eastern Europe might lead to military action against West Berlin.[5] Although Soviet troop presence in the GDR may still provide the opportunity for such action in the immediate future, eventual Soviet troop withdrawals make this increasingly unlikely.

Second, West Germans rightly feared that Soviet domination of Eastern Europe and their stationing of large military forces there provided a convenient staging ground for an attack against the West. Continued Soviet support for reforms in Eastern Europe and the establishment of democratic regimes across Eastern Europe have lessened the Soviet noose around Eastern Europe and, in the eyes of many West Germans, signaled an end to Soviet domination. Recent Soviet unilateral military concessions and the possibility that most, if not all, Soviet

[2]Asmus, 1989, p. 20.

[3]*Frankfurter Allgemeine Zeitung*, 1989c.

[4]Reunification under the so-called "Two Plus Four" plan now appears probable (Lewis, 1990). West German modernization plans will probably change drastically should reunification occur, but it is not clear that this would diminish greatly West German modernization objectives until Soviet forces leave East Germany. (This corresponds largely to the so-called "Genscher" plan, which would ban all non-German NATO forces from current East German territory after reunification and would permit Soviet forces to remain in East Germany pending a negotiated conventional forces settlement.) In any event, West German forces will probably not incur deep cuts for several years, indicating that the Bundeswehr will maintain current modernization plans, adjusted for arms control, in the short term.

[5]There were, for example, four major international crises between 1947 and 1962 over the status of Berlin.

forces will soon quit Eastern Europe have greatly reduced the perceived threat of Soviet military action.[6]

Finally, the high probability of deep cuts in Soviet conventional forces through the CFE process has further decreased the Soviet threat. Rapid progress at the Vienna negotiations and accompanying political commitments from the Soviet Union and the United States to expedite agreements lessen the probability of failed negotiations. First-stage CFE reductions, which include roughly 50 percent cuts in Soviet forces in the Atlantic to the Urals area, would greatly decrease the Soviet threat.

As the perceived threat of Soviet attack has decreased, debate over NATO strategy and structure has increased. In addition, there have been occasional debates about West German membership in NATO, further complicating Bundeswehr modernization goals.

There have been no serious suggestions that the Federal Republic leave the NATO alliance, however. Strong popular support for the alliance continues, including majority support for nuclear weapons.[7] Broad political support for NATO among West Germany's parties also exists, although there has been a decrease in support of NATO forward-defense strategy.

Several factors account for the growing doubts about NATO strategy and structure.[8] West Germans have long been concerned that NATO's adoption of flexible response left them too dependent on the American nuclear guarantee. However, two events in the 1970s and 1980s contributed to the unraveling of the security consensus and greatly increased the debate about NATO strategy. First, the INF debate highlighted the contradictions between security policy and long-term West German political goals with the East, leading left-of-center politicians, particularly Social Democrats, to question underlying NATO strategy. More recently, right-of-center politicians began to question NATO strategy and the value of American security guarantees in the aftermath of the Reykjavik summit and the "double zero" outcome of the INF negotiations. The debate over NATO strategy, force structure, and West German support for NATO is certain to continue as NATO begins discussions on short-range nuclear weapons modernization in 1992.

---

[6]Some recent reports suggest that all Soviet troops will be out of Eastern Europe within five years.

[7]*Bild Zeitung*, 1989. Almost 50 percent support nuclear weapons in the alliance as long as the Soviet Union possesses them; 24 percent favor no NATO nuclear weapons under any conditions. Also see Asmus, 1989, pp. 23, 27–44. For official statements on the importance of West German membership in NATO, see Foreign Broadcast Information Service, 1989c.

[8]See Asmus, 1989, especially pp. 18–26, for background on the initial consensus for NATO strategy and structure and its unraveling.

A growing number of West Germans have also begun to question the need for and role of their armed forces, particularly in light of the decreased threat, the perceived success of Ostpolitik, and a sense that the Bundeswehr is swallowing scarce federal funds.[9] Many West Germans argue that economic and political powers embodied in Ostpolitik are more appropriate international tools than military strength, pointing to recent reforms in the East as evidence of the correctness of this policy. Although West German political parties disagree over the degree of political and economic ties necessary, all believe that greater interaction with the East is appropriate and implicitly suggest a reduced military effort.

Despite this, in 1989, 90 percent of West Germans believed that the Bundeswehr is needed to maintain peace in Europe.[10] Defense Minister Stoltenberg has rejected criticism aimed at the legitimacy of the Bundeswehr, arguing that weakening it at the present time ignores the risks of failed reforms in Eastern Europe and in the Soviet Union.[11] Stoltenberg argues further that equal forces in NATO and the Warsaw Pact are critical to European stability and the emergence of a common Europe in the coming decade. Despite this agreement on the need for the Bundeswehr, disagreement continues over specific roles and missions.

Broad agreement exists that the future of the Bundeswehr will be largely determined by changes in the Soviet Union and Eastern Europe.[12] Even the most conservative political elements acknowledge that existing modernization efforts were developed under different circumstances. In particular, modernization plans were developed before the arrival of Secretary Gorbachev when the prospects for German unification and arms control were bleak. Major changes now look inevitable; in fact, changes in modernization plans have been announced in anticipation of CFE agreement.[13] Until such agreement occurs, West Germany will continue to pursue existing modernization efforts.

---

[9]As Sec. III explains, West German defense spending occupies about one-tenth of all (i.e., on-budget and off-budget) federal outlays.

[10]*Welt am Sonntag*, 1989.

[11]Foreign Broadcast Information Service, 1989e. Also see *Frankfurter Allgemeine Zeitung*, 1990a.

[12]For recent official statements on the effects of the decrease in the Soviet threat on the Bundeswehr, see Presse- und Informationsamt der Bundesregierung, 1989; Foreign Broadcast Information Service, 1989c.

[13]See Sec. V for a summary of recently announced changes in the Bundeswehr.

The Importance of Modernization

West Germany will for the immediate future remain the most critical European player in NATO's defense strategy.[14] (This will remain so as long as Soviet forces are in Eastern Europe and regardless of the outcomes of reforms in the East, CFE, and German reunification.) The German Army [Heer] supplies about 50 percent of NATO's ready land forces, 60 percent of its ready tanks, and 67 percent of all ground-based air defense.[15] The German Air Force [Luftwaffe] provides 30 percent of NATO's tactical aircraft, while the German Navy [Marine] provides 30 percent of north and west European NATO member naval forces. The navy is particularly important in the Baltic Sea, where it contributes 70 percent of NATO's total sea forces and 100 percent of NATO's sealift forces.

Skepticism regarding West Germany's ability to achieve its modernization objectives is not limited to outside observers. Many observers, including some within the MoD, have suggested that major financial constraints will lead to reductions in or cancelations of modernization programs in the 1990s.[16] Arms control agreements may substantially decrease modernization requirements and lead to a more optimistic appraisal of West Germany's ability to meet its objectives. However, a first-stage CFE agreement that marginally reduces NATO forces may only modestly improve the chances of achieving modernization objectives.

The Federal Republic of Germany (FRG) remains committed to a strong defense and to the alliance. As noted above, a majority of members of all political parties continue to support FRG membership in NATO. Similarly, West Germany's military forces continue to be well regarded in terms of capabilities, readiness, and equipment. However, increasing economic, demographic, and political pressures are certain to undermine modernization efforts.

Identifying the FRG's modernization objectives permits U.S. and NATO planners to coordinate long-term military and weapon acquisition strategies. This results in a more efficient use of defense resources and permits long-term planners to carefully orchestrate changes in

---

[14]Continued reforms in Eastern Europe, especially in the GDR and the Soviet Union, will probably decrease the relative importance of the German contribution in the long term.

[15]For information about service contributions to NATO, see Presse- und Informationsamt der Bundesregierung, 1988a.

[16]Most concern centers on the high costs of German participation in the European Fighter Aircraft (EFA) and the Panzerabwehrhubschrauber (PAH-2) programs. Some have suggested that as many as 100 other programs may have to be canceled if Germany maintains its commitment to EFA. See Aviation Advisory Service, 1987; Thelen, 1988; *Current News*, 1987a; *World Weapons Review*, 1988.

strategy in advance. Similarly, U.S. and other NATO planners are more able to react in a timely manner to uncertainties in the planning process and to more effectively coordinate long-term NATO policies.

Identifying potential problems in achieving modernization objectives may highlight approaching difficulties in long-term planning, and this may encourage rationalization, standardization, and other efficiency measures.

APPROACH

This report compares the financial requirements of achieving Bundeswehr modernization goals with a range of projected budgetary resources. The financial requirements of major equipment production and projected resources are estimated for two cases: in the absence of conventional arms control in Europe and following a CFE agreement.

- The study identifies major equipment and financial requirements necessary to meet modernization objectives.
- An analysis of historical defense budget data and aggregate economic trends establishes a range of likely defense budget resources.
- The study develops a model of the West German defense budget to project future resources for major equipment requirements.
- The financial requirements of major equipment modernization are compared with projected resources for such items and the implications of imbalances are examined.

STRUCTURE

Section II summarizes Bundeswehr modernization goals to the year 2005, starting by outlining modernization goals embodied in Bundeswehr 2000. Based on this restructuring, it identifies missions and major equipment assets of West German armed forces today and estimates major equipment replacement rates and costs. Section III forecasts a range of aggregate defense budget resources. Section IV offers a model of the West German defense budget, estimates future funding available for the production of major equipment items, and compares requirements for the production of major new equipment items with these funding levels. Section V examines changes in West German requirements and resources under conventional arms control scenarios. Section VI discusses the resource-requirements imbalance. Section VII examines the effects of shortfalls on the West German security debate

and describes how West German central planners might react to defense budget shortfalls. It briefly discusses the implications of these actions for West German, U.S., and NATO defense policy and planning and their influence on the West German security debate.

II. MISSIONS, MAJOR EQUIPMENT, AND MODERNIZATION OBJECTIVES

PLANNING CONSTRAINTS

Bundeswehr planners have recognized increasing pressures on the West German military structure for several years. This pressure originates from West Germany's shrinking cohort of draft-age males and the realization that today's military manpower levels cannot be maintained under current manpower policies and conscription laws. Political pressures outlined above have also influenced defense planning. However, additional constraints *and opportunities* have had a major influence on long-term West German defense planning.

There is a recognition that West Germany's military future must remain nonnuclear. Germany's history and rising public opposition to nuclear power and nuclear weapons require this course. Even as the Soviet threat decreases, MoD planners recognize the need to structure forces that diminish the danger of a short-warning Warsaw Pact attack and provide a credible forward defense. Bundeswehr planners expect continued modernization of Soviet forces in the 21st century, forcing planners to modernize Bundeswehr units. Planners also recognize that economic constraints, based in part on competition from other federal expenditure programs such as health and social security, may limit increases in defense spending. This has led to widespread concerns that available defense resources may not increase in real terms in the 1990s and early 2000s. Finally, technical opportunities and expected technological breakthroughs, primarily in the areas of sensors, communications equipment, and deep strike weapons, have greatly influenced Bundeswehr planning.

MODERNIZATION GOALS IN THE ABSENCE OF ARMS CONTROL

These constraints and perceived opportunities have led the Bundeswehr to explicitly state conditions necessary to achieve Bundeswehr 2000 goals:[1]

[1]Presse- und Informationsamt der Bundesregierung, 1988c.

- Centralized expenditures for common missions, including reconnaissance, radio signal communications, and air transport.
- Elimination of overlapping missions and the clear definition of service responsibilities.
- Lowering of operations expenditures through increased use of simulation.
- Avoidance of unexpected real cost growth in weapons procurement by freezing weapon specification in the development phase and establishing price ceilings.
- Consistent and more efficient use of existing weapons platforms to increase fighting power.

ARMY

Army modernization objectives emphasize several important changes in future composition and the army's role in West Germany's defense effort. The highlights include:

- Greater reliance on technology, especially the development of sensors, drones, command and control capabilities, accurate long-range artillery, and defensive systems.
- Greater emphasis on mobility, including the creation of two air-mobile divisions.
- Greater emphasis on deep operations and the increased use of barriers.
- Clear division of responsibilities between the army and the air force. The army will be responsible for operations up to 100 kilometers from the Forward Edge of the Battle Area (FEBA), and the air force will be responsible for operations beyond 100 kilometers.[2]
- Decrease in the levels of readiness (accompanied by a greater reliance on reserves).[3]
- Decrease in the number of year-round active personnel to 318,000 and an increase in the number of active-duty equivalent personnel (i.e., various reserve categories) to 26,000.[4]

[2]Defense Marketing Service, 1989.

[3]The Army will have about 17,000 fewer active soldiers under the new structure, and readiness levels will fall from 90 percent today to between 50 percent and 70 percent. *Wehrtechnik*, 1988i.

[4]Flume, 1988c

Army Structure Changes

Substantial changes in the army structure are planned, including changes in both the Field and Territorial Army. These changes are apparent primarily at the division and brigade levels and are summarized in Table 1.

The Field Army structure scheduled to be implemented in 1991[5] will continue to be based on three Corps: the First Corps in Münster (NORTHAG), the Second Corps in Ulm (CENTAG), and the Third Corps in Koblenz (CENTAG). The Third Corps will continue to be smaller than the first or second. Each of the larger corps will maintain one air-mobile division, while the third will receive a mixed air-mobile brigade.[6] Each corps will operate target acquisition drones,[7] CL-289 reconnaissance drones, attack drones,[8] and LAPAS airborne reconnaissance aircraft by the late 1990s.[9] Each corps is expected to operate multiple-launch rocket systems (MLRSs) in conjunction with these reconnaissance assets, and each will maintain PAH-1 attack helicopter regiments, BO-105M and Alouette scout helicopters, as well as UH-1D and CH-53G transport helicopters.[10]

The new army structure will continue to consist of 12 divisions, although there will be some important changes in division types. Most notably, there will be a decrease from 12 to 10 mechanized divisions and an addition of two air-mobile divisions.[11] The air-mobile divisions in the First and Second Corps will operate one brigade of attack helicopters. These will include PAH-1 and PAH-2 attack, escort, and scout helicopters. The divisions will also contain one air-mechanized brigade with two paratrooper and two air-mechanized battalions, one medium and one light helicopter regiment.[12] The composition of the mixed air-mobile brigade planned for the Third Corps closely parallels these air-mobile divisions. The army's increased emphasis on mine warfare will probably lead to the strengthening of the engineer battalions in each division. Reconnaissance drones and MLRS artillery will be posted to each division.[13]

---

[5]Haasler, 1988b. If the Soviet threat continues to fall and the prospects for conventional force agreement continue to be favorable, this date and Bundeswehr 2000 structure may change considerably.

[6]The composition of the mixed air-mobile brigade is discussed below.

[7]Haasler, 1988b.

[8]Flume, 1988c; Haasler, 1988b.

[9]LAPAS aircraft will be operated by the Luftwaffe.

[10]*Wehrtechnik*, 1988e.

[11]Haasler, 1988b.

[12]Flume, 1988c; Csoboth, 1988.

[13]Flume, 1988c. Haasler, 1988b. Drones may be posted at the division and corps levels.

Table 1

ARMY STRUCTURE

	Current Structure	Structure 2000
Field Army (brigades)		
Tank	17 3 tank btn 1 mechanized btn 1 artillery btn	16 2 tank btn 2 mechanized btn 1 artillery btn
Mechanized infantry	15 3 mechanized btn 1 tank btn 1 artillery btn	12[a] 2 mechanized btn 2 tank btn 1 artillery btn
Light infantry	0	5 4 infantry btn 1 engineer btn 1 artillery btn
Mountain	1 4 mountain btn 1 artillery btn	1 4 mountain btn 1 artillery btn 1 tank btn
Rear-area security		2 5 rifleman btn
Airborne	3 4 airborne btn	2 2 paratrooper btn 2 air mechanized btn
Attack helicopter	0	2
"Mixed" air-mobile	0	1 1 air-mobile mechanized btn 1 paratrooper btn 1 mixed transport regiment
Territorial Army (brigades)		
Home-defense	12	0
Home defense regiments	15	15
Franco-German	0	1

[a]Equipment vintage is the only apparent difference between future tank and mechanized infantry battalions.

btn = battalion

The new Field Army structure will result in an increase in the number of brigades from 36 to 42,[14] and an increase in brigade types. The army will contain ten brigade types,[15] an increase of five from the current structure. Twenty-eight of the 42 brigades will be mechanized, a decrease from current levels of 32.

Tank brigades will continue to dominate the army structure, although this represents a slight decrease from the current 17. Tank brigades will consist of two tank battalions, two mechanized battalions, and one artillery battalion, a decrease of one tank battalion and an increase of one mechanized battalion per brigade. Tank brigades in the early 1990s will be equipped with Leopard 2 main battle tanks, replacing remaining Leopard 1 and M-48 tanks currently in operation.[16] All tank brigades will be equipped with the Marder fighting vehicle; slightly less than one-half will acquire the Marder 2, while the remainder will receive upgraded Marder 1 Armored Personnel Carriers (APCs) in the early to mid-1990s. A subsequent purchase of Marder 2 vehicles may occur to equip all brigades. Finally, tank brigades will be equipped with Panther tank destroyers, as well as other reconnaissance armored vehicles.[17]

Twelve mechanized brigades in the Army Structure 2000, representing a decrease from 15 in the current army structure, resemble the composition of planned tank brigades. Mechanized brigades will contain two tank battalions, two mechanized battalions, and one artillery battalion, an increase of one tank battalion and a decrease of one mechanized battalion from current levels. However, these brigades will be equipped with upgraded Leopard 1 rather than Leopard 2 tanks.[18] In all other respects, these brigades will parallel tank brigade structure except mechanized brigades will probably not receive Marder 2 APCs because of budgetary constraints.[19] Structure 2000 includes two types of mechanized brigades whose compositions differ slightly. Each brigade will contain two tank, two mechanized, and one artillery battalion; however, six type 1 brigades will contain four companies per tank battalion, and the remaining six type 2 brigades will contain only three companies per tank battalion.[20]

---

[14]The 42nd brigade should be counted as one-half of a brigade since this is the Franco-German brigade and is not under NATO's direct command.

[15]Flume, 1988c. This includes two types of mechanized brigades.

[16]*Wehrtechnik*, 1988e.

[17]Ibid.

[18]Flume, 1988c.

[19]*Wehrtechnik*, 1988e.

[20]Haasler, 1988b.

Structure 2000 will introduce five light infantry brigades, each with four infantry battalions, one engineer battalion,[21] and one artillery battalion. Infantry brigades will be trained to fight most future battles on foot. In previous structures, infantry battalions had fought primarily from armored vehicles. Infantry brigades will be equipped with nonupgraded Leopard 1 tanks,[22] Panther tank destroyers,[23] and reconnaissance armored vehicles. Infantry brigades will continue to rely on M-113 APCs for troop transport, although these may be replaced by Marder 1s transferred from mechanized and tank brigades.[24] Infantry brigades may receive additional transport helicopter support to increase mobility in the new structure.[25]

The five air-mobile brigades constitute the most radical development. Each air-mobile division in the First and Second Corps will contain one attack helicopter brigade and one air-mechanized brigade. The Third Corps will contain one mixed brigade with both attack helicopters and air-mechanized assets. The attack helicopter brigades in each air-mobile division will be equipped with PAH-1, PAH-2, and escort and scout helicopters[26] and will concentrate on destroying attacking armored equipment. Wiesel armored fighting vehicles transported by UH-1D, NH-90, and CH-53 helicopters are planned for air-mechanized brigades in air-mobile divisions.[27] Air-mechanized brigades will contain two paratrooper and two air-mechanized battalions. The mixed brigade will contain one mixed attack helicopter regiment as well as one mixed transport helicopter regiment, one paratrooper and one air-mechanized battalion.[28]

The establishment of these air-mobile brigades indicates a major shift in battlefield responsibilities from the air force to the army. Specifically, the army will obtain responsibility for counterattacks up to a distance of about 100 kilometers from the FEBA. This transfers responsibility for close-air support and battlefield air interdiction missions from the air force to the army. Army attack helicopters, augmented by army artillery, MLRS, and attack and reconnaissance drones, are expected to provide virtually all combat power up to 100

[21]This is an addition from previous infantry structures, resulting from an increased emphasis on mine-laying. Flume, 1988c.

[22]Haasler, 1988b.

[23]*Wehrtechnik*, 1988e.

[24]This should occur if there is a complete replacement of Marder 1 by Marder 2 in tank and mechanized brigades.

[25]Flume, 1988c.

[26]Haasler, 1988b.

[27]*Wehrtechnik*, 1988e.

[28]Csoboth, 1988; Haasler, 1988b.

kilometers. The air force will perform close-in missions in emergency situations; however, regular air force close support will not exist in the new structure.

Rear-area security, mountain, and the Franco-German brigade[29] complete the new structure. Two rear-area security brigades will contain five light infantry battalions and will operate nonupgraded Leopard 1 tanks. These brigades will operate in the First and Second German Corps only. One mountain brigade with four mountain battalions and one artillery battalion will continue to operate. However, this brigade will be augmented with one tank battalion equipped with Leopard 1 tanks.[30] Mountain brigades will also contain Panther tank destroyers.

The Territorial Army will undergo several important changes in the new structure. The 12 home-protection brigades will be disbanded. (These roles will largely be taken over by rear-area security brigades in the Field Army.) Then, 15 currently unattached home-protection regiments will perform reservist training in peacetime and rear area defense in war; however, their readiness will decrease as the number of active soldiers declines. In a crisis or war, these regiments will be initially staffed by active soldiers but will be rounded out by reservists.

Personnel and Readiness Changes

The shrinking draft-age cohort has led planners to place a greater emphasis on the use of on-duty reserve soldiers to maintain current Bundeswehr active force personnel levels. The army currently maintains 341,000 active soldiers, of which 336,000 are active duty regulars. The remaining 5,000 represent the average number of on-duty reservists on annual training. In the future, the number of active army soldiers will fall to 318,000.[31] Planners expect, however, to use 26,000 ready- or on-call reservists to reach a level of 344,000 soldiers and meet future peacetime requirements levels.

This reduction in the number of active duty soldiers will lead to reductions in army readiness, although West German officials insist that these levels will be adequate against a Warsaw Pact surprise attack.[32] Today's 90 percent readiness rate will drop to between 50

[29]This brigade is technically attached to the Territorial Army.

[30]Flume, 1988c.

[31]Ibid. This level is not expected until 1995.

[32]Not all officials agree with this assessment. See Hubatshek, 1988. Recent assessments indicate that the Warsaw Pact's surprise attack capability has decreased substantially.

percent and 70 percent,[33] as a direct result of decreases in the number of active soldiers. Fifteen of the 28 mechanized brigades in the new structure will maintain three ready battalions (70 percent readiness rate); however, the remaining two battalions in each brigade, although fully equipped, are only 10 percent staffed and will become ready only after the call-up of reserve personnel. For example, a tank brigade with two tank battalions (one ready), two mechanized battalions (one ready), and one artillery battalion (ready) would become 100 percent ready in the following manner. Approximately one-half of the active personnel from the ready tank and mechanized battalions would transfer to the equipped but unmanned tank and mechanized battalions. Thus, all tank and mechanized battalions in this brigade would be 50 percent staffed. Reservists, as they become active, would fill in each battalion until these were 100 percent ready.[34] Planners expect this to occur in a period of less than 48 hours.

Equipment Requirements

Army Structure 2000 indicates a large number of modernization programs, a majority of which concern armored assets.[35] Planners expect several upgrade and modernization programsfor main battle tanks. Figure 1 illustrates the projected composition of main battle tanks to the year 2005. The M-48, used primarily in rear area security brigades in the Territorial Army, will leave the inventory in 1991. About 2,100 Leopard 1 tanks will remain until at least the year 2000, although slightly more than one-half will be upgraded from the current A2/3 status to A5. Upgraded Leopard 1s will operate in mechanized and mountain brigades. Nonupgraded Leopard 1s will remain in service with infantry and rear-area security brigades.[36] Beginning about the year 2000, Leopard 2s should begin to replace Leopard 1s in all nontank brigades. The transfer should occur with the introduction of the KW2000 to tank brigades.[37]

Several changes are also planned for army armored personnel carriers and other armored fighting vehicles (AFVs). Figure 2 summa-

---

[33]Flume, 1988c; and Presse- und Informationsamt der Bundesregierung, 1988c.

[34]This reliance on ready reserves has also led army planners to increase the number of officers in each company from two to three. Flume, 1988c.

[35]At the time of this writing, it appears that a unified Germany might acquire equipment currently in use in the East German military services. This could affect its long-term modernization objectives and equipment requirements.

[36]These will also operate from rear-area security regiments.

[37]KW2000 is sometimes called KW 90. It is unlikely that the KW2000 production run will be sufficient to replace all Leopard 2 tanks in tank battalions before 2005.

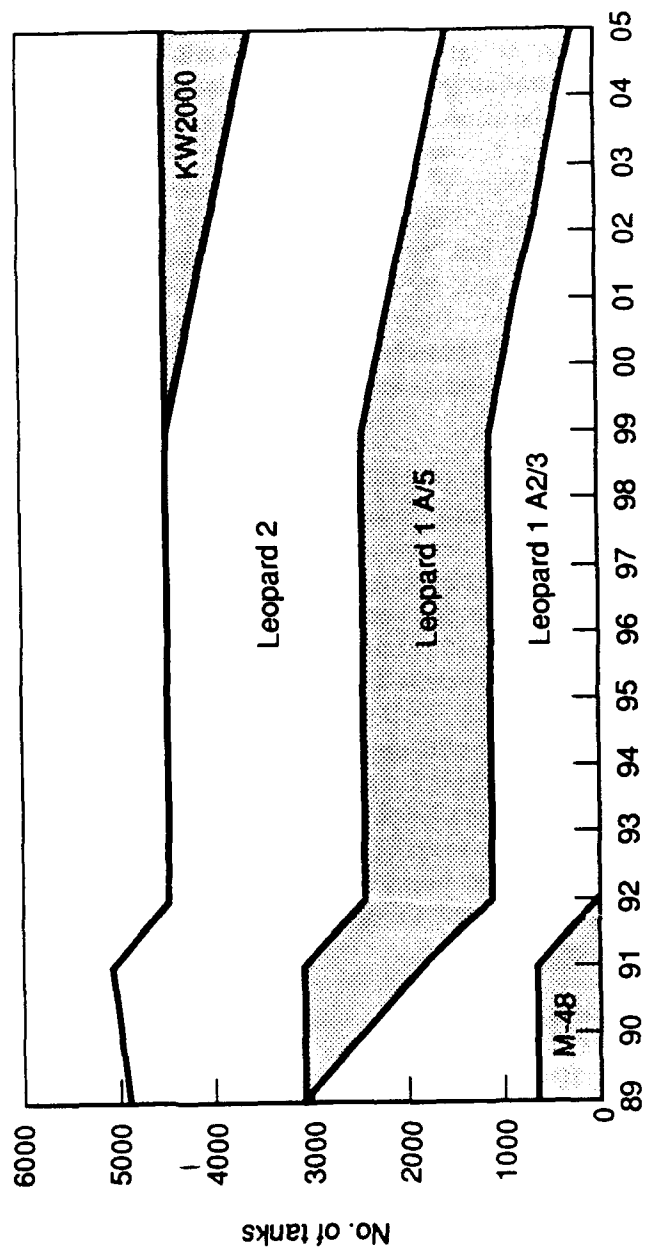


Fig. 1—Projected composition of main battle tanks

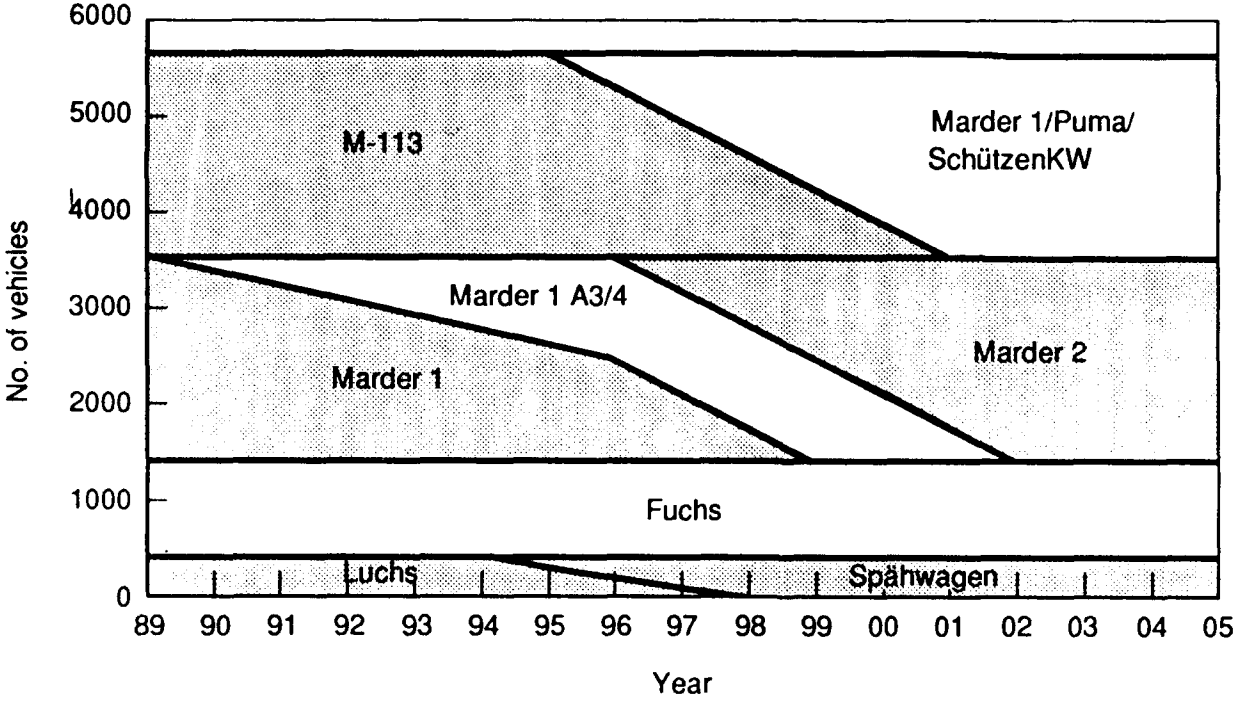


Fig. 2—Projected composition of major AFV/APCs

rizes the changing composition of major APC/AFVs until 2005.[38] Beginning in 1989, approximately one-half of the Marder 1 A1/2 vehicles currently in tank and mechanized brigades will be upgraded to the A3/4 version. Upgraded Marder 1s will probably remain in tank brigades, while nonupgraded Marder 1s will remain in mechanized brigades until the middle of the 1990s. In 1996, the first production order of 841 Marder 2 AFVs is scheduled to enter the tank brigade inventory, replacing the Marder A3/4 version, which will then probably replace nonupgraded Marder 1s in mechanized brigades. An additional production run of more than 1,000 Marder 2s will be required to replace remaining upgraded Marder 1s in mechanized brigades. The requirement for Marder 2 totals about 2,100.

The army also hopes to replace several other armored assets. The M-113, which currently serves as troop transport, should be replaced by either the Marder 1, Puma, or Schützenkampfwagen. (Marder 1 replacement will occur only if there is a purchase of 2,100 Marder 2s, allowing the transfer of Marder 1 to replace the M-113.) Production of the Puma or SchützenKW, should the MoD decide on a new armored vehicle, should begin in 1996 and require a total production run of 2,100.[39] The army also plans to replace the Luchs reconnaissance vehicle in the mid-1990s, although the exact replacement equipment remains unspecified. This will require a production run of more than 400 armored reconnaissance vehicles. Finally, the introduction of airmobile brigades should lead to the purchase of more than 300 Wiesel AFVs. Additional equipment requirements include purchases of armored engineering and mountain vehicles in the early 1990s, including Pioneerpanzer 2, Bergepanzer 3, and the Keiler Minenräumpanzer. No replacements or modernization programs are apparent for the Fuchs transport or M-577 command post vehicles.

Artillery modernization plans center on the PH2000, the army's planned family of howitzers, and the MLRS. PH2000 should replace FH-70 and M-109G 155 mm howitzers beginning in 1995 and 2000, respectively. PH2000 will replace the latter only after an upgrade program, now scheduled for the early 1990s. The total requirement for the PH2000 is more than 1,000.[40] Additional MLRS production should allow the army to replace its Lance and LARS systems in the next few years.

---

[38]It excludes Wiesel, Pioneerpanzer 2, Bergepanzer 3, and other armored assets with a total purchase of less than 200.

[39]As Table 4 indicates, the army may choose to replace M-113 with Marder 1 rather than purchase the Puma or Schützenkampfwagen. Since the Marder 2 will not enter the inventory until 1996, I have assumed that the M-113 replacement (Marder 1, Puma, or Schützenkampfwagen) enters in 1996.

[40]Geisenheyner, 1987b.

A great deal of emphasis has been placed on the development of the army's attack drone KDrH. Analysis has led planners to believe that the KDrH is more efficient than continued use of aircraft in attacking targets within 100 kilometers of the forward line of own troops (FLOT). This drone will augment artillery in attacking targets beyond the range of MLRS. An initial purchase of at least 4,000 drones is planned.[41]

The MLRS and KDrH will require the purchase of two new tactical reconnaissance systems. KZO and CL-289 drones are designed to provide real-time or near real-time target acquisition data to commanders. The KZO will be a division asset and will operate as a target designator for MLRS at ranges of up to 50 kilometers. The CL-289 will be a corps asset and will provide data at ranges of up to 100 kilometers.

The army also plans to modernize its tank destroyer armored vehicles and other anti-tank weapons. Armored tank-killers Jaguar 1 and 2 will also be replaced in the mid-1990s by Panther,[42] which is based on a Leopard 1 chassis. A replacement of Milan, HOT, and perhaps TOW anti-tank weapons by Trigat-3 (also referred to as PARS) is scheduled. Trigat-3 will be produced in two variants: the medium-range (MR) version (2,000 meters) will replace Milan in ground units, while the long-range (LR) version (4,000 meters) will replace HOT and TOW. These systems should enter service in the mid- to late 1990s.

The army plans a modernization of its air defense equipment, including Stinger replacement of Redeye. Stinger will operate from Panther and from attack and observation helicopters. Roland systems, placed on a Marder chassis, will be upgraded in the mid-1990s. Roland systems will also probably augment or replace other close-in defense systems such as the RH202. Gephard will be upgraded in the mid-1990s as well.

The army's increased emphasis on air-mobile operations, including the establishment of two air-mobile divisions, will probably increase helicopter requirements in the 1990s and early 2000s, which should lead to a considerable number of upgrades and replacement programs for army helicopters. Figure 3 illustrates the future projected composition of army helicopters to 2005. BO-105M and SA-318 Alouette aircraft should remain in service as scout helicopters until about 2005, although a replacement of the Alouette force may be required near the year 2000. A replacement for some BO-105M helicopters is probable if the army proceeds with plans to modify 54 existing BO-105M aircraft

[41]Defense Marketing Service, 1989.

[42]Panther will be equipped with Pars-3LR and Stinger and will have both anti-tank and anti-helicopter missions.

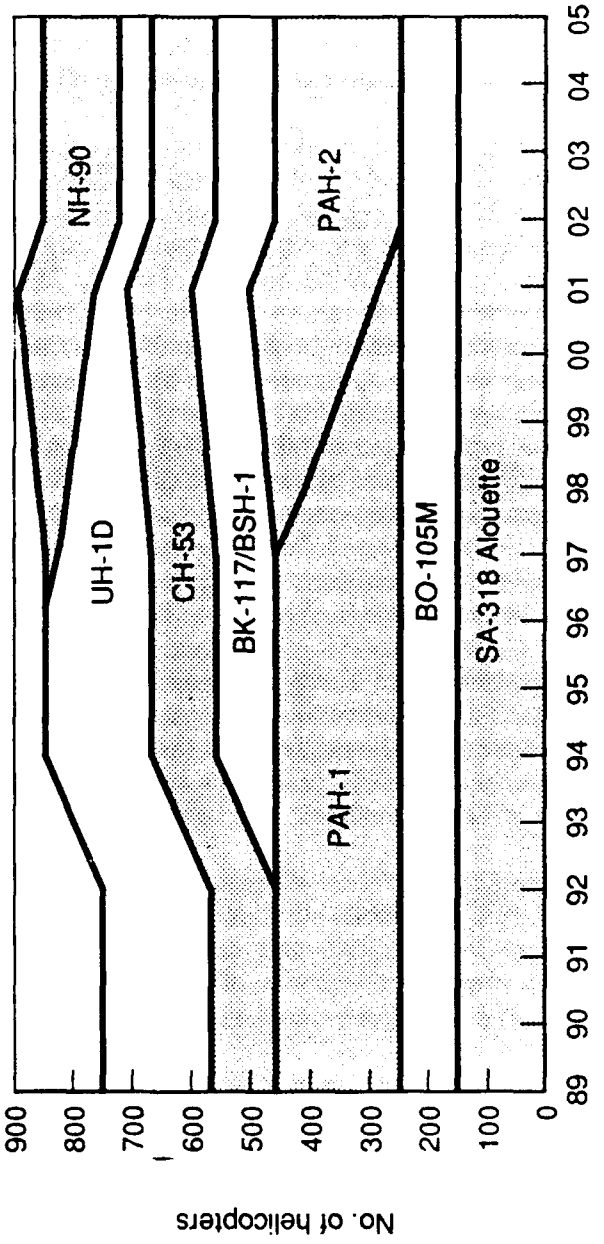


Fig. 3—Projected composition of German Army helicopters

to escort PAH-2 anti-tank helicopters.[43] Further, the army expects to begin operations in the late 1990s with the PAH-2 anti-tank helicopter.[44] In the near term, the PAH-1 will be upgraded pending the introduction of the PAH-2. The cooperative PAH-2 venture with France will lead to the production of 212 PAH-2 helicopters to replace PAH-1s now in service. Also, the army plans to introduce either upgraded PAH-1 helicopters or the BK-117 in an escort role in the late 1990s. These will operate with PAH-2 anti-tank helicopters. In addition, the army expects to maintain its medium- and heavy-lift transport helicopters, although the establishment of two air-mobile divisions will lead to additional transport helicopter requirements. Some UH-1D helicopters will be upgraded in the late 1990s, although most will be retired by 2005; the NATO helicopter 90 (NH-90) should augment the UH-1D.[45] No replacements are scheduled for CH-53 helicopters until 2010.

Table 2 summarizes current major army equipment, replacement, and modernization programs planned for the 1990s and 2000s and estimates the production costs of army equipment. The total production costs of army modernization are DM 56 billion, expressed in DM 1987.

AIR FORCE

The German Air Force will also undergo several changes in Bundeswehr 2000. The high points include:

- The transfer of responsibility for operations within 100 kilometers of the FEBA to the army. Support of land operations inside this boundary will be limited to emergency situations.[46]
- An increased emphasis on attacks against air and land forces in deep operations.
- An increased emphasis on real- and near-real-time tactical reconnaissance efforts and electronic warfare capabilities.

---

[43]This assumes that the army purchases BK-117 instead of upgrading BO-105M to escort roles. See Table 4.

[44]The introduction of PAH-2 may be delayed, although its eventual procurement is expected even under the changing security environment. *Süddeutsche Zeitung*, 1989.

[45]Ibid. All NH-90 procurement plans, including those for the navy and air force, may be postponed following a CFE agreement.

[46]Presse- und Informationsamt der Bundesregierung, 1988c.

Table 2

GERMAN ARMY EQUIPMENT
(Millions of DM 1987)

Current Equipment	No.	Average Age	Replacement Equipment	No.	IOC	Unit Cost	Total Cost[a]	Costs, 1990–2005
Tanks								
M-48	650	24	None[b]					
Leopard 1	2,437[c]	18	Leopard 2[d]	250	1991	4	1,000	500
			Upgrades[e]	1,300	1988	1.27	1,650	825[f]
			Leopard 2[g]	1,800	2000	0[h]	0	0
Leopard 2	1,800	3	Upgrades[i]	1,800[j]	1992	1.27	2,285	2,285
			KW2000[k]	2,100[l]	2000	6	12,600	12,600
AFVs/APVs								
Marder 1[m]	2,136	15	Upgrades[n]	1,038	1989	.5	520	390
			Marder 2[p]	2,100[q]	1996	5	10,500	10,500
M-113	2,100	20	Puma[r]/SchützenKW/Marder 1[s]	2,100	1996	0[t]	0	0
SPz-2 Luchs	408	12	Spähfahrzeug	408[u]	1995	.7	285	285
TPZ-1 Fuchs	996[v]	5	None					
M-577 Command Post	220	24	None					
Krake 640	200		Wiesel	343	1991	.73	250	175
			Pioneerpanzer 2	140	1991	2	280	280
			Bergepanzer 3	50	1992	2	100	100
M548 Skorpion	300	3	None					
			Keiler Minenräumpanzer[w]	200	1992	2	400	400
Artillery								
M114 155 mm howitzer	587	25	None					
M101 105 mm howitzer	190	25	None					
FH-70 155 mm howitzer	215	8	Panzerhaubitze 2000	314	1995	3	940	940
M-109G SP 155 mm howitzer	586	NA	Panzerhaubitze 2000	940[x]	2000	3	2,820	2,820
			Upgrades to M109A3G	860	1990	.2	170	125

Table 2—continued

Current Equipment	No.	Average Age	Replacement Equipment	No.	IOC	Unit Cost	Total Cost[a]	Costs, 1990–2005
M-107 SP 175 mm howitzer	140	NA	Upgrades to M110	140	1992	.2	280	210
M-110A2 SP 203 mm	226	NA	None					
LARS 110 mm	209	17	MLRS	180	1989	8.9	1,600[y]	800
MLRS	2	2	None					
Lance	26	NA	MLRS	20	1989	8.9	180	90
			Kampfdrone (KDrH)[z]	4,000	1998	.25	1,000	1,000
Reconnaissance								
			CL-289[aa]	188[bb]	1992	8.5	1,600	1,200
			KZO drone[cc]	13[dd]	1995	7.7	1,000	1,000
Anti-tank								
JPz-4-5 SP	120	22	None					
106 mm	105	NA	None					
Milan	2,100	12	Trigat-3MR[ee]	400[ff]	1994	2.33	935[gg]	935
HOT	1,450	7	Trigat-3LR	1,224	1998	3.36	4,115	4,115
TOW	177[hh]	11	None					
RPZ Jaguar 1	316	20	Panther[ii]	200	1995	4	800	800
RJPz Jaguar 2	250	20	Panther	200	1995	4	800	800
Air Defense								
20 mm RH202 towed	1,874	NA	Roland 2[jj]	NA	1990	NA[kk]	0	0
35 mm Gephard SP	432	NA	Wildcat Twin/Gepard 2	432	1994	4.6	2,000	1,800
40 mm L-70 Bofors	710	NA	None					
Redeye	723	NA	Stinger[ll]	3,400[mm]	1990	.45	1,530	1,225
Marder/Roland	143	7	Roland 2[nn]	143	1989	1.5	400	300
Air Assets								
SA-318 Alouette	148	16	None[pp]					
BO-105 M[qq]	100[rr]	6	None					

Table 2—continued

Current Equipment	No.	Average Age	Replacement Equipment	No.	IOC	Unit Cost	Total Cost[a]	Costs, 1990–2005
PAH-1[ss]	209	6[tt]	Upgrades	209	1993	5.8	1,200	600
			PAH-2	212	1998[uu]	10	6,000[vv]	6,000
			BK-117	100	1993	2.8	280	280
			BSH-1[ww]	54	1993	5	0[xx]	0
CH-53D/G	107	13	None[yy]					
UH-1D	185	15	Upgrades	55	1997	3	165	165
			NH-90[zz]	130[aaa]	1997	17[bbb]	2,210	2,210
Total								55,755

SOURCES: Unless otherwise indicated, data based on Defense Marketing Service, 1989; IISS, 1988; *Jane's Armour and Artillery*, 1988; *Military Technology*, 1989; Haasler, 1988a, 1988b; Flume, 1988c; *Wehrtechnik*, 1988i; Schneider, 1986; or author's estimates.

NOTE: IOC = Initial operational capability.

[a]Some numbers are rounded.

[b]100 may be converted to armored recovery vehicles. However, most will probably be sold or given to other NATO members. 150 are destined for Turkey, 75 for Greece; Denmark is interested in purchasing 110.

[c]These are in tank, mechanized, and rear-area brigades. Replacements are likely for tank and mechanized divisions only since rear-area brigades are being disbanded.

[d]Replacing remaining Leopard 1 tanks in tank brigades. This should be sufficient to equip all tank battalions with Leopard 2 in the late 1990s.

[e]Short-term upgrade to A5 only for Leopard 1 tanks in mechanized, infantry, and mountain brigades. (Leopard 1s in infantry and rear-area brigades and regiments will not be upgraded.) These tanks will operate until about the turn of the century. After the year 2000, Leopard 2 tanks will replace Leopard 1s in mechanized, infantry, and mountain brigades and the KW2000 will in turn replace Leopard 2s in tank brigades. Initial plans called for 1,845 upgrades.

[f]Although the in-service date is 1988, one-half of the expenditure will fall after 1989.

[g]These Leopard 2s, currently in tank battalions, will replace Leopard 1s in mechanized, infantry, and mountain battalions with the introduction of the KW2000.

[h]These Leopard 2s are already in the inventory.

[i]Upgrades include command and survival features.

Table 2—continued

[j]The last two batches of Leopard 2s may not be upgraded.

[k]Replacing Leopard 2 in tank brigades beginning in about 2000. Earlier designated Leopard 3 and KW90.

[l]One-for-one replacement. An additional requirement in the long term for about 1700 KW90 may exist to replace all Leopard 1s and M-48s. This will result in a force of approximately 2,050 Leopard 2 and 3,000 KW90 main battle tanks. DMS reports a total of 5,000 KW90; 1,700 anti-tank vehicles, 800 anti-tank/anti-helicopter, and 2,500 mobile infantry combat vehicles (MICVs). The MoD may buy Marder instead of KW90 as a cost savings measure.

[m]In mechanized and tank brigades.

[n]Upgraded to A3, A4 in the short term. These will initially go to tank brigades but will eventually be replaced by Marder 2 in 1996. These upgrades will then be moved to mechanized brigades until additional Marder 2s are ordered.

[p]The initial production run of these should replace upgraded Marder 1 A3/4 vehicles in tank brigades.

[q]Current plans to order 841, although the total requirement over the 1989–2005 period is 2,100 if all Marder 1s are to be replaced.

[r]Proposed by industry, although procurement now seems unlikely.

[s]May be replaced by some Marder 1s if sufficient Marder 2s are purchased to replace Marder 1s in mechanized brigades. This would greatly reduce the production run requirement and production costs. There is some discussion of Fuchs replacing M-113, although this seems unlikely.

[t]Assumes sufficient purchase of Marder 2 to allow transfer of Marder 1 to this role. If the Marder 2 purchase is not sufficient to allow transfer of Marder 1 to replace M-113, the cost savings from a smaller Marder 2 purchase are almost exactly offset by the requirement to purchase Puma or a SchützenKW. Thus, the total requirement in both cases is comparable.

[u]One-for-one replacement.

[v]504 are basic transport, 87 as electronic equipped (EloKa), 265 as radio (Funkfahrzeug), and 140 as ABC (Nuclear, Biological, and Chemical protection). *Wehrtechnik*, 1988b, p. 110.

[w]Will augment Skorpion.

[x]This represents the total PH2000 outlays and includes the eventual replacement of the M-109 as well. Geisenheyner, 1987b.

[y]Total MLRS buy. Includes 202 SPLL (self-propelled launcher vehicles), 65K Phase I rockets, 20K Phase II rockets, and 15,800 training rockets.

[z]This will attack armored targets beyond the range of MLRS out to 100 km. *Wehrtechnik*, 1988f.

[aa]Collaborative program with Canada and France. Operated from corps level (up to 150 km) and thus does not directly replace Luchs or other reconnaissance assets. CL-289 range to 70 km. CEFAMOS, designed by Dornier, is also discussed as an additional reconnaissance drone.

[bb]11 systems with 188 drones. Destined for corps and division artillery.

[cc]Surveillance, target acquisition to 50 km (division level), primarily for MLRS, although data for MLRS operations will also be provided by CL-289.

Table 2—continued

[dd]Initial production run of 13 systems and 130 drones.

[ee]Helicopter and ground launch variants. Medium-weight variant to replace Milan.

[ff]Launchers. DMS reports 22,050 medium-variant missiles.

[gg]Total Trigat (MR and LR) development costs for all participants are DM 2.5 billion. Germany's share may be near DM 500 million. Lenorovitz, 1988.

[hh]Number of launchers. Approximately 20,000 missiles have been ordered.

[ii]Panther based on Leopard 1 chassis. Will be used in tank and mechanized infantry battalions. Initially HOT then PARS-3LR equipped.

[jj]Provides close-in defense, previously provided only by RH202. Foss, 1987.

[kk]Assumes all expenditure in Roland 2 category shown below.

[ll]Stinger will be placed on BSH-1, PAH-2, and Panther.

[mm]This includes Stinger on BSH-1, PAH-2 helicopters, Panther, but excludes 1,000 for air force point defense.

[nn]Upgrade. Air force and navy receiving first Roland 2 units.

[pp]Csoboth, 1988, p. 54. The age of Alouettes indicates a possible replacement before 2005.

[qq]M variant operates as scout helicopters and P as PAH-1.

[rr]Some BO-105-M helicopters will probably remain in the scout role, although the total number may decrease if 54 BO-105Ms are modified to serve as BSH-1.

[ss]Also called BO-105Ps. Equipped with Stinger for escort. 200 being upgraded by MBB in late 1980s.

[tt]Aviation Advisory Service, 1982a.

[uu]Mordoff, 1987a.

[vv]Aviation Advisory Service, 1987. Mordoff, 1988 reports DM 9 billion development program cost.

[ww]Joint venture with Kawasaki. Will buy either this or BK-117. Interim solution until the PAH-2 is operational. This helicopter or the modified PAH-1 will fly escort and limited ground attack missions. de Briganti, 1988. Should fly escort and ground attack with PAH-2 to early 2000s, according to Csoboth, 1988, p. 52; Zeilinger, 1988, p. 68.

[xx]Assumes that BSH-1 upgrade from PAH-1 and BK-117 are comparable in cost and Army will purchase only one.

[yy]These will be upgraded and are expected to operate into the early 21st century. *Jane's Defence Weekly*, 1987c.

[zz]This may be postponed following CFE agreement. *Süddeutsche Zeitung*, 1989.

[aaa]At least some UH-1Ds will remain in the inventory until 2008. This accounts for the less than one-for-one replacement by NH-90. Marquitan, 1988, p. 37.

[bbb]Mordoff, 1987a. German share of development costs are DM 1 billion. Flume, 1988a, 1988d; and Honeck, 1988, p. 64.

Structure and Personnel Changes

The current German Air Force structure will change only marginally in the transition to the Bundeswehr 2000. The most important of these changes concerns the transfer of responsibility for close-in operations to the army and the corresponding transfer of Alphajet squadrons to training aircraft.

The Luftwaffe will continue to commit its resources to NATO's 2d and 4th Allied Tactical Air Forces (ATAF). The Luftwaffe also supports NATO's 2ATAF through AIRBALTAP, the allied air forces' Baltic Sea operations.

The number of Luftwaffe divisions (four, consisting of two air defense and two fighter/bomber squadrons) will remain unchanged in the new structure;[47] however, there will be notable changes in the number of aircraft squadrons. The transfer of the seven Alphajet squadrons to a training role will reduce the number of fighter/bomber squadrons. This will be compensated for somewhat by the introduction of two each Tornado IDS and ECR squadrons.[48] The net loss in fighter/bomber squadrons in the new structure is four. Other tactical aircraft squadron totals should remain constant. There are no planned changes in aggregate utility, transport, surface-to-air missiles, and helicopter squadrons in the Bundeswehr 2000.

The air force will face the largest personnel loss under the new military structure. The number of active airmen will fall from about 111,000 to 98,000.[49] An additional 9,000 active duty reservists will bring the active force total to 107,000. Considerable emphasis will be given to personnel savings and the procurement of personnel-saving equipment.

Equipment Requirements

Equipment requirements in the immediate future will concentrate on improvements in systemwide reconnaissance, command and control, and munitions effectiveness.[50] In the long term, many aircraft will be replaced, although in the near term, mostly mid-life upgrades are required.

---

[47]The 1st and 2nd divisions are assigned to 4ATAF; the 3d and 4th, with the exception of one fighter/bomber and one reconnaissance wing assigned to COMAIRBALTAP, are assigned to the 2ATAF. Kuebart, 1988, p. 25. The Luftwaffe is organized into three commands: air fleet, logistic, and administration.

[48]IDS=interdiction and strike; ECR=electronic combat and reconnaissance.

[49]Ministry of Defense, 1987, and Presse- und Informationsamt der Bundesregierung, 1988c.

[50]Wibel, 1988, p. 18.

Major tactical aircraft assets will undergo several changes in the next 15 years. Figure 4 illustrates the projected composition of fighter and attack aircraft to the year 2005.

In the near term, RF-4E reconnaissance aircraft will be upgraded. In about 2000, these aircraft will be replaced by an undesignated aircraft. Tornado ECR aircraft will be augmented in their roles with the introduction of anti-radiation drones (DAR). The introduction of Egrett in the mid-1990s will provide an additional reconnaissance capability.

The most important modernization program planned for the Luftwaffe is replacement of the eight F-4F squadrons. Four squadrons are primarily assigned to perform air defense missions, although they retain some multirole capability. The remaining four perform ground attack missions. In the short term, one-half of all F-4F squadrons will receive mid-life upgrades, including avionics intended to contribute to a future look-down, shoot-down capability. The Luftwaffe is expected to purchase at least 200 EFA to replace these F-4F squadrons.[51] In the long term, an additional 50 EFA are scheduled to be purchased.

The introduction of two additional Tornado IDS squadrons in the early 1990s will compensate somewhat for the eventual transfer of seven Alphajets to training roles. This will increase the number of Tornado IDS squadrons to 12. However, this transfer will decrease the Luftwaffe's close air support and battlefield air interdiction ground attack capability.

Few changes are expected for utility or transport aircraft. The Transall C-160 will shortly undergo a mid-life upgrade and is expected to remain operational until 2010. UH-1D helicopters will be slowly replaced by the NH-90 in the late 1990s, although one-half of the current inventory should be upgraded and available for continued service from the late 1990s. Current plans call for the purchase of 60 NH-90 aircraft. Fokker 614 and Boeing 707 aircraft are likely to be replaced under the new structure, although the costs of these replacement aircraft will be modest, as will replacement costs for utility aircraft, such as Hansa and Do-28.

---

[51]Both the Social Democrats (SPD) and the Free Democrats (FDP) oppose EFA procurement. *Der Spiegel*, 1989; *Frankfurter Allgemeine Zeitung*, 1990a. Complications remain in EFA development. For example, the British prefer a Ferranti radar, while the Germans prefer Telefunken. The aircraft may be produced with different systems for each participant. *Frankfurter Allgemeine Zeitung*, 1990b and 1989b. EFA's less-than-bright future is evidenced in a recent statement by Messerschmitt-Boelkow-Blohm (MBB), EFA's prime German contractor. *Flight International*, 1989, reports the following MBB statement: "The only problem areas are weight, performance, radar, electronic combat equipment, timeframe, and cost."

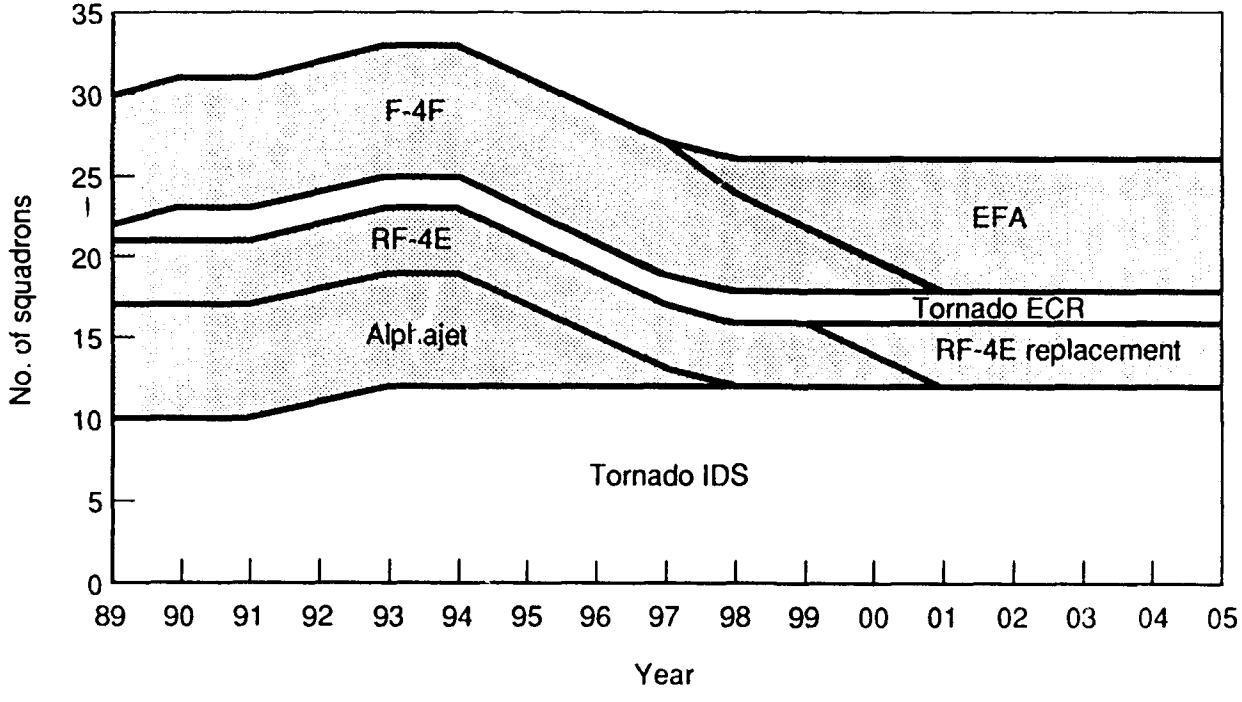


Fig. 4—Projected composition of Luftwaffe fighter and attack aircraft

Surface-to-air missile (SAM) modernization will proceed as Patriot and Roland replace Nike and Hercules. In the long term, M-SAM[52] will replace IHawk SAMs. The costs of these are large, although the United States will bear some of the costs associated with the protection of U.S. bases in Germany.[53] Finally, the Luftwaffe plans to purchase perhaps 1,000 Stinger air defense weapons for point defense.

There are numerous modernization plans for Luftwaffe munitions and missiles. For example, the Luftwaffe expects to purchase more than 10,000 Advanced Medium-Range Air-to-Air Missiles (AMRAAMs) and Advanced Short-Range Air-to-Air Missiles (ASRAAMs).[54] AMRAAM is expected to be operational in 1994, while ASRAAM will become operational near the year 2000. Maverick and AIM-9 Sidewinder upgrades will continue in the early 1990s, equipping F-4F and Tornado aircraft. Finally, the Luftwaffe plans to purchase the Modular Abstand Waffe, (MAW, or MSOW), the Mehrzwechwaffe (MW-1), and the Vertikalbordwaffe (VBW). At least 500 MSOWs will be purchased, while about 1,000 MW-1s are expected to be purchased.

Table 3 summarizes current Luftwaffe equipment, modernization plans, and estimated production costs of modernization. The total production costs of air force modernization are DM 60 billion, expressed in DM 1987.

NAVY

Structure and Personnel Changes

The structure of the German Navy will remain essentially unchanged in the Bundeswehr 2000. This results directly from the navy's continued mission emphasis in the Baltic and in waters surrounding NATO's northern flank.

The navy will retain its air division, including two combat and reconnaissance wings, one anti-submarine warfare (ASW) and maritime patrol wing, and one search-and-rescue (SAR) wing. The navy is also expected to retain its destroyer flotilla with four squadrons, its fast patrol boat flotilla with four squadrons, its submarine flotilla with two squadrons, and several mine warfare and other support units.

---

[52]Also designated Taktischeluftvertiedigungssystem, or TLVS.

[53]These costs to the United States are excluded in the following table, which estimates German SAM modernization costs.

[54]This may be canceled following CFE agreement. *Süddeutsche Zeitung*, 1989.

Table 3

GERMAN AIR FORCE EQUIPMENT
(Millions of DM 1987)

Current Equipment	Squadrons No.	Average Age	Replacement Equipment	Squadrons No.	IOC	Unit Cost	Total Cost[a]	Costs, 1990–2005
Fighter/Attack Aircraft								
RF-4E[l]	4/76	17	Upgrades[b]	4/76	1990	13.2	1,000	300
			Undesignated	4/76	2000	45	3,420	3,420
			Anti-radiation drone[c]	4,000	1995	.16	640	640
			Egrett/Lapas	15[d]	1991	100[e]	1,500	1,500
			Tornado ECR	2/35	1989	90	3,150	2,110
F-4F	8/152	13	Upgrades[f]	4/76	1991	13.2	1,200	600
			EFA[g]	8/250	1998	83[h]	20,750[i]	20,750
Tornado IDS	10/210	6	Upgrades[j]	10/210	1996	13.2	2,770	2,770
Alphajet	7/173[k]	7[l]	Tornado[m]	2/35[n]	1992	75	2,625	1,315
Transport								
C-160D	4/89	19	Upgrades[p]	4/89	1995	4	355	355
Challenger 601	0/7	2	None					
VFW Fokker 614	0/3	12	Undesignated[q]	0/3	1998	3	10	10
B-707-320	0/4	20+	Undesignated[r]	0/4	1991	95	380	380
UH-1D	4/105	15	Upgrades[s]	2/53	1997	3	160	160
			NH-90[t]	2/60	1997	17[u]	1,020	1,020
Utility								
Hansa HFB-320 (ECM)	0/13[v]	12	Challenger 601	0/7	1998	5	35	35
Do-28-D2	0/60	25	Do-328[w]	0/60	1992	3	180	180
Rockwell OV-10B/Z	0/16	19	None					
T-37/8 trainers	0/74	26	Alphajet/other[x]	0/70	1995	15	1,040	1,040
P-149D trainers	0/28		None					

Table 3—continued

Current Equipment	Squadrons No.	Average Age	Replacement Equipment	Squadrons No.	IOC	Unit Cost	Total Cost[a]	Costs, 1990–2005
Surface-to Air Missiles								
Nike/Hercules	216[y]	26[z]	Patriot	14[aa]	1988	285	4,000[bb]	2,000
			Roland[cc]	95[dd]	1988	26	2,470	1,235
IHawk	216[ee]	NA	Upgrades	216	1992	.5	110	110
			M-SAM	43[ff]	2000	150	6,460	6,460
			Stinger	1,000[gg]	1990	.45	450	400
Missiles (Flugkörper) and Munitions								
			HARM	950[hh]	1993	1	1,000	1,000
			ASRAAM[ii]	4,663	2000	.5	2,300	2,300
			AMRAAM	7,963	1994	.6	4,780	4,780
			Maverick B/D/G	1,600	1989	.38	600	400
			MAW	500	1995	3	1,500	1,500
			AIM-9L upgrades	2,800	1989	.39	1,000	1,000
			VBW	1,000	1995	1	1,000	1,000
			MW-1	1,000	1991	2	2,000	1,500
			BAP-100					
Total								60,270

SOURCES: Unless otherwise indicated, data based on Defense Marketing Service, 1989; IISS, 1988; *Military Technology*, 1989; *Wehrtechnik*, 1988d; Kuebart, 1988; Jungkurth, 1988; or author's estimates.

[a]Some numbers are rounded.

[b]This includes improvements in the infrared and data transmission capabilities.

[c]Suppression of enemy air defense (SEAD)/Wild Weasel, electronic warfare, anti-radiation missions.

[d]*Jane's Defense Weekly*, 1988a.

[e]Ibid. Development alone is DM 275 million.

[f]Includes a radar (APG-65) for use with AMRAAM. Amme, 1988, p. 70.

[g]The Luftwaffe is also considering this in a ground-attack role since the Alphajet cancelation. *Jane's Defence Weekly*, 1987b.

Table 3—continued

[h]Aviation Advisory Service, 1988, reports DM 16.5 billion for production cost of 200 or 82 DM million each. *Defense News*. 1988, reports a fly-away cost of DM 83 million.

[i]FRG development share DM 6.7–7.6 billion, Mordoff, 1987a; Clark, 1988. *Der Spiegel*, 1987, estimates DM 110 million program unit cost. DMS reports DM 16.6 billion approved for production and DM 5.8 billion for FRG development share. Development and procurement costs are DM 6.72 and DM 20.8 billion, respectively, for 250 aircraft, including spares and representing a price 20% less than Tornado. *Wehrtechnik*, 1988d, pp. 24–25.

[j]Control and communications upgrade. The recently ordered 2 IDS squadrons will probably not undergo this upgrade.

[k]Aviation Advisory Service, 1979. *Der Spiegel*, 1987, reports 160. Will remain combat operational until the mid-1990s. Amme, 1988, p. 80.

[l]Aviation Advisory Service, 1979, 1982b.

[m]An additional 35 to 60 IDS considered. Mordoff, 1987a; *Current News*, 1987b.

[n]*Der Spiegel*, 1987, reports 30 aircraft.

[p]Undergoing mid-life upgrade LEDA. No replacement to 2010, according to Aviation Advisory Service, 1988. Germany will probably acquire the Future Large Military Transport collaborative project aircraft in about 2010.

[q]A replacement aircraft with more capacity and a longer range is being sought to replace the VFW-614.

[r]Environmental restrictions require replacing these transports. Three of these 707s may be converted to Airborne Warning and Control System (AWACS) trainer/cargo aircraft.

[s]About one-half will be upgraded. The remainder will remain in service until 2005. Flume, 1987, p. 64.

[t]This may be postponed following a CFE agreement. *Süddeutsche Zeitung*, 1989.

[u]Flume, 1988d, using an exchange rate of DM 1.8=$1.

[v]Six ECM, seven training/transport.

[w]This program thus far has no state support.

[x]These are Alphajets, which Tornados will replace. These may upgrade to extend their lifetime as the USAF is doing. *Aviation Week and Space Technology*, 1988.

[y]Three batteries for Nike/Hercules and Hawk.

[z]Amme, 1988, p. 70.

[aa]36 total Patriot fire-control units (plus four maintenance and two training units); the United States is buying 12, but these are German operated; an additional 12 will be operated by Germany, but owned by the United States for 10 years; the last 12 purchased by Germany. *Wehrdienst*, 1988a, p. 1.

Table 3—continued

[bb]This price is for 14 fire units and 800 missiles and includes costs for two training units.

[cc]Will also undergo an upgrade. Sixty-eight fire units will be operational in 1991.

[dd]Sixty-eight Rolands are designated for the Luftwaffe; 27 more will be used by the Luftwaffe to defend U.S. bases in the FRG, and 20 more are destined for the navy; Foss, 1987. Total Roland purchase is 115. *Wehrdienst*, 1988a, p. 1.

[ee]68 firing units and 36 batteries.

[ff]2,700 missiles.

[gg]Based on total Bundeswehr buy of 4,400.

[hh]Purchase for both air force and navy.

[ii]This may be canceled following a CFE agreement. *Süddeutsche Zeitung*, 1989.

The number of on-duty active personnel will fall from 38,700 to 34,100.[55] However, 4,000 active duty reservists will be added.

Equipment Requirements

The German Navy is in need of a modernization program. A majority of major surface combatants are now more than 20 years old. The average age of submarines is 20, and virtually all mine-counter measures vessels (MCMVs) are approaching the 30 year mark. Other equipment, including ship tenders and maritime patrol aircraft, are almost certain to be replaced in the coming 15 years. Figure 5 illustrates the composition of major combatants to the year 2005.

The largest modernization program centers on the major surface combatants. Of the 15 frigates and destroyers currently in service, nine will almost certainly be replaced before 2005. The navy plans to replace its Lütjen, Hamburg, and Köln-class destroyers and frigates in the 1990s. Replacement equipment includes a combination of Type 123 and NFR-90 vessels in the mid- to late 1990s.[56]

The navy also plans to replace one-half of its fleet of Type 205 and 206 submarines. All six Type 205 submarines will be replaced in the mid-1990s with the Type 212. Twelve of the 18 Type 206 submarines will receive upgrades in the mid-1990s; the Type 212 will replace those not receiving upgrades. Modernization plans for minor combatants, including MCMVs, corvettes, and tenders, are incomplete. However, fulfilling the objective of maintaining current force structure indicates the required replacement of up to 85 percent of vessels in this category. Funding has reportedly been budgeted for the replacement of Type 331 and Type 340/1 MCMVs. Type 332 and 342 vessels replacing these should enter service in the early to mid-1990s. Funding has also been approved for the upgrading of the Type 143 and 148 fast attack boats.[57] Additional funding in later years is necessary if the navy is to achieve its modernization goals for other MCMVs and tenders.

Bundeswehr planners hope to modernize or replace some of the aging air assets. Tornado aircraft should operate well into the 21st century; however, replacement aircraft for the Atlantic maritime patrol and Dornier Do-28 aircraft are planned. Several possible replacements for the Atlantic exist, including the P-3 Orion. The NH-90 should

---

[55]Presse- und Informationsamt der Bundesregierung, 1988c.

[56]One Type 122 frigate was in operation in 1989 as indicated in Table 4. NFR-90 procurement may be canceled after CFE agreement. *Süddeutsche Zeitung*, 1989. Britain's recent withdrawal from the program makes procurement increasingly unlikely. However, procurement of a similar ship is expected. de Briganti and Hitchens, 1989.

[57]Ibid. The number of upgrades may be cut in half following a CFE agreement.

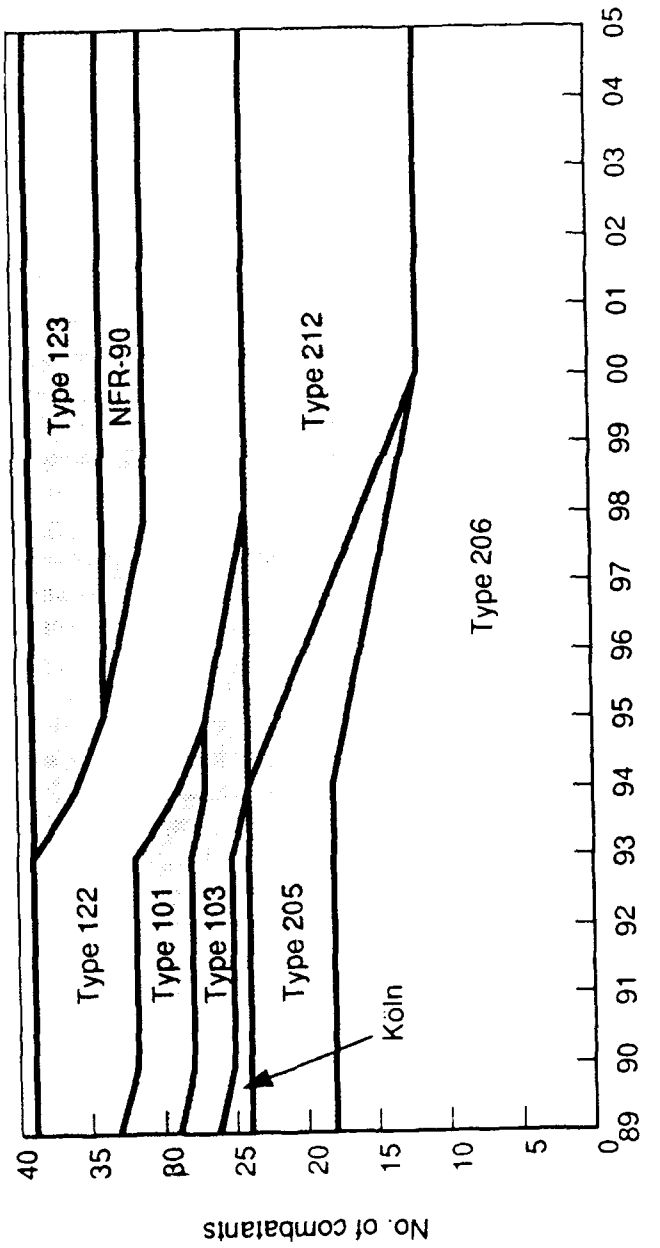


Fig. 5—Projected composition of major German Navy combatants

replace Dornier aircraft, as well as Sea Lynx and Sea King SAR and ASW helicopters in the late 1990s.[58]

The navy also expects to modernize its anti-ship missile inventory. First, the Kormoran 2 should augment or replace existing Kormoran 1 missiles. Second, ANS, RAM, and Seasparrow ship-based anti-ship missiles are planned for the 1990s. Finally, the helicopter-launched Sea Skua is planned for the Lynx helicopters.

Table 4 summarizes German Navy equipment, replacement, and modernization programs, and their production costs. The total production costs of modernization are DM 27 billion, expressed in DM 1987.

TOTAL PRODUCTION REQUIREMENTS AND THE EFFECTS OF UNEXPECTED COST GROWTH

Table 5 summarizes the total financial requirements of modernizing major equipment.

The total production costs of equipment modernization are DM 143 billion. However, as noted previously, these costs are based upon current estimates, undoubtedly understating the eventual financial requirements, since cost growth is common, particularly for systems that have not yet reached the production stage. Cost growth for many of the systems outlined above may be substantial.

One example of unexpected real cost growth is the Tornado aircraft currently operational in the British, German, and Italian air forces. The Tornado has experienced considerable development and production cost growth since 1970; Tornado production costs *in real terms* have increased at an annual rate of 5 percent since 1970.

Studies in West Germany also point toward the likelihood of real production cost growth.[59] For example, in 1984, the general price index for aircraft increased 7.2 percent per year while the general price index rose 2.5 percent. Thus, the unexpected cost increase for aircraft was about 4.6 percent.[60] Aircraft costs increased at three times the rate of goods in the general economy. Previous work at RAND has also demonstrated the likelihood of production cost growth in major systems.[61] Earlier RAND studies reached similar conclusions.[62]

---

[58]Table 6 assumes no Dornier-28D replacement until 2005.

[59]Hartig, 1988, p. 39.

[60]Ibid., p. 40.

[61]For example, a study of 32 major systems in the 1970s demonstrated 5 to 6 percent annual cost growth. Dews et al., 1979, p. 39. This figure represents cost growth beyond full-scale development approval.

[62]Perry et al., 1971. This study of 24 programs in the 1960s showed an average 44 percent increase in costs.

Table 4

GERMAN NAVY EQUIPMENT
(Millions of DM 1987)

Current Equipment	No.[a]	Average Age[b]	Replacement Equipment	No.	IOC	Unit Cost	Total Cost[c]	Costs, 1988–2005
Submarines								
Type 206	18[d]	15	Upgrades	12	1991	110	1,300	1,150
			Type 212	6	1995	300	1,800	1,800
Type 205	6	21	Type 212	6	1995[e]	300	1,800	1,800
Major Surface Combatants								
Lütjens (Type 103B)	3	21	NFR-90	3	1998	450	1,350	1,350
Hamburg (Type 101A)	4	27	Type 123[f]	4	1994[g]	650	2,600	2,600
Bremen (Type 122)	6[h]	7	None					
Köln	2	27	Type 122	1	1989	450	450	0
			Type 123	1	1994	650	650	650
Minor Surface Combatants								
Type 420 Thetis Corvettes	5	26	undesignated	5	1997	100	500	500
Type 351 Troika MCMVs	6	29	undesignated	6	1994	125	750	600
Type 331 MCMVs	12	29	Type 332	10	1992	130	1,300	900
Type 340/1 Schütze MCMVs	19	27	Type 343	10	1992	120	1,200	800
Type 393 Ariadne MCMVs	8	26	undesignated	8	1994	125	1,000	1,000
Type 394 Frauenlob MCMVs	10	21	undesignated	10	1997	125	1,250	1,250
Type 143 Fast Attack	20	13	Upgrades[i]	20	1988	28	550	0
Type 143 A Fast Attack	20	7	None					
Type 148 Fast Attack	20	15	Upgrades[j]	20	1990	28	560	280
Rhein tenders	10	25	undesignated	5[k]	1995	300	1,500	1,500
Lüneberg tenders	8	20	undesignated	4[l]	1998	300	1,200	1,200

Table 4—continued

Current Equipment	No.[a]	Average Age[b]	Replacement Equipment	No.	IOC	Unit Cost	Total Cost[c]	Costs, 1988-2005
Marine Air Assets								
Tornado	4/112[m]	5	None					
Breguet Atlantic 1	2/19	23[n]	P-3, MPS-90	2/18	1994	70	2,165	2,165
Dornier-28D	1/19	25	NH-90/Unspecified[p]	1/19	2005	0	0	0
Sea Lynx								
Mk88(ASW)	1/22[q]	4	NH-90[r]	1/72[s]	1997	35[t]	1,260	1,260
Sea King Mk 41(SAR)	1/20[u]	13	NH-90	1/36	1997	35	1,260	1,260
Missiles (Flugkörper)								
			KORMORAN 2[v]	88[w]	1995	2.9	215	215
			Harpoon	40	1994	20	800	100[x]
			ANS Anti-ship	60	1995	48	2,800	2,800
			RAM Anti-ship	58[y]	1992	28.4[z]	1,650	1,650
			Sea Skua	140	1988	.7	100	25
			Seasparrow RIM-7H	126	1994	1	125	125
			Roland[aa]	20[bb]	1988	26	520	260
Total								27,240

SOURCES: Unless otherwise indicated, data based on Defense Marketing Service, 1989; IISS, 1988; *Military Technology*, 1989; *Jane's Fighting Ships*, 1988; *Wehrtechnik*, 1988[a], p. 53; Hatch, 1988.

[a]Indicates squadrons/number of aircraft for assets.

[b]From launch date.

[c]Some numbers are rounded.

[d]12 being modified to type 206A. Improvements include DBQS-21D sonar, LWU-83 target acquisition system and the DM2A3 torpedo.

[e]Plans for Type 211 have been abandoned because of budgetary constraints; the Type 208 has been abandoned because of technical problems.

[f]Short-term solution until NFR-90 plans are finalized. NFR-90 purchase may replace these.

Table 4—continued

[g]*International Defense Review*, 1988.

[h]Four are operational, the remaining two are undergoing trials.

[i]Includes improved electronic warfare and air defense capabilities. Should be completed this year. Designated Type 143B.

[j]Presse- und Informationsamt der Bundesregierung, 1988c, p. 10. These may not be upgraded following a CFE agreement. *Süddeutsche Zeitung*, 1989.

[k]Assume five are upgraded at a minimal cost and the remaining five are replaced.

[l]Four will be refitted, the remainder will be replaced in the 1990s.

[m]Aviation Advisory Service, 1982a. Four squadrons are fighter/strike, one reconnaissance unit with 28 Tornados.

[n]*Air Actualité*, April 1988.

[p]*Defense and Economy World Report*, 1987.

[q]Includes five Lynx on order from 1988.

[r]This may be postponed following a CFE agreement. *Süddeutsche Zeitung*, 1989.

[s]Honeck, 1988, p. 64.

[t]Based on Flume, 1988d, and an exchange rate of DM 1.8=$1.

[u]Two have been lost in accidents. All being upgraded to combat role.

[v]Air-to-ship missile.

[w]Some already in the inventory.

[x]Most of these will be transferred from Bremen-class frigates, resulting in minimal costs.

[y]Number of launchers. 1,923 missiles.

[z]Includes missiles.

[aa]Will also undergo an upgrade beginning possibly as early as 1989. 68 fire units from 1991. Kuebart, 1988, p. 26.

[bb]68 Rolands are designated for the Luftwaffe; 27 more will be used by the Luftwaffe to defend U.S. bases in the FRG, and 20 more are destined for the navy; Foss, 1987. Total Roland purchase of 115. *Wehrdienst*, 1988b.

Table 5

PRODUCTION COSTS OF MAJOR EQUIPMENT
(Millions of DM 1987)

Service	Costs
Army	55,755
Air Force	60,270
Navy	27,240
Total	143,265

Clearly, the eventual production costs of major equipment will exceed current estimates. However, because of the high number of weapons systems noted here, it is infeasible to estimate individual system cost growth scenarios. A range of feasible annual production cost growth, 0 to 8 percent, has been used to estimate future costs. Table 6 illustrates the aggregate effects of these cost growth rates on major system production costs. It assumes annual production cost growth of 0 percent, 5 percent, and 8 percent compounded from 1990 to expected system IOC for all major army, air force, and navy systems. Systems already in production or slated for delivery in 1990 are assumed to have no cost growth.[63]

Table 6 indicates a range of major equipment requirements from DM 143 billion to DM 233 billion. The middle-case scenario estimates servicewide major equipment production requirements of DM 194 billion from 1990–2005. In short, modest cost growth may result in substantially higher financial requirements, which can be compared with a range of resources outlined in the next two sections.

[63]For various reasons, some other systems are assumed to experience no or little cost growth despite their IOC date in the 1990s.

Table 6

EFFECTS OF MAJOR EQUIPMENT PRODUCTION COST GROWTH
(Millions of DM 1987)

Equipment	Cost Growth		
	0%	5%	8%
Army			
Armored vehicles	28,340	41,450	52,045
Artillery	4,985	6,045	6,785
Drones	3,200	4,075	4,720
Anti-tank	6,650	9,260	11,240
Air defense	3,325	3,325	3,325
Helicopters	9,255	13,225	16,285
Subtotal	55,755	77,380	94,400
Air Force			
Fighter/attack	33,405	46,820	57,340
Transport/utility	3,180	4,105	4,775
Air defense/SAMs	10,205	14,280	17,710
Missiles/munitions	13,480	16,605	18,950
Subtotal	60,270	81,810	98,775
Navy			
Submarines	4,750	5,800	6,530
Major surface	4,600	5,760	6,565
Minor surface	8,030	10,405	12,135
Aircraft	4,685	6,175	7,265
Missiles/munitions	4,915	5,945	6,650
Air defense	260	260	260
Subtotal	27,240	34,350	39,405
Servicewide total	143,265	193,540	232,580

III. FORECASTING GERMAN DEFENSE SPENDING

This section forecasts a range of West German defense spending to 2005.[1] Forecasts are based on historical data and therefore do not include probable decreases in spending resulting from the decreased Soviet threat or the effects of conventional arms control on German unification; these forecasts probably overstate defense resources should current Soviet and Eastern European trends continue. (Section V discusses the effects of the decreased Soviet threat and conventional arms control agreements on defense spending.)

The defense budget's share of GDP, constant defense spending over time, and the defense budget's share of total government expenditures are analyzed to forecast a range of future defense spending levels. Then, demographic and other budgetary and economic data are analyzed to forecast likely trends in other areas of the national budget. These other expenditure categories may compete with the MoD for scarce government funds, providing some insight into their effects on future defense budgets.

Aggregate West German defense spending is often expressed in two forms: the first reflects total spending as found in category [Einzelplan] 14 of the German federal budget. The second is the more common NATO definition. Einzelplan 14 excludes some expenditures found in the NATO definition and is therefore always less than the NATO definition. For example, Einzelplan 14 excludes military personnel pension expenditures,[2] membership in NATO's civilian structure, and other items.[3] These excluded expenditures total DM 11 billion in the 1989 budget. The NATO definition in recent years has added about 20 percent above that shown in Einzelplan 14.[4] This report explicitly notes these two expenditure definitions.[5]

---

[1]See Sandler and Murdoch, 1986; Don, 1986, for a more detailed budget forecasting methodology.

[2]These are found in Category 33 of the German federal budget.

[3]These include armed force housing, host nation support, federal border guard, and Parliamentary Commission for the armed forces. Presse- und Informationsamt der Bundesregierung, 1988a, p. 3.

[4]These expenditures outside Chapter 14 have increased in relative terms over the past 25 years. In the 1960s, they totaled about 10 percent of Chapter 14 expenditures.

[5]Beginning in 1989, several minor defense budget personnel expenditures and credits have been shifted to Einzelplan 14. *Wehrtechnik*, 1988i.

HISTORICAL MODELS

Defense's Share of GDP

Nations may typically maintain a roughly constant defense spending share of GNP or GDP.[6] Many NATO countries have maintained a roughly constant defense budget share of GDP since the early 1970s.[7] Thus, defense spending is a function of GDP growth.

West German defense spending's share of GDP indicates a fairly steady although not precipitous decline in defense expenditure share of GDP. Defense share of GDP has averaged about 3 to 4 percent since 1955. The high point occurred in 1963 at 5.2 percent and the low point in 1958 at 2.8 percent. Currently, the defense share is slightly greater than 3 percent. Decade averages illustrate a steady decline. In the 1960s, the defense share of GDP was 4.3 percent; it fell to 3.4 percent in the 1970s and has continued to decrease, although slightly, to 3.2 percent in the 1980s. Defense spending growth has not kept pace with GDP growth.

Long-term macroeconomic growth (and hence defense budget growth) may be forecast using either historical data or macroeconomic models. For example, the yearly GDP growth rate from 1955–1988 was 3.5 percent; however, the rate from 1965–1974 was only 3.1 percent, and the rate from 1975–1988 fell to just 2.0 percent. The average 1980s growth rate is 1.9 percent. However, West Germany seems likely to benefit greatly from Europe's economic integration in 1992 and long-term growth may be nearer 3 percent.[8]

About 3 percent represents one optimistic estimate for macroeconomic growth rates from 1990 to 2005. Defense spending appears unlikely to increase at a rate parallel to the economy, although an increase in defense spending at an annual growth rate of 2.5 percent is plausible, particularly if a reversal occurs in Soviet and Eastern European reforms. This results in average defense expenditures of DM 60 billion and an aggregate defense budget of DM 956 billion from 1990 to 2005.[9]

---

[6]There is little difference in the FRG's GNP versus GDP. This section uses GDP data.

[7]This includes France (about 3.8 percent since 1970), Canada (about 2.2 percent since 1973), the Netherlands (about 3.1 percent since 1970), and Denmark (about 2.3 percent since 1972).

[8]See, for example, *The Economist*, 1989.

[9]These figures reflect 2.5 percent annual growth following announced MoD expenditure levels to 1992.

Defense Spending in Real Terms

Some nations maintain constant defense spending in real terms. West German defense spending in real terms has increased considerably since the mid-1950s. (Spending was very low in real and nominal terms in the mid- to late 1950s as Germany recovered from World War II.) The average NATO-defined budget in the 1960s was DM 45.8 billion; this increased to DM 53.6 billion and DM 61.0 billion in the 1970s and 1980s, respectively. However, increases have slowed in the 1980s. For example, defense expenditure growth has slowed from between 2 and 3 percent per year in the 1960s and 1970s to about .4 percent in the 1980s.[10] Ministry of Defense projections show real annual increases of less than 1 percent until 1992. In short, West German defense spending in real terms appears to be flattening considerably.[11]

Defense's Share of On-Budget Federal Expenditures

The defense budget's historical share of German on-budget federal expenditures provides insight into past defense and nondefense spending priorities and may indicate future defense budget spending levels.[12] For example, recent increases in nondefense programs, such as health or social security, might indicates that it will become increasingly more difficult for the German defense expenditures to maintain a constant share of federal expenditures.

Defense spending as a share of general government spending has fallen from 30 percent in 1965 to about 20 percent in 1987, while some programs have increased slightly. Most notably, the German federal debt and expenditures for youth, women, and health research have increased. Large increases in federal debt began only recently, while increases for youth, women, and health research became more notable in the early 1970s. Most other categories, including transportation, labor and social affairs, education, federal employee pensions, and economic-related expenditures have remained fairly stable.

This relative decrease in defense spending has occurred as aggregate on-budget federal government expenditures as a share of GDP have remained constant.[13] Expenditures reached nearly 16 percent of GDP

[10]Average expenditure growth from 1975–1989 (the last 15 years) is 0.9 percent.

[11]The 1990 request shows about a 1.5 percent real increase over 1989 spending.

[12]On- and off-budget expenditures are explained below and in App. A. Historical off-budget data are unavailable and are not examined. Germany's eventual reunification suggests potentially major changes in German federal expenditures. These are not examined.

[13]General German government (including off-budget social security, and state and local) expenditures are much higher, of course, than that reflected in this figure.

on three occasions since 1965—each of these coincided with economic recessions. This share has declined in recent years to slightly more than 13 percent. A continuation of this reduction in federal government expenditures as a share of GDP indicates that programs *in general* will not be able to increase as rapidly as the economy expands. Of course, individual programs, such as defense, may increase as a share of total expenditures, but only at the expense of nondefense programs.

In sum, defense spending has fallen relative to other spending programs and now averages about 20 percent of on-budget government spending. A reversal in this trend, while possible, appears unlikely.

FUTURE TRENDS IN FEDERAL GOVERNMENT EXPENDITURES

The German federal budget contains on- and off-budget expenditure categories that correspond roughly to on- and off-budget expenditure categories in the United States. Off-budget expenditures include all transfer payments financed through payroll deductions.[14] These include almost all pension, health, and other social expenditure categories. On-budget categories account for the remaining share of federal expenditures.[15]

Off-budget Expenditures

In 1985,[16] aggregate off-budget social security spending totaled about DM 400 billion, in DM 1987, 60 percent of all federal expenditures. Pension payments to retired individuals are about two-thirds of off-budget expenditures. Other social benefits, including accident and health insurance, and other social expenditures represent the remaining one-third.

Germany's demographic situation indicates potential increases over the next 15 years in off-budget pension expenditures. In particular, the increasing number of retired individuals may result in upward pressure on expenditures. The pension-age population is expected to increase

[14]Off-budget expenditures also include several additional, but minor, expenditure categories. These are not examined.

[15]State and other local expenditures in Germany are substantial. In the last several years, these have been comparable to on-budget federal expenditures.

[16]Latest year available.

by about 12 percent between 1990 and 2005, excluding pensioners in the GDR who may exert additional pressure on expenditures.

At the same time, as the pension-age population increases between 1990 and 2005, the working population is expected to decrease 8 percent. Thus, under existing pension contribution and benefit schemes, the pension fund may fall into an approximate 20 percent deficit over the next 15 years.[17]

This pension fund deficit may be trimmed in several ways, including benefit reductions, pension contribution increases, or increased on-budget contributions to the pension fund. (The latter reflects the use of general tax revenues to eliminate the off-budget pension fund deficit.) On-budget contributions currently required to eliminate the pension fund shortfall are about DM 24 billion. This has increased in recent years and is discussed in more detail below.[18]

On-budget Expenditures

Trends in many on-budget federal government expenditure categories result from political decisions within participating ministries and the Bundestag and are difficult to forecast. Additionally, uncertainties caused by the financial requirements of unification complicate on-budget forecasts. However, expenditure trends in some categories, such as labor, social affairs (including some social security, war victims, and accident benefits), and education are related to demographic factors. This section examines future expenditure trends in Labor and Social Affairs (Einzelplan 11 of the federal budget) and Youth, Women, and Health Research (Einzelplan 15). (Education expenditures are very small at the federal level and are not examined.)[19] These two expenditure categories account for slightly less than one-half of nondefense expenditures. Appendix A describes these estimates in greater detail.

---

[17]This figure (1.12/.92 = 21 percent) assumes unchanged contributions per worker and unchanged benefits per pensioner.

[18]These increases may have been exacerbated by the return of many pension-age ethnic Germans from the Soviet Union and other Eastern European countries. The West German government offers pension benefits to these immigrants, although they have not contributed to the pension fund, obviously placing a strain on the fund balance.

[19]Overcrowding in German universities may lead to increased federal expenditures to attract more professors and construct more buildings. An increase in federal expenditures from DM 1 to DM 2 billion may occur through most of the 1990s. However, the aggregate federal contribution will remain small. Widman, 1989.

Labor and Social Affairs

Labor and Social Affairs expenditures account for the largest nondefense share of West German federal government expenditures. Expenditures for pensions constitute the largest category within Labor and Social Affairs, 40 percent. On-budget pension expenditures represent general federal revenues used to eliminate pension account shortfalls. Accident and health benefit insurance expenditures account for 27 percent of total expenditures, while war victim benefits account for about 20 percent. Unemployment compensation, other minor benefit programs, and administrative expenditures account for the remainder.

Forecasts of nonpension Labor and Social Affairs categories based on demographic factors do not indicate any substantial changes from 1990 to 2005. However, on-budget pension expenditures may increase considerably to reduce the off-budget pension fund deficit or to pay for the introduction of GDR pensioners. Table 7 illustrates forecasts for all Labor and Social Affairs expenditure categories, assuming continued current benefits and contribution schemes. Appendix A outlines Labor and Social Affairs expenditure forecasts in greater detail.

Aggregate expenditures appear unlikely to increase at an annual rate of more than 7 percent under current benefit and contribution schemes. This probably overstates future expenditures since some adjustments are likely in benefit and contribution schemes; however, there will be increased difficulty in limiting social expenditures and a potential to crowd out defense and other federal expenditures.

Table 7

LABOR AND SOCIAL AFFAIRS EXPENDITURE FORECAST
(Millions of DM 1987)

Expenditure	1990	1995	2000	2005
War victims	11,990	10,730	9,600	8,600
Pensions	24,000	52,000	82,000	97,000
Other social	40,235	44,420	49,000	54,150
Total	76,225	107,150	140,600	159,750
Average annual increase (%)		7.0	5.6	2.6

Youth, Women, Family, and Health Research

Youth, Women, Family, and Health Research expenditures account for about 8 percent of nondefense expenditures, including allowances to families based on their number of children, educational assistance benefits, civil service expenditures for young men who choose not to join the military services, and minor medical research expenditures.

Child allowance expenditures constitute the largest category, recently accounting for two-thirds of all expenditures. Educational assistance benefit expenditures account for 18 percent, and medical research and administrative expenditures account for the remainder.

Forecasts of expenditures based on the number of children do not indicate any substantial changes from 1990 to 2005. Aggregate expenditures should not increase at more than about 2 to 2.5 percent in the 1990s, decreasing after 2000, when expenditures should be level. These expenditures appear unlikely to contribute greatly to pressures within the federal budget to decrease defense spending, particularly after 2000.

CONCLUSIONS

Most on-budget expenditure categories appear unlikely to increase rapidly in the next 15 years, although German unification will probably result in increases in some categories. However, on-budget social security expenditure increases, necessary to reduce off-budget pension fund deficits, may increase pressures to reduce long-term defense and other federal spending. On-budget social security expenditures are certain to increase unless the government successfully increases worker contributions to the social security fund and decreases pension benefits. If not, there may be increased incentives to mitigate this pension fund shortfall by decreasing other expenditures, including defense. Defense budget expenditure patterns since 1975 may indicate these tightening constraints.[20] Thus, even if the threat of war with the Soviet Union or others increases, defense budget expenditures seem unlikely to increase at an annual rate of more than 2.5 percent in a high-resource scenario.[21] This roughly parallels expected economic growth, although it is slightly less.

In a low-resource scenario, defense spending may be more tightly constrained by these nondefense requirements and may fall at an annual rate of 1 percent per year from 1990 to 2005. This assumes that off-budget expenditure growth, combined with government

[20]Based on conversations with MoD and Finance Ministry staff.

[21]Recent expenditure patterns indicate that this rate is very optimistic.

reluctance to increase social security taxes on workers, limits growth opportunities for defense expenditures. A middle case estimates .4 percent average annual defense budget growth, paralleling average growth in the last decade. These scenarios probably overstate defense spending since they do not consider the effects of decreases in the perceived Soviet threat or changes in Eastern Europe. Average 1990–2005 expenditures in the high-, middle-, and low-resource scenarios are DM 60, 53, and 49 billion, respectively, expressed in DM 1987.

IV. THE GERMAN DEFENSE BUDGET MODEL

The budgetary model developed in this section is a residual model. It estimates funding available for the production of major weapons by subtracting constant funding and personnel expenditures from total projected resources. For example, the MoD, regardless of specific mission requirements,[1] will spend a certain portion of its funds on necessary maintenance, operations, basic research and development, and administrative costs, either in absolute or percentage terms. These expenditures, as well as a range of personnel cost estimates, are subtracted from aggregate MoD resources. The residual represents available funding for the production of major equipment items.

The residual model is constructed such that investment expenditures, and major equipment expenditures in particular, are assumed to be the greatest discretionary defense budget categories. In other words, if aggregate defense spending changes, operations and personnel expenditures will change relatively less than investment expenditures. For example, decreases in aggregate expenditures will lead to modest reductions in operations and personnel expenditures and to large reductions in investment expenditures.

A cursory examination of historical expenditure data appears to confirm these assumptions. For example, simple regressions demonstrate almost no relationship between aggregate defense and operations expenditures and aggregate defense and personnel expenditures; however, there is a significant positive correlation between aggregate defense and investment expenditures.[2]

---

[1]Of course, certain expenditures are related to mission requirements. Maintenance costs for 14 aircraft, for example, would be quite different than maintenance costs for 14 aircraft squadrons; however, in general terms, expenditure for such items as clothing, food, and the development and production of some minor procurement items are constant or functionally related to other spending categories.

[2]This series of regressions explains the relationships between the independent variable (aggregate defense expenditures) and three dependent variables (personnel, operations, and investment). Forcing the dependent variable coefficients to sum to 1 results in a β value for investment of .6. In other words, investment expenditure falls (rises) .6 percent for each 1 percent fall (rise) in aggregate defense expenditures.

DEFENSE EXPENDITURE CATEGORIES AND MODEL STRUCTURE

The West German defense budget is often broken down into two major categories: investment and operations.[3] Operations expenditures include personnel expenditures. Historical data demonstrate the division of resources among these three categories. Appendix C contains further detailed statistical information on West German defense spending since 1965.

Personnel and investment together have maintained roughly 75 percent of total expenditures, while operations make up the remaining share. One notable trend between 1965 and 1972 is the relative decrease in investment expenditure and the relative increase in personnel costs. Personnel expenditures have increased from just over 25 percent in the mid-1960s to more than 40 percent in the late 1980s. Investment expenditure share has fallen by roughly the same magnitude.

Einzelplan 14, the defense section of the annual West German federal budget provides a much greater level of detail. Table 8 illustrates German defense budget chapters and their 1989 spending levels.[4] German MoD category classification numbers are also shown. Each category's share of total defense spending is listed in parentheses. In addition, each chapter is identified as operations, personnel, or investment expenditure.

Table 8 indicates 22 defense budget categories, ranging from minor expenditures, such as religious affairs with 1989 expenditures of DM 52 million, to personnel and investment expenditures with expenditures in the billions of deutschemarks.[5]

The West German defense budget is centrally planned and task-oriented. There are no separate categories for service personnel or equipment expenditures. For example, Chapter 19, aircraft and missiles, includes expenditures for the procurement of all Bundeswehr aircraft, including those purchased for army and navy missions. The German Navy's Tornado IDS aircraft and the German Army's helicopters and drone purchases are found in this category. Similarly, all SAMs, including those purchased for the air force and navy, are found in the land category.

As Table 8 indicates, most expenditures occur in several categories: personnel 42.5 percent (categories 3, 4, and 23), land equipment 14.7

[3]Einzelplan 14 breaks down defense spending into 22 categories. These have remained mostly unchanged since 1965 and are explored shortly.

[4]These expenditure amounts are those of the proposed 1989 defense budget.

[5]There is no category 9.

Table 8

THE 1989 DEFENSE BUDGET
(Millions of DM)

Chapter	Expenditure	Percent[a]	Category[b]
1. Central Staff	642	1.2	O
2. General Administration	366	.7	O
3. Active Force Personnel	12,202	22.9	P
4. Civilian personnel	7,580	14.2	P
5. Training, education	364	.7	O
6. Religious affairs	52	.1	O
7. Protection of Rights	7	0	O
8. Public Health	588	1.1	O
10. Food	668	1.3	O
11. Clothing	620	1.2	O
12. Construction	5,170	9.7	I
13. Engineering	108	.2	I
14. Communications	1,941	3.6	I
15. Land Equipment	7,843	14.7	I
16. NBC Protection	107	.2	I
17. Quartermaster	778	1.5	O
18. Ships	1,892	3.6	I
19. Aircraft	3,879	7.3	I
20. R&D	3,040	5.7	I
21. Procurement office	1,195	2.2	O
22. NATO membership	1,386	2.6	O
23. Social security	2,861	5.4	P
Total	53,300	100	

[a]Some numbers are rounded.

[b]O–operations, P–personnel, I–investment.

percent (category 15), air equipment 7.3 percent (category 19), sea equipment 3.6 percent (category 18), and military research and development (R&D) 5.7 percent (category 20).[6] These constitute 73.8 percent of total expenditures and will be the focus of the budgetary model.

[6]Building construction and maintenance also constitute a large share of total expenditures, although this will not be examined closely in the model. Maintenance constitutes a majority of this expenditure.

OPERATIONS AND ADMINISTRATIVE EXPENDITURES

This section examines 11 operations and administration categories in the German defense budget. Many of these are very minor expenditures. Together, they account for about one-fourth of all German defense budget expenditures.

Central staff, general authority and administration, and technology and procurement office represent most administrative expenditures. Their share of total defense spending since 1965 has remained fairly constant.[7] Recent expenditure data place this between 4 and 5 percent. The budgetary model assumes this continued constant spending as a share of total defense spending, estimating expenditures at the 1976–1989 average of 4.6 percent. Future central staff, general authority and administration, and technology and procurement office expenditures are estimated at 1.34 percent, 1.03 percent, and 2.25 percent, respectively.

Foodstuffs and clothing have also accounted for a sizable amount of total defense spending since 1965. However, these amounts appear constant in real spending terms rather than as a share of total defense spending. The average foodstuffs expenditure in the 1965–1975 period was DM 700 million; that in the 1975–1989 period will be near DM 670 million. Average clothing expenditure increased slightly from just under to slightly more than DM 500 million. Future spending on these items is estimated at DM 1,180 million (DM 670 million for foodstuffs and DM 510 million for clothing).

Several minor operations expenditure categories also appear related to aggregate defense spending. Some of these constitute less than .1 percent of total spending; however, in the aggregate, these constitute about 3 percent of defense spending. The share of defense spending that includes religious affairs, protection of rights, health services, and quartermaster expenditures has increased since the mid-1960s. The average share from 1965–1975 was 2.6 percent; this increased to 3.1 percent from 1976–1989. The greatest increase occurred in quartermaster expenditures, which increased at an annual average rate of 1.7 percent. The future miscellaneous operations and administrative

[7]Several changes in these expenditure categories since 1965 have led to minor data adjustments, and this figure reflects these adjustments. For example, the MoD transferred some expenditure authority from general authority to nondefense categories after 1972, resulting in a large decrease in expenditures. Accordingly, the figure estimates general authority share of defense spending from 1965–1972. A one-time personnel appropriation to the Bundesministerium accounted for the sharp peak in 1974. A one-time payment to the United States in 1967 also greatly inflated this category's 1967 expenditure share. This has also been removed to preserve consistency. Finally, NATO membership expenditures, listed under general authority from 1965 to 1969, have been removed to preserve consistency. NATO membership expenditure is described below.

expenditure share is estimated at the 1976–1989 average of 3.1 percent.[8]

Education has become an increasingly costly but minor category. Education expenditure share of defense spending since 1965 has increased from less than .2 percent in 1965 to almost .7 percent in 1989. The average annual increase in education's expenditure share of total spending is more than 7 percent. A continued increase in education expenditures is projected to 2005, although at one-half the rate of increase since 1965. This results in a defense budget share of 1.2 percent in 2005.

Finally, Germany spends a nonnegligible portion of its defense budget on membership in NATO. This includes NATO infrastructure, collaborative weapons programs, and administrative expenditures. (NATO membership expenditure before 1969 is found in the general authority and administration category.)

NATO membership expenditure share has increased considerably since 1969 from just over 1 percent to nearly 4 percent. The average expenditure share from 1965–1975 was less than 1 percent; this has increased to 2.2 percent in the 1980s. Much of this increase in the early 1980s resulted from German participation in the NATO AWACS program. However, some of this increase has resulted from participation in such collaborative weapons projects as Tornado, Hawk, and EFA; a majority of the increases are apparently in infrastructure costs. Continued NATO membership expenditure share is estimated at 2 percent, reflecting recent expenditure levels adjusted for AWACS production expenditure.

PERSONNEL EXPENDITURES

Three expenditure categories will be examined: active forces, civilian, and social security. Expenditures for retired service personnel are included in Einzelplan 33 and are not examined.

Review of Active Force Structure

The German military has maintained at least 495,000 peacetime active duty or active duty equivalent personnel since 1975. A majority of them are active force soldiers, although many are reservists on active duty.[9] Table 9 lists the number of current active personnel in the army, air force, and navy.

[8]Individual budget shares are religious affairs, .1 percent; protection of rights, .02 percent; public health, 1.05 percent; and quartermaster, 1.91 percent.

[9]Reservist categories are discussed in greater detail below.

Table 9

CURRENT ACTIVE PERSONNEL BY SERVICE[a]

Service	No. (000)
Army	347
Reserve duty training	7
Conscripts	175
Temporary careerists	131
Careerists	34
Air Force	110
Conscripts	36
Temporary careerists	54
Careerists	21
Navy	38
Conscripts	10
Temporary careerists	19
Careerists	9
Total	495
Conscripts	220
Careerists	268
Reserve duty training	7

[a]Some numbers are rounded.

Table 9 indicates four active force categories. Temporary careerists and careerists are combined in the following analysis. A fifth category, Standby Readiness component, will be introduced in the new military structure.

Careerist volunteers enter the German military for a period of up to 20 years and constitute about one-half of all active force personnel.[10] Many careerists, of course, may remain beyond their 20 year commitment. Most, however, enter as temporary careerists, as Table 9 indicates. A temporary careerist fulfils at least a two year obligation, although many become professional soldiers. About one-fourth of all careerists are currently professional soldiers. All careerists are subject to Standby Readiness component, a 12-month ready reserve obligation directly following their active duty.[11]

[10]Most enter as temporary careerists and later become professional soldiers. The number of professional soldiers should increase in the new structure. Hubatshek, 1988.

[11]In the future, the Standby Readiness component will be expanded to include key personnel on-call for a 12 year period.

About one-half of Germany's peacetime active force requirement is filled by conscripts. Since 1956, all German males between the ages of 18 and 27 have been subject to military or civil service.[12] Tentative approval had been given to allow women to volunteer for some non-combat roles, but it has now been rescinded.[13] The term of service since 1956 has varied between 12 and 18 months, and it now stands at 15 months. Plans to increase this to 18 months have been postponed until at least 1992. Conscripts must also serve or be available for service following their service period. All careerists are subject to service in the Standby Readiness component immediately following active duty. The importance of this ready reserve is expected to increase in the new military structure, although the cost implications of this are uncertain.[14] All conscripts must also serve a period of reserve duty following the Standby Readiness component.[15] The total obligation ranges from 9 months for enlisted personnel and 18 months for officers. All conscripts are eligible for service until age 45 in peacetime and age 60 in war.

Reservists soldiers play a key role in Germany's defense effort. This is expected to increase in importance in war and crisis situations. Currently, the Bundeswehr relies on more than 2.4 million available reservists to fill 900,000 positions during mobilization.[16] The reservist to requirement ratio is expected to fall from this approximate 3:1 ratio to about 1.3:1 in the 1990s, as the total number of available reservists falls to about 1.3 million and the reservist requirements increase to 1 million. In crisis and war, this reserve potential will permit the number of available military personnel to increase to 1.42 million.[17] However, substantial problems remain. Qualitatively, this lowered reservist to requirement ratio will make it increasingly difficult to maintain necessary skills. Quantitatively, the Bundeswehr must successfully mobilize virtually its entire reservist forces.

---

[12]Residents of Berlin are exempt. Consideration had been given to increasing this age range to 18–32 years. *Jane's Defence Weekly*, 1987a.

[13]Women currently may only serve in the medical corps. This tentative approval would have limited the number of women to 20,000. Tuohy, 1987; *The NATO Report*, 1988.

[14]No information is available on reservist versus careerist expenditures and thus no assessment of the future effects of increased reserves is possible.

[15]Reserves will spend up to 12 days annually on reserve duty training. Ministry of Defense, 1988; and *Der Mittler-Brief*, 1987. The previous requirement was 4–5 days annually.

[16]Ibid, p. 6; and Ministry of Defense, 1988.

[17]The breakdown is: 456,000 active soldiers, 773,000 ready and active reservists, 90,000 Wartime Host Nation Support, and 77,000 reservists for sustainability. Ministry of Defense, 1988, p. 3; and *Der Mittler-Brief*, 1987, p. 3.

Peacetime Active Force Requirements

The German Ministry of Defense has published a detailed description of personnel requirements in the Bundeswehr 2000. Table 10 illustrates current and projected active service categories. Bundeswehr 2000 projections represent personnel goals.

Reserve duty training and Standby Readiness component will increase from 7,000 to 39,000 in the Bundeswehr 2000. The number of careerists and conscripts will fall correspondingly. The service personnel breakdown is estimated as follows: army 351,000 (increase of 4,000), air force 107,000 (decrease of 2,900), and navy 38,100 (decrease of 600).[18] These personnel strengths include reserve duty training and Standby Readiness component personnel.[19]

Budgetary Model Estimates for Active Force Requirements

The budgetary model estimates expenditures for careerists and conscripts requirements. It does not estimate reserve duty personnel

Table 10

ACTIVE FORCE PERSONNEL: CURRENT AND BUNDESWEHR 2000 REQUIREMENTS
(Thousands)

Category	Current	BW 2000
Careerists	268	250
Conscripts	220	206
Reserve duty training	7	15
Standby Readiness component	0	24
Total	495	495

[18]Some numbers are rounded. Estimated from Presse- und Informationsamt der Bundesregierung, 1988c, pp. 7–10. Future personnel estimates represent those in the mid-1990s under Bundeswehr 2000. In the near term, the number of personnel (thousands) in each category is projected as follows:

Category	1990	1991	1992
Careerists	268	262	259
Conscripts	215	213	211
Active duty reservists	7	9.8	10.85
Ready reserve careerists	5	10.2	14.15

[19]Army total includes 26,000 reserve duty training and Standby Readiness component; the air force and navy 9,000 and 4,000, respectively.

expenditures. Instead, it assumes that expenditures for both reservist categories (reserve duty training and Standby Readiness component) are included in past careerist and conscript expenditures. Thus, the model may understate additional wage premiums necessary to achieve Bundeswehr personnel reservist goals.[20]

Careerist Personnel Estimates

Future salaries of military careerist personnel are a function of several factors, including the unemployment rate, real wage increases in the civilian sector, and perhaps some less quantifiable measures, such as levels of patriotism. Economic analyses have also demonstrated the effects of cohort size on relative wages.[21] Wages in small population cohorts relative to average wages will increase; conversely, the wages of large cohorts will decrease relative to average wages.[22]

This relative wage effect may have a considerable influence on careerist wages. For example, although precise data describing military personnel careerist recruits are unavailable, many careerists are probably recruited from the 18–23 year old cohort, which will decline precipitously in the 1990s. The wages paid to careerist recruits may increase at a more rapid rate than those in the average working population.[23] The cohort will increase slightly from 1995 to 2005, although it will not return to 1990 levels. Thus, the declining cohort will probably lead to increases in the relative wages of all young men, including those in the military.

This declining cohort is assumed to increase the relative wages of careerist recruits in the 1990s and early 2000s. The share of careerists affected by this wage effect is assumed to be 50 percent in 1995, 100 percent in 2000, and 50 percent in 2005, based on two principal

---

[20]This assumption is necessary since reserve expenditures are not included in available historical expenditure data. Premiums beyond current base salaries are expected since past careerists were not subject to additional service time planned in the Bundeswehr 2000. Additional conscript reservist compensation may also be necessary or approved by the Bundestag. Ministry of Defense, 1988, p. 7. For a general discussion of reservist expenditures, see *Wehrtechnik*, 1988i, pp. 46–48. Reserve duty training expenditure per soldier is estimated at twice the cost of conscript expenditure. Flume, 1988b, p. 9.

[21]Smith and Welch, 1981; and Welch, 1979.

[22]The disparity between different sized cohorts appears to decrease as years of work experience increases.

[23]The continued migration of young workers from the East and the unification of Germany could mitigate or perhaps eliminate these increases if personnel requirements do not increase.

assumptions. First, a ten year average term of service is assumed.[24] By 1995, 50 percent of current active personnel will have been replaced by new recruits from affected cohorts. Similarly, all current active personnel will have been replaced by new recruits by the year 2000. Second, in the long term, it is assumed the German economy substitutes away from young workers, thereby lessening their wages and the demand for them. Consequently, the number of youths affected by relative wage increases is assumed to fall after the year 2000.[25] The magnitude of this relative wage increase is estimated at .3 percent and is based on previous RAND research.[26]

This declining supply of potential careerists will probably lead to a second cohort-related wage increase. As the male cohort declines, the Bundeswehr must attract a substantially higher percentage of the working male population. For example, the Bundeswehr's annual recruiting requirement in this cohort will increase by roughly 45 percent between 1990 and 1995.[27] This cohort effect represents an additional wage premium the Bundeswehr must pay to increase its recruiting share in the 18–23 year old male cohort.[28] Cohort effect elasticities of .2 for enlisted personnel and .4 for officers are assumed.[29] In other words, for each percentage decrease in the youth cohort and in the absence of reductions in the number of required accessions, enlisted personnel wages are expected to increase .2 and officer wages .4 percent. The number of service personnel affected is assumed to increase from 50 percent of personnel in 1995 to 100 percent in 2000, and then to decrease to 50 percent in 2005.

---

[24]This is comparable to estimated average terms of service in other NATO countries, including the United States.

[25]The year in which the demand for youth labor declines has been set somewhat arbitrarily. In addition to a decreased demand after the year 2000, the relative wage effect is expected to dampen somewhat over time and to effectively decrease the number of personnel affected by relative wage increases. The relative wages of older careerists may fall as those of new careerists increase and thus may have a balancing effect on expenditures.

[26]Tan and Ward, 1985. Although this study forecast male youth wages in the United States, the model assumes that wage effects will be comparable in Germany and other European countries. 1990 is used as a baseline measure of the number of male youths. The model assumes a wage elasticity of .3. In other words, for each percentage drop in the cohort size, relative wages of youths increase .3 percent.

[27]Currently, the Bundeswehr's annual careerist requirement is probably about 25,000 based on a careerist's average length of stay of 10 years and an annual force of 250,000 careerists.

[28]The magnitude of this cohort effect is based on Tan and Ward's research. This assumes a wage elasticity of .5. Thus, in 1995, the cohort effect is Δcohort $\times$ wage share $\times$ elasticity = .4 $\times$ .5 $\times$ .5 = .1 or 10 percent.

[29]The magnitude of this cohort effect is based on Tan and Ward's research. The cohort effect is slightly overstated in the low personnel expenditure scenario since a reduction in requirements reduces recruiting share. It is also slightly understated in the high expenditure scenario for the same reason.

In addition to these cohort-related increases, the MoD must continue to offer wages comparable to those in the civilian sector or face both an exodus from current active force personnel and a decline in the number of recruits.[30] Historical earnings data provide one estimate of the future earnings of active military personnel. For example, since 1965, active force careerist earnings have increased at an annual rate of 2.5 percent, although this has fallen to 1.4 percent since 1976. The model assumes that the MoD must in the future maintain pay comparability to remain competitive with the private sector. Future civilian and military wage increases resulting from general economic conditions, based on economic growth projection and work force composition, are estimated at 2.5 percent per year.[31] The estimated magnitude of increases due to relative wage and cohort effects and general economic conditions is illustrated in Fig. 6. Increases shown are relative to 1990 careerist expenditures. The wage and cohort effects shown here may be mitigated by the effects of net immigration, European economic integration, and especially a move to draft women.

Projected expenditures for the careerist requirement are shown in Table 11 in three scenarios. In a low expenditure scenario, the MoD is assumed to pay no relative wage increase or any additional wage premium to attract a higher percentage of the youth cohort. In a high expenditure scenario, the MoD is assumed to pay the relative wage and cohort premium increases shown here. The middle case scenario is an average of these two. In all three scenarios, the MoD is assumed to pay increased wages because of general economic conditions.

These figures do not consider future qualitative careerist requirements, and this may understate future expenditures. For example, the Bundeswehr plans to increase the number of officers per tank battalion to compensate for the decrease in readiness and the increased reliance on reserve forces.[32] This increase will almost certainly be attainable only with the introduction of higher wages.

Conscript Personnel Estimates

Expenditures for conscripts are naturally much lower than those for careerists. For example, in 1989, the Bundeswehr expects conscript salaries to total just over DM 1.1 billion. Furthermore, it plans a

[30]The Bundestag recently offered higher reenlistment bonuses to reduce the outflow of careerist officers. *The NATO Report*, 1988.

[31]This is conservative if the FRG's GDP grows at 3 percent per year as some have suggested.

[32]A German tank battalion has 16 officers. This compares with 25 in East Germany and 43 in the U.K. *Wehrtechnik*, 1988i, pp. 46–48.

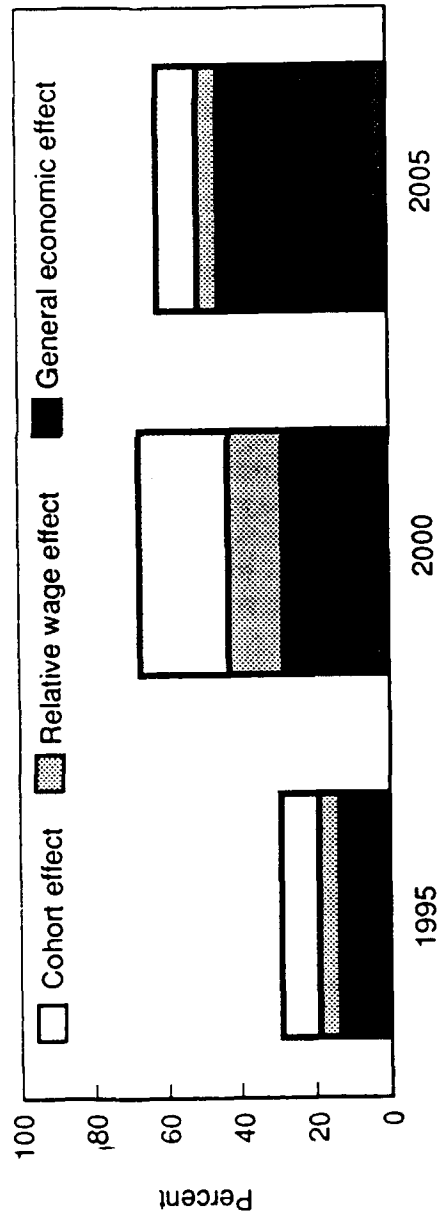


Fig. 6—Careerist wage increases relative to 1990 expenditures

Table 11

MODEL PREDICTION OF CAREERIST PERSONNEL EXPENDITURES
(Millions of DM 1987)

Expenditure Scenario	Cohort/Relative Wage Effects	Expenditures, 1990–2005
High	Maximum	225,616
Middle	Modest	209,788
Low	None	193,802

reduction in the number of conscripts from 222,000 to 206,000 in the Bundeswehr 2000. This represents a fall of 7 percent, which contrasts sharply with the relative fall in the available conscript pool.[33]

Under current draft laws, the declining draft-age cohort will result in a shortfall of up to 100,000 conscripts in the 1990s.[34] The Bundeswehr annual requirement is 225,000. (The Bundeswehr and other national organizations, such as the border patrol, police, etc., have a requirement of 250,000 annually.)[35] MoD planners have several ways to lessen the severity of this demographic trough.[36] First, they may extend the period of service to 18 months beginning in 1992. Second, they have deferred the drafting of many eligible males until they have reached the end of their eligibility. Thus, the demographic trough has been lessened by taking advantage of the excess supply just preceding this trough. (This will mitigate the shortfall in the near term, but not after about 1997.) Third, they have decreased medical standards and removed the marriage exemption.[37] (This will prove to be more costly since married conscripts receive a higher salary than unmarried conscripts.) MoD planners have also established new regulations, which

[33]The decrease in the 19-year-old male cohort between 1988 and 1994 is nearly 50 percent.

[34]Presse- und Informationsamt der Bundesregierung, 1988b, p. 5.

[35]*Der Mittler-Brief*, 1987, p. 2. The Bundeswehr's requirement is estimated at 225,000. Presse- und Informationsamt der Bundesregierung, 1988b, p. 5.

[36]The solutions were originally outlined by the Commission on Long-term German Military Planning in 1981. Presse- und Informationsamt der Bundesregierung, 1988b, p. 5. Although tentative approval had been given to allow up to 20,000 women to volunteer for some noncombat roles, it has now been rescinded. Tuohy, 1987, p. 1; *The NATO Report*, 1988.

[37]*Army Gazette*, 1987.

will probably reduce the number of conscientious objectors.[38] Figure 7 illustrates the number of conscript solders under these MoD plans.

The number of conscripts in all national services cannot be met under current policies. In the future, that number can probably be met only if the Bundeswehr adopts an 18-month term of service and is successful in its efforts to limit conscientious objectors and medical exemptions, and to increase the conscription of married males.[39]

The average compensation paid to full-time conscripts in 1989 was about DM 5,100. This represents about one-fourth of average wages paid to careerists. Wage payments to conscripts have also increased at a much slower pace than payments to careerists. From 1965 to 1989, for example, conscript wages increased at about 1 percent per year.

Conscript expenditures are estimated in three scenarios. In a low-expenditure scenario, estimated future conscript wage increases are assumed to increase at 1 percent per year. No additional costs resulting from the potential conscription of a higher number of married males are assumed. In the high-expenditure scenario, unmarried conscript wages are assumed to increase at an annual rate of 2.5 percent, reflecting expected real wage increases. This scenario also assumes a 10 percent increase in married conscripts and a married conscript wage 20 percent greater than that for single males. The middle case averages these high- and low-expenditure scenarios. The results are listed in Table 12.

Social Security Expenditures

Finally, social security expenditures for peacetime active force soldiers are estimated based on historical increases. The low-expenditure scenario assumes no real increases per active soldier. This parallels observed social security expenditures since 1976. The high-expenditure case assumes annual real increases of 2.3 percent, reflecting expected real earnings increases comparable to expected wage increases that are due to general economic conditions. The middle case averages the high- and low-expenditure scenarios.

Social security expenditures are projected to fall between DM 2700 and DM 3700 million from 1990 to 2005. None of these scenarios

[38]Greater incentives to choose military rather than alternative service have also been installed. For example, men who choose civilian service will now be required to serve 20 months. Under old laws, this service period was 15 months. About 60,000 annually in a pool of 250,000 draftees refuse entrance into the military as conscientious objectors. Not all are granted conscientious objector status. Presse- und Informationsamt der Bundesregierung, 1988b, pp. 7, 16.

[39]It would be technically possible to meet conscript goals without the 18-month service period, although this would require the drafting of almost all eligible males, regardless of their physical or mental attributes.

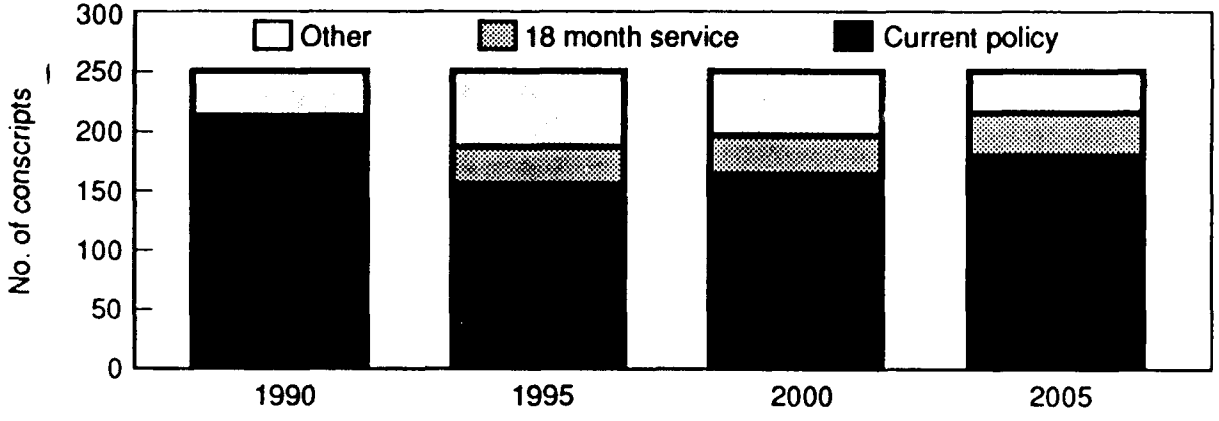


Fig. 7—Conscripts under various policies

Table 12

MODEL PREDICTION OF CONSCRIPT PERSONNEL EXPENDITURES
(Millions of DM 1987)

Expenditure Scenario	Wage Increase (percent)	Increase in Married Conscripts (percent)	Expenditures, 1990–2005
High	2.5	10	22,355
Middle	1.75	5	21,002
Low	1	0	19,649

reflects potential changes in the German social security system, which might change this estimate considerably.

Civilian Force Requirements

The number of civilian personnel in the MoD and associated organizations in Germany has remained essentially constant since 1965. Currently, the number of civilian personnel totals 169,000. This is only slightly less than several years in the mid-1970s, when 176,000 civilian personnel were employed. A fitted regression line to the number of civilian personnel from 1965 to 1989 shows an average annual .1 percent decline.

Substantial restructuring within the MoD may lessen the requirement for civilian personnel in the future; however, recent data indicate a continuation of about 169,000. In a low-expenditure civilian personnel scenario, the number of civilian personnel within the MoD from 1990 to 2005 may fall at a rate of perhaps 1 percent per year, resulting in an eventual 16 percent decrease in personnel. In a high-expenditure scenario, the number of personnel is expected to remain at 169,000. A middle-case scenario estimates a continued .1 percent decline in personnel requirements similar to what occurred from 1965 to 1989.

Historical data indicate that real civilian wages have increased at a faster rate than GDP growth, averaging 2.4 percent since 1965.[40] However, annual growth rates since 1976 have been slower, averaging only about 1 percent. Three wage-growth scenarios are estimated: a low-expenditure scenario of 1 percent per year, a high-expenditure case at 2.5 percent per year based on expected increases in per capita GDP,

[40]This is based on salaries and does not include other minor expenditures found in Einzelplan 14, Chapter 4.

and a middle case at 2 percent per year. These estimated cost scenarios, based on changes in the number of civilian personnel and estimated wage increases, are highlighted in Table 13.

INVESTMENT EXPENDITURES

The investment category today accounts for s. ly more than 30 percent of all defense expenditures in Einzelplan 14. This section examines minor and major investment categories, including major equipment production expenditures. Minor investment categories include: construction and office maintenance; engineering; Nuclear, Biological, and Chemical (NBC) protection equipment; and communications. Major investment categories include land production, sea production, air production, and R&D.

Minor Investment Categories

Construction and office maintenance, engineering, NBC, and communications equipment account for 14.5 percent of all defense spending in the 1989 defense budget. Construction and office maintenance spending, with current expenditures of more than DM 5 billion, dominates these other minor categories.

Construction and office maintenance expenditures include general management and construction of military facilities, security services, reimbursement to German states for the use of facilities, and other minor expenditures. Administrative functions, including building maintenance, constitute approximately 70 percent of construction expenditures.

This type of expenditure has remained virtually constant in DM 1987 since 1970, averaging about DM 5.5 billion. From 1965 to 1969,

Table 13

MODEL ESTIMATION OF CIVILIAN PERSONNEL EXPENDITURES
(Millions of DM 1987)

Expenditure Scenario	Change in Number (percent)	Wage Increase (percent)	Expenditures, 1990–2005
High	0	2.5	149,859
Middle	−1.5	2	143,806
Low	−16	1	122,170

expenditures were slightly higher, possibly because of greater infrastructure projects. Future expenditures are estimated at the 1976–1989 level of DM 5.46 billion.

Engineering expenditures are a fairly minor part of the aggregate defense budget, representing just more than .2 percent of aggregate defense spending. This category includes both maintenance and procurement of engineering equipment, although maintenance expenditures dominate this category, averaging almost two-thirds of the total.

These expenditures have declined since 1965. For example, from 1965–1975 they averaged DM 177 million; this has fallen to an average of DM 122 million since 1976. It is unlikely that this decline will continue because the army plans to increase its emphasis on mine warfare and blockade operations. Accordingly, annual expenditures of DM 150 million are estimated, greater than levels since 1980 but less than those since 1965.

Communications expenditures include rental, maintenance, and production of communications equipment. In 1989, nearly 80 percent of expenditures was on the production of new equipment.

Communications expenditures have averaged just over DM 1.5 billion since 1965. Average expenditures since 1975 have been slightly higher than those between 1965 and 1975. Continued annual expenditures of DM 1.53 billion are assumed to 2005, representing the average since 1965.

NBC procurement remains a minor expenditure in the aggregate defense budget. In 1989, for example, expenditures were just slightly more than DM 100 million, less than .2 percent of aggregate defense spending.

NBC material expenditures experienced a sharp decline in the early to mid-1970s, perhaps from U.S.-Soviet nuclear arms control successes and continued expectations of détente. Since 1975, there has been a steep average annual increase of nearly 5 percent, sharply contrasting the average annual 7 percent decrease from 1965 to 1975. NBC expenditures are estimated at the post-1975 average of DM 93 million.

Major Investment Categories

Figure 8 outlines major equipment production items associated with various expenditure categories. This section examines these categories, as well as all research and development expenditures.

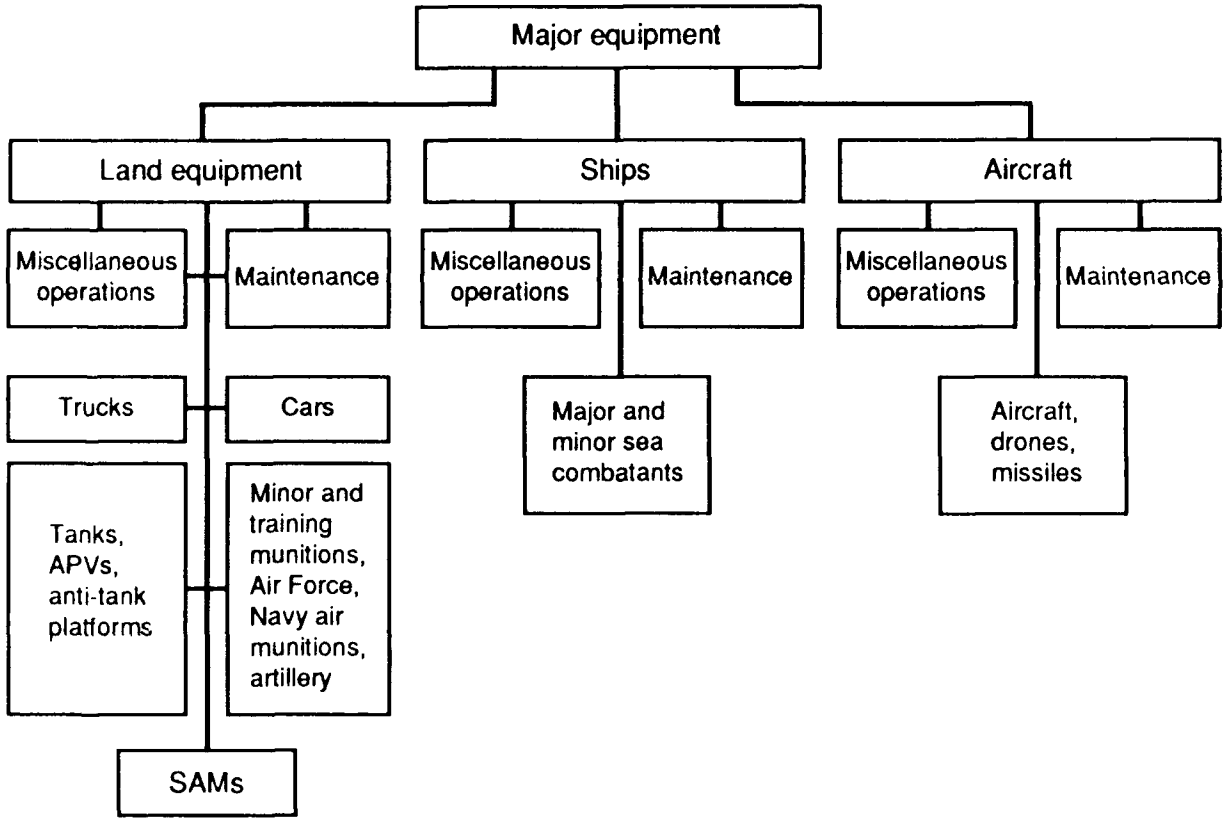


Fig. 8—Major equipment/expenditure categories

Land Production

Land production includes all land equipment procured by the navy and air force as well as the army. This category contains several subheadings: maintenance, trucks and other heavy transport; armored vehicles; automobiles; munitions; and other. Land production also contains additional minor operating costs. It has averaged 14.2 percent of total spending and 52.4 percent of major equipment production (land, air, and sea) spending since 1965. Figure 9 illustrates the breakdown of land production in DM 1987.

Trucks, armored vehicles, munitions, and other account for about two-thirds of land equipment expenditure. Maintenance expenditures constitute a majority of the remaining one-third. Truck expenditures in 1989 totaled more than DM 500 million. This includes expenditures for large troop truck transports and supply transport vehicles, but does not include expenditures for smaller transport vehicles and passenger automobiles.

Historical data demonstrate the cyclical nature of truck expenditures as a share of land production. Expenditure share peaked in 1970, 1979, and 1986, probably representing the introduction of new or additional transport vehicles. The average expenditure share in 1967–1972 is 9.0 percent; it falls slightly to 8.7 percent from 1973 to 1982, but increases to 10.2 percent from 1983 to 1989. The average expenditure share from 1983 to about 1991 will almost certainly decrease as expenditures decrease. Transport vehicle expenditure share is estimated at 9.7 percent until 2005, representing the average expenditure share from 1973 to 1989.[41]

Land maintenance includes maintenance of most army systems but also land-based air force and navy equipment. Expenditures in 1989 totaled DM 1.8 billion.

Maintenance expenditures, following fluctuations in the 1960s and early 1970s, have remained fairly constant in real terms since 1972. From 1965 to 1971, annual expenditures averaged just under DM 1.8 billion; this average climbed only several tens of millions after 1971. Land equipment maintenance expenditure is estimated at DM 1.82 billion, representing the historical average since 1965.

Limited miscellaneous operations expenditures are included within the land production category. These are expected to reach slightly more than DM 100 million in 1989 and include depot operations and security, supply maintenance, and transport costs.[42]

---

[41]1965–1972 is excluded since 1965 may have also been a peak expenditure year. Inclusion of this time period might overstate expenditure share.

[42]This excludes apparent one-time operations expenditures in 1965 and 1966.

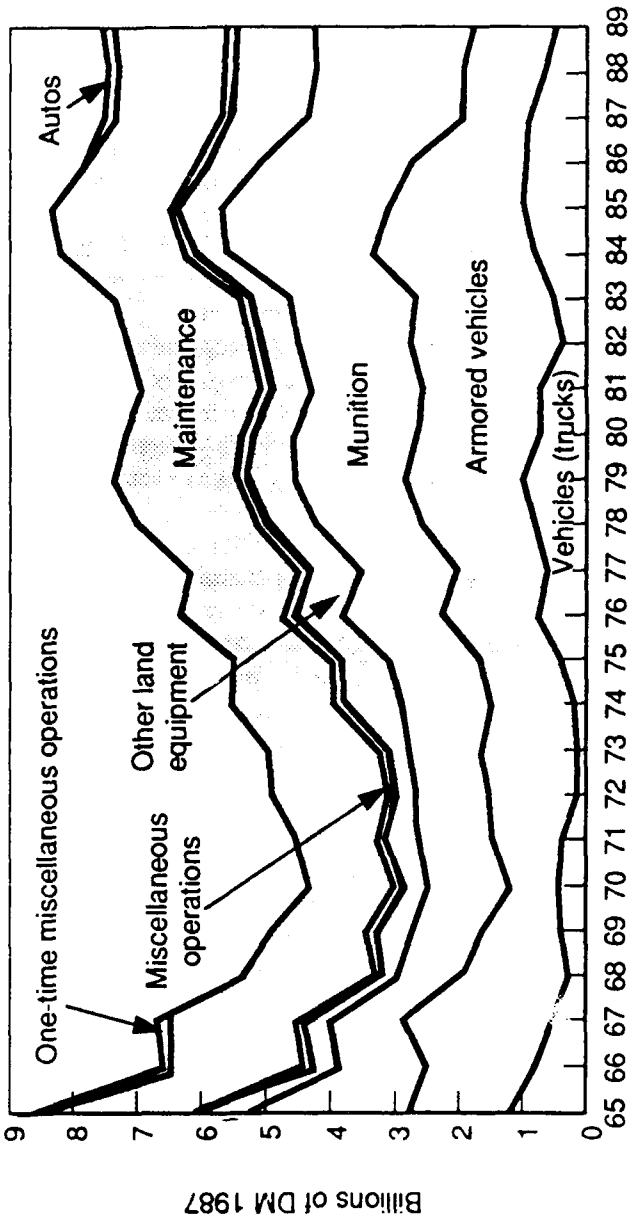


Fig. 9—Land production expenditures

Miscellaneous land operation expenditures have remained constant at slightly more than DM 100 million. From 1965 to 1975, the average annual expenditure was DM 110 million; it has remained at this level since 1976. Annual miscellaneous land equipment operations expenditure is estimated at DM 110 million.

The budgetary model also estimates future expenditure on automobiles. These data are limited to 1987–1989, but they lie in the DM 50 to DM 60 million (in DM 1987) range. Future automobile expenditures are estimated at 1989 levels of approximately DM 60 million.

Minor munitions expenditures estimations require two steps. First, aggregate munitions (practice ammunition, minor munitions, aircraft munitions,[43] artillery, and anti-tank munitions) share of land production is estimated at its historical average of 25.8 percent. Second, minor munitions expenditures (practice and other munitions not accounted for in Sec. II) are estimated at 65 percent of aggregate munitions based on practice and other munitions shares of 40 and 25 percent, respectively.[44] In short, 65 percent of the munitions category is designated for minor munitions; the remainder is designated for major equipment outlined earlier, including artillery, SAM systems, and anti-tank munitions.[45]

In summary, the model estimates expenditures for land maintenance, trucks and troop transport, autos, and training and minor munition procurement. The land residual estimates resources for the production of all armored vehicles, munitions (except minor equipment and training ammunition), artillery, and surface-to-air missile air defense systems.

Sea Production

Sea production constitutes a minor yet important part of the German defense budget. This category has averaged 3 percent of total spending and 11.2 percent of major equipment production since 1965. It includes three major categories: procurement of ships, boats, and other sea vessels; maintenance; and miscellaneous operating expenses. Figure 10 illustrates the historical division among these three categories.

Miscellaneous operating expenses include ship charter costs, port operating expenses, and other minor expenditures including accident

[43]It is unclear whether aircraft munitions should be included in this or the air production category. To avoid any possible double-counting, I have assumed that the model accounts for aircraft munitions in this category, which may slightly understate projected shortfalls.

[44]*Wehrdienst*, 1988a, p. 1.

[45]It excludes anti-tank platforms.

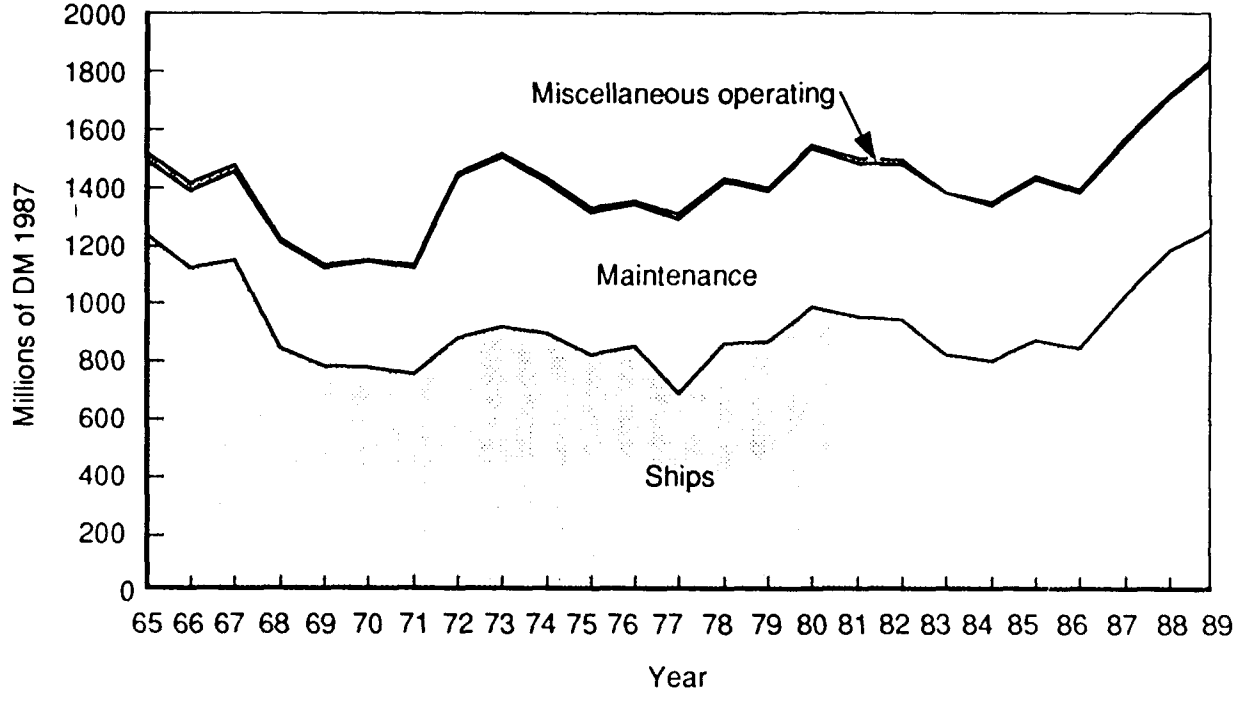


Fig. 10—Ship production expenditures

prevention. Typically, these total only about DM 13 million annually; the budget model accordingly estimates minor sea operating expenditure at this historical average.

Maintenance expenditures constitute a large share of total sea procurement expenditures. Maintenance has consistently been more than 30 percent of sea procurement since 1968. These expenditures reached a high point of nearly 50 percent in 1977 but have since declined to historical averages. The average from 1965 to 1975 was 30.8 percent; this has increased to 38.9 percent since 1976. The high average ages of German Navy vessels probably account for this increase in relative maintenance costs. Maintenance expenditure share is estimated at the post-1976 average of 38.9 percent.[46]

Air Production

This category includes aircraft, missiles, and drones purchased on behalf of all military services. It has averaged 9.9 percent of defense spending and 36.4 percent of major equipment production since 1965. Its three major categories are miscellaneous operating expenditures, procurement, and maintenance. It has historically often contained specific line-item expenditures for the production of major aircraft systems, most recently Tornado and Alphajet. Figure 11 illustrates the breakdown of air production expenditures since 1965.

Miscellaneous operating expenditures constitute only a small fraction of this category's total expenditures, including aircraft charter costs; payments for the use of civilian airfields, transport and depot expenditures; and other.

Miscellaneous air operating expenses as a share of air procurement have increased considerably since 1980. However, this increase has resulted primarily from an overall decrease in air procurement expenditures rather than a marked increase in operation costs. The model estimates air operating expenditures at 1 percent of air procurement, approximately the historical average from 1965 to 1980.

Air maintenance expenditures constitute a considerable share of air procurement expenditures and have ranged from DM 1.5 to DM 2 billion since 1965. The average from 1965 to 1975 was DM 1.8 billion, and it has fallen considerably to DM 1.5 billion since 1976. Recent data indicate an expected increase to DM 1.6 billion. Air maintenance expenditures are estimated at DM 1.62 billion to 2005, considerably

[46]Most observers expect continued increases in maintenance expenditures. See Flume, 1988b, p. 9.

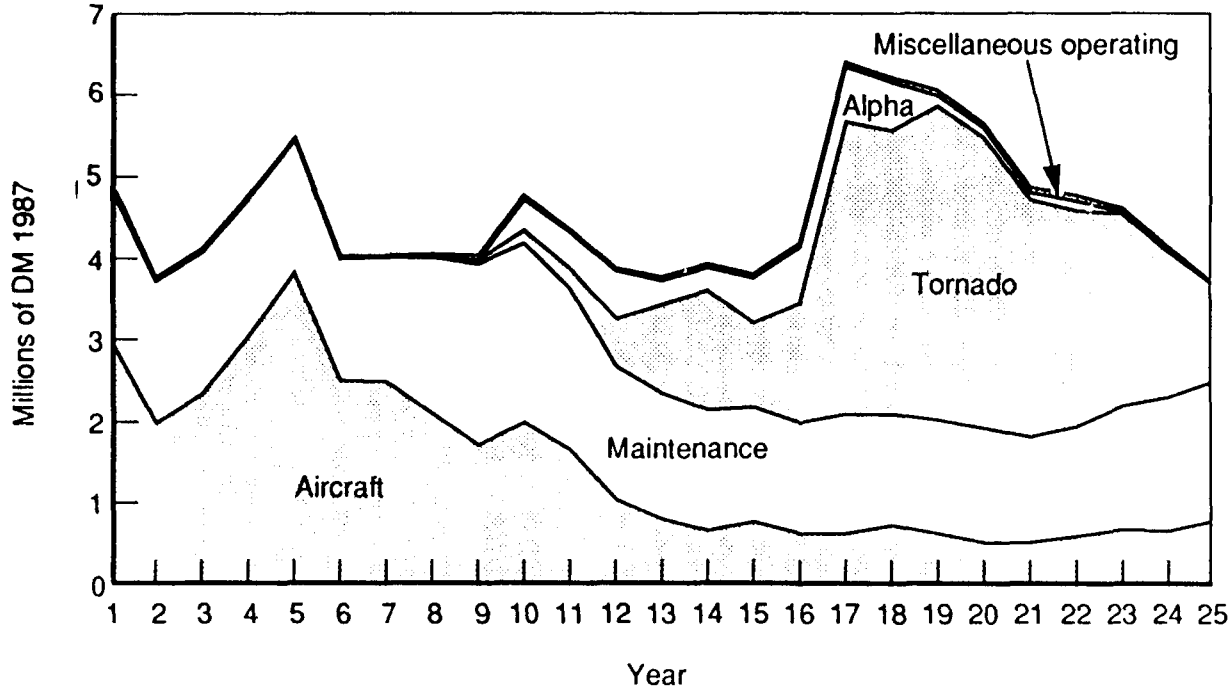


Fig. 11—Air production expenditures

lower expenditure than historical averages, although slightly above that since 1976.[47]

The residual estimates resources available for the production of all fixed- and rotary-wing aircraft, drones, and missiles.[48]

R&D

R&D typically constitutes about 5 percent of total defense spending, about DM 3 billion in 1989. R&D contains several categories: basic research, military development, and miscellaneous expenditure categories, including operations. A majority of expenditure falls under military development. This category also typically contains line-item development expenditures for major fighter aircraft. For example, it currently lists development expenditures for Tornado and EFA.

R&D expenditures have been fairly constant in real terms since 1965.[49] The average from 1965 to 1975 was nearly DM 2.3 billion, while the average since 1976 was only slightly more. A substantial portion of the total falls under basic research and operations. For example, in 1989, basic research and operations totalled nearly DM 500 million, about 16 percent of the R&D budget and close to the historical average of 16.8 percent. Aggregate R&D expenditure is estimated at its historical average of DM 2.27 billion.

SUMMARY OF MODEL ESTIMATES AND RESOURCES IN THE MIDDLE-CASE SCENARIO

Table 14 summarizes the budget model and provides estimated resources in the middle-case scenario.

The land residual estimates resources available for the production of tanks, AFV/APVs, anti-tank platforms, artillery, anti-tank weapons, and air defense equipment. The sea residual estimates resources

[47]It is uncommon for maintenance expenditure to continually decrease, according to data from other nations. In fact, some evidence points toward higher, if not constant, maintenance share of procurement expenditures. See Nation, forthcoming, Sec. IV.

[48]It excludes resources for aircraft munitions. These are found in the land equipment munitions category.

[49]R&D expenditure data illustrate major fighter aircraft development expenditures since 1965, including expenditures for the F-104, Tornado, and EFA. Aircraft development's average share of total R&D has fallen slightly since the mid-1970s, although its historical share of R&D is about 24 percent. Germany's nonfighter aircraft development budget will be squeezed by EFA development costs unless they remain at current estimated levels or aggregate development funding is greatly increased. For example, EFA development costs of DM 6 billion spread over 15 years (DM 400 million per year) would barely fit within the budget. It seems unlikely that EFA development costs will remain at this level given estimated Tornado development costs to date of DM 7.6 billion (in DM 1987).

available for the production of all ships, including submarines and major and minor combat vessels. The air residual estimates resources available for the production of all fixed- and rotary-wing army, air force, and navy aircraft, drones, and missiles. Together, these represent total major equipment production resources.

Table 14

DEFENSE BUDGET MODEL CATEGORIES, DEFINITIONS, AND MIDDLE-CASE VALUES
(Millions of DM 1987)[a]

Variable	Definition	Derivation	Middle case, 1990–2005
B	Defense budget	Exogenous	845,370
O_f	Fixed operations[b]	Exogenous	18,880
O_v	Variable operations[c]	.106 × B	89,775
E_a	Active personnel	Exogenous	230,655
E_c	Civilian personnel	Exogenous	143,805
S	Social security	Exogenous	48,455
R	Research and development	Exogenous	36,320
M	Minor production	Exogenous	115,730
P	Major production	$B-O_f-O_v-E_a-E_c-R-S-M$	161,750
L	Land production	.524 × P	84,755
L_f	Fixed land production	Exogenous	31,840
L_v	Variable land production	.265 × L	22,435
L_r	Land residual	$L-L_f-L_v$	30,480
S	Ship production	.112 × P	18,115
S_f	Fixed ship production	Exogenous	210
S_v	Variable ship production	.389 × S	7,045
S_r	Sea residual	$S-S_f-S_v$	10,860
A	Air production	.364 × P	58,875
A_f	Fixed air production	Exogenous	25,920
A_v	Variable air production	.01 × A	590
A_r	Air residual	$A-A_f-A_v$	32,365
M	Major equipment residual	$L_r+S_r+A_r$	73,710

[a]Some numbers are rounded.

[b]Includes food and clothing.

[c]Includes central staff, general administration, training and education, religious affairs, protection of rights, public health, quartermaster, procurement office, and NATO membership.

V. RESOURCES, REQUIREMENTS, AND CONVENTIONAL FORCE REDUCTIONS

CONVENTIONAL FORCE REDUCTIONS

An agreement reducing conventional forces in Europe appears probable in the next several years.[1] NATO and Warsaw Pact negotiators at the CFE discussions in Vienna have agreed in principle to first-stage reductions involving main battle tanks, armored troop carriers, and artillery. Warsaw Pact force reductions would be about 50 percent, while NATO-wide reductions would be about 10 percent. Negotiators have similarly agreed to sub-limits on equipment in specific geographic areas and to limits on the absolute size of national forces in Europe. National limits, for example, stipulate that no nation could have more than 30 percent of total equipment (a measure designed to limit Soviet forces). Soviet equipment could also not exceed the combined equipment of NATO forces on the territories of its allies. Negotiators have not agreed to, but continue to discuss, 15 percent reductions in the number of combat aircraft[2] and helicopters and to discuss reductions in active military personnel. These specific agreements correspond largely to the NATO proposal advanced in March 1989 and to President Bush's subsequent proposal in May 1989.

The Warsaw Pact has not only largely agreed to the NATO proposal but has suggested second- and third-stage reductions of greater magnitude. Warsaw Pact negotiators have suggested Phase II reductions of an additional 25 percent in equipment and personnel. In Phase III, they suggest further reductions and a restructuring to defensive postures. Warsaw Pact and NATO negotiators have agreed in general terms to reductions beyond Phase I--although discussions on Phase II and III reductions have been informal, further reductions of 50 percent have apparently been discussed.[3] This analysis addresses CFE I reduc-

[1]Agreements are not inevitable, although the rapid pace of negotiations suggests that only major unresolved disputes between NATO and the Warsaw Pact (or perhaps disputes within each alliance) will prevent agreement in the near to medium term.

[2]The main obstacle to agreement in this category is the difference in NATO and Warsaw Pact definitions of combat aircraft. The Warsaw Pact excludes interceptor and training aircraft from their total. The United States tabled a compromise calling for a new limit on combat planes and the establishment of separate limits on air defense interceptors and training aircraft. Gordon, 1990.

[3]Dean, 1989, p. 31.

tions and assumes 10 percent reductions in designated equipment and personnel.[4]

CFE, GERMAN REQUIREMENTS, AND RESOURCES

National reductions in equipment and personnel will depend upon final definitions of armaments (such as the inclusion or exclusion of equipment in storage and the precise definition of main battle tanks) and the degree of reduction across participating nations (equal or unequal reductions across participants); however, CFE I will almost certainly reduce overall requirements and the costs of West German modernization as well as West German defense resources, as the perception of the likelihood of war in Europe decreases.

Requirements

The German MoD recently announced a planned restructuring of its forces in anticipation of successful CFE talks. The MoD has implied, although not directly stated, that these changes will not occur in the absence of a CFE agreement. At the same time, it has acknowledged that its Bundeswehr 2000 goals are overambitious and unrealistic.[5]

The MoD is attempting to adopt a more flexible planning process early on should CFE succeed.[6] Although the details are limited and may change considerably following reunification, they do provide sufficient information to draw broad insights into German military structure and thus modernization requirements following CFE agreement.

West German strategy and structure will change only slightly following first-stage CFE agreement. The Bundeswehr emphasizes that its post-CFE structure does not include abandoning NATO's forward defense concept or the Bundeswehr's basic missions.[7] However, the post-CFE Bundeswehr plan also notes that its eventual strategy and structure depend on the posture of Warsaw Pact forces as determined by second- or third-stage CFE reductions. In the short term, however, the Bundeswehr expects that the danger of a short warning attack will persist. The Bundeswehr has accordingly continued to emphasize its requirements for increased command and control, intelligence, and mobility capabilities.

---

[4]Fifteen percent for aircraft and helicopters.

[5]Foreign Broadcast Information Service, 1989b.

[6]Naumann, 1989, p. 32.

[7]Presse- und Informationsamt der Bundesregierung, 1989, p. 2. Also see Naumann, 1989.

Equipment requirements should fall modestly under post-CFE plans. There are no major changes in requirements for the air force, although it will direct its efforts toward air defense and reconnaissance. Average reductions of 15 percent may occur in line with current CFE I goals.

The navy should experience slightly larger decreases in modernization requirements, although these appear unlikely to be directly tied to CFE agreement. The Bundeswehr intends to maintain "fewer, more modern" ships, although it declines to specify the number of reductions.[8] Plans include reductions in the number of submarines, minelayers, MCMVs, and fast attack craft. The Bundeswehr may reduce its total number of ships by 50 percent, although that amount is probably exaggerated.[9]

The greatest changes in modernization plans are expected in the army, although its basic structure, including the number of corps and divisions, will remain unchanged. Two of the mechanized divisions will be capable of only defense and delay operations rather than attack, defense, and delay operations as planned in the Bundeswehr 2000.[10] The army's basic goals of improved technology, mobility, and a greater reliance on reserves remain. Six brigades will be cut from the Field Army after CFE I agreement, leaving a total of 35 brigades.[11] (Additional cuts may occur after 1995 if further arms control efforts are successful.) The Territorial Army should include the Franco-German brigade and six home defense brigades, including nine home defense regiments (skeletonized in peacetime).

Reductions in German modernization requirements in two cases are assumed. In the first case, CFE I is assumed to reduce army and air force production requirements 10 percent for main battle tanks, armored troop carriers, and artillery, and 15 percent for combat aircraft and helicopters.[12] For example, CFE I would reduce the planned replacement of Marder 2 APVs from 2,100 to 1,890 and would reduce Germany's PAH-2 procurement from 212 to 180. Reductions of 30 percent in the navy's procurement of submarines, minelayers, MCMVs, and fast attack craft are also included. (Corresponding reductions in minor equipment and other expenditure categories, including personnel, are addressed in the next section since these affect major equipment production resources as defined by the residual budget model.)

---

[8]Presse- und Informationsamt der Bundesregierung, 1989, pp. 4–5.

[9]*Frankfurter Allgemeine Zeitung*, 1989d.

[10]Ibid.

[11]Presse- und Informationsamt der Bundesregierung, 1989, p. 3.

[12]These figures represent force *ceilings* and thus larger reductions are possible, but not planned.

In the second case, CFE I reductions of 10 and 15 percent are applied to all army and air force equipment, respectively, whether it is included or excluded from CFE negotiations. Fifty percent reductions in navy submarines, minelayers, MCMVs, and fast attack craft modernization requirements are also included in this case.

Specific reductions in the production of major equipment under CFE I are assumed to result in equivalent reductions in expenditures. For example, a 10 percent reduction in main battle tank requirements is assumed to lead to a 10 percent reduction in estimated 1990–2005 expenditures on main battle tanks.[13] Estimated German CFE I major equipment production requirements in the middle-case scenario (i.e., including 5 percent annual cost growth to system in-service date) are shown below. CFE I(A) and CFE I(B) represent the first and second cases, respectively. As Table 15 indicates, aggregate requirements decline between 10 and 15 percent.

Resources

Agreement to reduce conventional forces in Europe will probably lead to decreases in available resources in NATO Europe, including Germany, as the perception of the likelihood of war in Europe declines. Germany's aggregate defense spending, fairly constant in real terms since 1985, may begin to decline in real terms under CFE agreements,

Table 15

MIDDLE-CASE GERMAN REQUIREMENTS UNDER CFE ASSUMPTIONS
(Millions of DM 1987)[a]

Service	Current	CFE I(A)	CFE I(B)
Army	77,380	70,645	69,640
Air force	81,810	74,895	69,540
Navy	34,350	30,805	28,440
Total	193,540	176,345	167,620
Change from current requirement (percent)	—	-9.7	-15.4

[a]Some numbers are rounded.

[13]This may be a somewhat optimistic assumption since current equipment cost estimates reflect current expected production runs. Shorter production runs, particularly for aircraft, are likely to result in higher per unit costs. Thus, a 10 percent reduction in requirements may lead to less than a 10 percent reduction in expenditures.

particularly with large force reductions in CFE Phases II and III. It is difficult to assess the potential magnitude of these reductions, although eventual decreases of perhaps several tens of percent (roughly corresponding with force reductions) may occur.

For the purposes of this analysis, aggregate German defense budgets under a CFE I agreement are assumed to remain flat in real terms. (This reflects roughly the same rate of growth in the middle-case earlier in this report and probably overstates budget levels following CFE I agreement.) CFE I is further assumed to result in average 10 percent reductions between 1990 and 2005 in all nonpersonnel budget categories, including operations, R&D, and minor equipment production. (Air force and navy maintenance reductions of 15 percent are included based on expected force reductions.) These assumptions increase available resources for major equipment production because of budgetary model construction.

Reductions in civilian and active military personnel based on recent MoD information are included in these resource estimates. Reductions in personnel also increase resources for major equipment production.

Civilian personnel reductions post-CFE I are not available. However, these are likely. This analysis estimates civilian personnel reductions of 10 percent.

More detailed planned reductions of active force personnel are available.[14] In the aggregate, the number of active personnel will be reduced from 495,000 to 470,000. This latter figure includes 10,000 reserve duty training and 40,000 Standby Readiness component personnel, indicating that the number of year-round active duty personnel will total 420,000, a reduction from 456,000 in Bundeswehr 2000 plans. Reductions are scheduled to begin in 1992 but not completed until 1995.[15] Additional reductions to 400,000 are possible if subsequent CFE agreements are reached.[16]

The number of professional soldiers is expected to fall from 96,000 to 92,500; the number of temporary careerists will decrease from 158,000 to 147,500 and conscripts from 206,000 to 180,000.[17] No major

---

[14]For information on active personnel reductions, see Foreign Broadcast Information Service, 1989c, 1989d; Schulte, 1989.

[15]Presse- und Informationsamt der Bundesregierung, 1989, p. 5. Also see *Süddeutsche Zeitung*, 1989; *Frankfurter Allgemeine Zeitung*, 1989a, 1989d.

[16]Some reports suggest lower levels. Foreign Broadcast Information Service, 1989a, p. 4 reports 380,000. Some in the Bundestag propose 250,000. Foreign Broadcast Information Service, 1989c; *Frankfurter Allgemeine Zeitung*, 1989d. For the SPD position, see Gerster, 1989. For the Green position, see Mechtersheimer, 1989.

[17]The service breakdown is 297,000 army, 91,200 air force, and 31,800 navy. No changes are planned in WHNS of 1.34 million.

changes are planned for reserve forces; however, full mobilization of reserves will take up to seven days rather than the current two.[18]

These expected personnel reductions have led planners to question the need for a service extension from 15 months to 18 months.[19] The SPD and Green parties propose a 12 month service period.[20] An independent commission may be established to determine service length.[21]

Based on these reductions in personnel, operations, and minor equipment, resources for the production of major equipment items are projected at DM 112 billion from 1990 to 2005. As noted above, a range of requirements under CFE I of DM 168 to 176 billion is projected.

---

[18]Foreign Broadcast Information Service, 1989d.

[19]*Frankfurter Allgemeine Zeitung*, 1990a; Foreign Broadcast Information Service, 1989b; and *Frankfurter Allgemeine Zeitung*, 1989d, and 1989e.

[20]Mechtersheimer, 1989; and Gerster, 1989.

[21]*Frankfurter Allgemeine Zeitung*, 1989e; and *Der Spiegel*, 1989.

changes are planned for reserve forces; however, full mobilization of reserves will take up to seven days rather than the current two.[18]

These expected personnel reductions have led planners to question the need for a service extension from 15 months to 18 months.[19] The SPD and Green parties propose a 12 month service period.[20] An independent commission may be established to determine service length.[21]

Based on these reductions in personnel, operations, and minor equipment, resources for the production of major equipment items are projected at DM 112 billion from 1990 to 2005. As noted above, a range of requirements under CFE I of DM 168 to 176 billion is projected.

---

[18]Foreign Broadcast Information Service, 1989d.

[19]*Frankfurter Allgemeine Zeitung*, 1990a; Foreign Broadcast Information Service, 1989b; and *Frankfurter Allgemeine Zeitung*, 1989d, and 1989e.

[20]Mechtersheimer, 1989; and Gerster, 1989.

[21]*Frankfurter Allgemeine Zeitung*, 1989e; and *Der Spiegel*, 1989.

VI. THE RESOURCE-REQUIREMENTS IMBALANCE

Section II estimated total major equipment requirements for German armed services from 1990 to 2005, reflecting required funding for major equipment production. Aircraft munition expenditures are subtracted from aggregate requirements to avoid possible double counting, reducing requirements about 2 percent. Requirements can then be compared with resources projected by the budget model.

RESOURCE-REQUIREMENTS IMBALANCE IN THE ABSENCE OF ARMS CONTROL

Major Equipment Funding Shortfalls

Table 16 illustrates major equipment requirements, resources, and shortfalls as estimated by the budget model. These figures represent the difference between major equipment production resources and requirements.

Table 16 indicates a variety of resource-requirements results. Available resources for major equipment, as calculated in the budgetary model, are listed across the top. Requirements for major equipment, as estimated in Sec. II, are listed along the left side of the table. The

Table 16

MAJOR EQUIPMENT FUNDING SHORTFALL
(Billions of DM 1987)[a]

	Resources		
Requirements	High (190)	Middle (74)	Low (5)
Low (141)	50[b]	-67	-136
Middle (191)	-1	-117	-186
High (230)	-40	-156	-225

[a]Some numbers are rounded.
[b]Surplus.

middle case results in a DM 117 billion shortfall, representing 14 percent of the projected defense budget from 1990 to 2005. A low requirement-high resource scenario results in a DM 50 billion surplus, and a high requirement-low resource scenario results in a DM 225 billion shortfall. This high requirement-low resource scenario shortfall represents a 29 percent defense budgetary shortfall.

Funding shortfalls across land, sea, and air budget categories may roughly indicate army, navy, and air force major equipment funding shortfalls, respectively. In the middle case, land, sea, and air shortfalls total DM 47, 23, and 45 billion, or 41 percent, 20 percent, and 39 percent shares of the total shortfall, respectively. Land, sea, and air average historical shares of total major equipment production are 52 percent, 11 percent, and 37 percent,[1] respectively; thus, the sea category (roughly corresponding to the navy) appears the greatest underfunded based on projected shortfall to production share ratios.

Defense Budget Shortfalls

Equipment shortfalls represent the difference between major equipment production resources and requirements and understate an additional increase in aggregate defense spending necessary to eliminate major equipment production shortfalls caused by including several variable expenditure categories such as maintenance, minor equipment production, and operations in the budgetary model. These expenditures result in lower available resources for major equipment production. Table 17 indicates aggregate defense budget increases necessary to eliminate major equipment shortfalls and to pay for additional maintenance, minor equipment production, and variable operations expenditures.

Table 17 indicates aggregate defense budget shortfalls roughly 38 percent greater than the major equipment shortfalls described in Table 16.[2] For example, in the middle case, the shortfall is DM 161 billion, or roughly 19 percent of aggregate spending during the 1990–2005 period. In the high requirement-low resource case, the aggregate defense budget shortfall is DM 309 billion, representing a 40 percent budget shortfall. In the low requirement-high resource case, a DM 68 billion surplus is projected.

[1]Numbers do not add because of rounding.

[2]Aggregate defense budget surpluses are similarly 38 percent greater than equipment surpluses.

Table 17

DEFENSE BUDGET FUNDING SHORTFALL
(Billions of DM 1987)[a]

	Resources		
Requirements	High	Middle	Low
Low	68[b]	-92	-186
Middle	-1	-161	-255
High	-55	-215	-309

[a]Some numbers are rounded.
[b]Surplus.

Temporal Distribution of Shortfalls: *Middle Case*

A comparison of spendout rates for major equipment production with resources estimated by the budget model provides a crude temporal measure of major equipment production shortfalls.

In order to assess the magnitude of requirements over approximate five-year intervals, middle-case production expenditures are assumed to correspond directly with IOC dates discussed above. For example, production expenditure for the NFR-90 is assumed to occur in 1996, or in the 1996–2000 time period.[3] Estimated spendout rates for equipment demonstrate an uneven shortfall distribution over the 15-year period examined. In particular, estimated shortfalls are the greatest in the 1996–2000 period. Table 18 indicates estimated shortfalls for approximate five-year periods in the middle-case scenario. The largest estimated middle-case equipment shortfall occurs in the 1996–2000 period.[4] This corresponds to an apparent large increase in equipment requirements, including the Bundeswehr's planned initial purchases of EFA, as well as PAH-2 helicopters and Marder 2 armored fighting vehicles. The major equipment production shortfall in this period is roughly two-thirds of the aggregate 1990–2005 shortfall. In short, under current modernization goals, the Bundeswehr may experience its greatest difficulty in the 1996–2000 time period.

[3]There are minor exceptions to this simple rule. For example, large expenditures, such as those for PAH-2, EFA, Type 212, Type 123, and P-3, have been spread over ten- rather than five-year periods.

[4]If resources are averaged over the 15-year period, the relative magnitude of the 1996–2000 shortfall diminishes, although it remains considerably greater than shortfalls in other periods.

Table 18

TEMPORAL DISTRIBUTION OF EQUIPMENT SHORTFALLS: MIDDLE CASE
(Billions of DM 1987)[a]

Period	1990–1995	1996–2000	2001–2005
Resources	40	21	13
Requirements	61	92	36
Shortfall	-21	-72	-23

[a]Some numbers are rounded.

REQUIREMENTS-RESOURCES IMBALANCES UNDER CFE I

Major Equipment and Defense Funding Shortfalls

Table 19 illustrates major equipment requirements and contrasts these with resources as estimated by the defense budget model under CFE assumptions. These figures represent the difference between resources and requirements defined according to arms control assumptions in Sec. V. Once again, minor accounting adjustments that reduce German requirements, highlighted above, are necessary to contrast requirements with available resources.

Much smaller shortfalls exist under these assumptions. CFE agreement reduces defense budget shortfalls from 19 percent (the estimated middle-case figure in the absence of arms control) to between 9 and 10

Table 19

MAJOR EQUIPMENT AND DEFENSE BUDGET SHORTFALLS: CFE I REQUIREMENTS[a]

	CFE I(A)	CFE I(B)
Major equipment requirements	173,770	165,430
resources	111,620	111,620
shortfall	-62,155	-53,815
Defense budget shortfall	-85,460	-73,995
Defense budget shortfall/ defense spending	10.3%	9.0%

[a]Some numbers are rounded.

percent. (These figures reflect flat defense spending. Lower annual increases, more likely following CFE agreement, result in larger shortfalls.) CFE I agreement will reduce modernization requirements and major equipment and defense budget shortfalls; however, CFE I will not eliminate shortfalls. Further reductions in requirements, such as those discussed in CFE II and III, increases in resources, or both, may be necessary to avoid future shortfalls.

Reductions in defense resources, arguably more likely after CFE I agreement, may exacerbate shortfalls. For example, under CFE IB requirements (i.e., a 13 percent reduction in major equipment requirements) and a defense budget decline of 2 percent per year, equipment and defense budget shortfalls increase to DM 118 and 162 billion, respectively. The latter represents a 20 percent defense budget shortfall. To meet CFE I requirements in the middle-case, the defense budget must increase at an average annual rate of almost 2 percent.

CONSERVATIVE NATURE OF THE MODEL AND REQUIREMENTS

The conservative nature of the model and cost estimates about major equipment requirements probably understate the magnitude of these funding shortfalls. For example, the model uses optimistic assumptions about some operations and minor equipment categories (no or little real growth), despite some historical evidence that operating and maintenance costs increase over time.[5] These assumptions probably overstate available major equipment resources.

Conservative requirement estimates also contribute to understating budgetary shortfalls. As indicated in Sec. II, for example, items already in production were assumed to incur no additional cost growth. Modest cost growth after initial production is not uncommon, however. Similarly, shortfalls may be somewhat understated since requirement cost estimates have used the lowest realistic cost estimates. In some cases, requirements for some minor equipment items, such as rifles, have been ignored. Finally, estimating requirements over this long time period invariably understates requirements in distant out-years. For example, although this report focuses on requirements from 1990 to 2005, 90 percent fall in the first ten years, or 67 percent of the time period. Many of these eventual requirements reflect likely mid-life upgrades and equipment replacement not yet anticipated.

[5]For example, maintenance expenditures appear to maintain a constant share of procurement in Germany's sea procurement category. The model estimates German air and land maintenance expenditures as constant real expenditures, perhaps understating maintenance expenditures.

Tables 16 and 17 indicate a fairly wide range of shortfalls (and two surplus cases), although the shortfalls illustrated in the bottom two rows and two right-hand columns are more likely. The low requirement-high resource surplus assumes 2.5 percent per year real defense budget growth, no equipment cost growth, and no increase in active force wages despite the declining youth cohort. The likelihood of each of these is remote. In particular, the declining youth cohort will affect personnel costs, and equipment requirements, particularly air systems, are likely to experience substantial unanticipated cost growth.

Other shortfalls in the table are more likely. Requirements based on modest equipment cost growth of 5 to 8 percent, as indicated by the bottom two rows, are more likely based on historical cost growth information. (This may tend toward 5 percent in Germany since many modernization efforts center around army land equipment, which typically experiences slightly lower cost growth than many air and sea systems.) Similarly, middle- or low-case resources, indicated in the two right-hand columns, are more likely than an annual 2.5 percent increase; historical data indicate that defense budget growth nearer the middle case of .4 percent would be expected if threat perceptions remain stable.

VII. CONCLUSIONS

PLACING SHORTFALLS IN THE PROPER CONTEXT

The magnitude of projected shortfalls should be put into the appropriate perspective. First, conventional arms control agreements and the continued rapid changes in Eastern Europe will almost certainly reduce Bundeswehr modernization requirements. However, a reversal of Soviet and Eastern European reforms and an increased threat perception remain possible. Should this occur and German leaders decide to pursue Bundeswehr 2000 modernization goals, substantial shortfalls are probable.

Second, the magnitude of shortfalls should be viewed from a force planning perspective. For example, the middle-case shortfall in the absence of arms control, DM 161 billion, represents a 19 percent budget shortfall. The middle-case shortfall under CFE I is DM 74 billion, or a 9 percent shortfall; long-term projected shortfalls of that size are not uncommon. The 19 percent shortfall would probably cause alarm among planners, who would modify plans. The 9 percent shortfall would not cause planners to make major changes, but it is based on flat budgets. If planners are not confident about maintaining this level of resources, shortfalls would probably cause corrective actions to be taken.

These potentially large shortfalls are also less daunting when placed in a broader economic context. For example, even the low resource-high requirement shortfall of DM 309 billion (a 40 percent budget shortfall) represents not a technical problem, but a policy choice to limit defense spending. Additional defense resources of this magnitude are unlikely given historical federal budget priorities; however, the magnitude of this shortfall against total federal outlays or West German GDP is very small. For example, this shortfall is comparable to a single year of on-budget expenditures or about one-half of annual West German federal outlays. This shortfall is even smaller compared with West German GDP, representing less than 1 percent of GDP between 1990 and 2005. A commitment to increase defense spending is unlikely, but it is possible if the threat of Soviet attack increases.

EFFECTS ON THE SECURITY DEBATE

Projected shortfalls may accelerate the security debate and lead to arguments for large conventional force reductions and correspondingly large budget savings. Some political leaders may argue for a German equivalent of the "peace dividend" and a redirecting of defense resources to domestic programs. For example, some may argue that the costs of modernizing the GDR infrastructure prevent continued large defense budgets. The combination of continued reforms in the East with budgetary woes provide strong arguments for very large reductions or at a minimum a public debate on West Germany's security requirements. This will probably intensify the debate on West Germany's role in NATO, NATO's legitimacy and strategy, and the need for and role of the Bundeswehr.

Projected shortfalls could marginally weaken Germany's commitment to NATO. Although a majority of each party's members support continued membership, large projected shortfalls might lead to increased criticism of the social costs of the Bundeswehr, which could stir up the debate about German neutrality. An exodus from alliances by the two Germanys (or a reunified Germany) to gain international support for reunification currently appears unlikely, although recent events suggest a neutral reunified Germany (or a Germany not integrated into NATO's command structure) may be more palatable to the West than was once thought.

Large shortfalls will almost certainly accelerate the debate on NATO strategy, particularly NATO's forward defense concept. The need for forward defenses will diminish as the perceived threat of a surprise Soviet attack falls. Large shortfalls would probably cause substantial cuts in active personnel and readiness, and these will diminish the credibility of the forward defense concept. Such cuts might lead to a new military structure emphasizing lighter, more mobile forces.[1] Germany's adoption of this alternative would force major revisions in NATO strategy and the composition of national contributions to NATO.

Bundeswehr restructuring will undoubtedly occur in light of change in the East. However, political leaders might argue for changes in West Germany's grand security strategy. Decreased threats from the East and continued friendly relations with the West pose the question of defining Germany's security interests. Should West German forces continue to be poised for combat against increasingly unlikely threats from the East? As Ostpolitik is revived in Eastern Europe, will West

[1]A major restructuring might provide no short-term budget relief since restructuring would require budget increases to purchase new equipment.

German forces continue to prepare to battle Polish, Hungarian, or Czech forces? Are larger shifts plausible, including an increased international peacekeeping role commensurate with West Germany's economic power? Answers to these questions depend on developments in the East, but their frequency will almost certainly increase as economic and demographic pressures intensify the debate on the Bundeswehr.

REACTIONS BY BUNDESWEHR PLANNERS

Reactions by MoD planners will vary largely depending on the emerging security environment and the results of West Germany's security debate. However, if substantial shortfalls are likely, planners may be forced to make difficult choices, from stretching out procurement purchases to large personnel reductions and abandoning the capability to perform specific missions.

Reductions in Active Personnel

A continuation of current trends will undoubtedly lead to reductions in active service personnel considering Germany's youth cohort decline and the expected increases in wages resulting from this decline. (The drafting of women or immigrants, although unlikely, would solve the manpower problem regardless of progress at CFE.)[2] As noted above, Bundeswehr planners have already drafted plans to reduce active personnel strength following a CFE I agreement. That requirement may be reduced further as Soviet forces are withdrawn from the GDR and the threat of a surprise attack falls. Similarly, moves toward highly mobile forces may reduce active personnel requirements. In both cases, however, the need for reservists would probably increase.

Minimum operational requirements for forward defense operations limit the possibilities for large personnel cuts without changes in NATO strategy. In particular, the Bundeswehr is hesitant to reduce the number of active personnel below 456,000, fearing that would endanger forward defense operations.[3] However, West German political leaders tend to ignore such military requirements as the operational

[2]The continued influx of East German youth could conceivably do much to alleviate West Germany's manpower problem.

[3]*Frankfurter Allgemeine Zeitung*, 1989a. For a more detailed description of the operational minimum and the debate surrounding it, see Davis et al., 1989. Davis argues that the operational minimum, measured in division equivalents, is between the low 20s to the mid-30s, depending on terrain, military judgments, and other assumptions. It could be lower with stabilizing measures, such as confidence-building measures.

minimum because the security debate is most often driven by political and economic rather than military factors.[4] The possibility of large personnel cuts below the operational minimum cannot be ruled out even in the absence of changes in NATO strategy. German personnel reductions below operational minimums may themselves provide the catalyst for changes in NATO strategy.

Reduction in active strength personnel would reduce German personnel expenditures and budget shortfalls. For example, in the middle case, active force personnel expenditures would fall about DM 1.5 billion annually for every 10 percent reduction in personnel. A gradual reduction of just over 20 percent (to 400,000 active personnel) would result in savings of DM 25 billion between 1990 and 2005, reducing shortfalls modestly or better, depending on arms reductions.

Reductions in Readiness

German planners might also mitigate the effects of a substantial shortfall by decreasing readiness if the Bundeswehr and NATO shift away from forward defense strategy. Fifty percent decreases in operating and maintenance expenditures in the middle-case scenario would save more than DM 30 billion over the 1990–2005 time interval.[5] Such a large reduction would unquestionably diminish the fighting capabilities of German forces, particularly in a short-warning attack scenario, and would be undertaken only after large asymmetric Warsaw Pact cuts.

Stretching Out Equipment Purchases

MoD planners may also consider stretching out equipment purchases. Big-ticket items, such as EFA, may be particularly susceptible to stretchout or cancellation. Changes in strategy, influenced by the security debate, may influence the choice of postponements. Postponing the in-service dates of several major equipment programs (Kampfwagen 2000, Marder 2, PAH-2, EFA, RF-4E replacement, M-SAM, NFR-90, and NH-90) by five years would reduce equipment expenditures in the short term.

Stretching out these programs would result in savings of at least DM 46 billion. However, major equipment expenditures, particularly maintenance expenditures, might increase in the longer term as older

[4]Asmus, 1989, p. 55.

[5]One potential target is funds for low-level Luftwaffe operations. Also, the MoD announced that army exercises would be greatly reduced because of public opposition. *Jane's Defence Weekly*, 1988b, p. 1446; and *The Economist*, 1988, p. 58.

equipment in need of replacement experiences higher failure rates. For example, a decision to postpone EFA production and in-service dates would force F-4F aircraft to remain in operation beyond their desirable retirement dates.[6] This might also lead to greater maintenance expenditures. Moreover, if existing equipment is forced to operate beyond its useful lifetime, its marginal contribution to the defense effort may scarcely be worth its marginal costs of operation. Finally, stretching out equipment purchases may mitigate short-term funding difficulties, although this inflates long-term requirements and makes them more difficult. For example, postponing these equipment projects five years might allow the MoD to modernize (although later than intended) as planned; however, funding levels for later planning periods would be more tightly constrained and the MoD would be even less likely to achieve its modernization goals beyond 2005.

Abandoning Missions

The German MoD may be forced as a last resort to abandon or sharply curtail its capability to perform some missions even if large reductions in Warsaw Pact forces do not occur. As noted earlier, two of the army's mechanized divisions will be capable only of defense and delay operations, rather than attack, defense, and delay operations as planned in Bundeswehr 2000. Additional reductions in the threat of attack might lead to similar actions for remaining divisions or other assets. There are currently no discussions within the MoD to consider this alternative, but the changing security environment may increase the probability of this option. The emergence of "defensive" strategies would probably have the greatest effect on the future composition of Bundeswehr missions.

The German MoD may reduce active personnel requirements, postpone or cancel equipment purchases, or reduce readiness levels to mitigate future shortfalls. Marginal reductions in personnel and equipment may be the most likely response to modest shortfalls. For example, a 20 percent active force personnel reduction, a 50 percent maintenance reduction, along with the postponement of several major modernization programs as outlined above essentially eliminate the pre-CFE middle-case defense budget shortfall. Reductions in requirements, as outlined in CFE, would allow Bundeswehr planners to make more modest reductions in personnel, equipment, and readiness, provided that defense resources do not fall precipitously.

---

[6]Postponing production in the collaborative EFA project seems unlikely unless EFA sales are made to third parties. In that case, early EFA production lots *could* be sold overseas and later production lots could be delivered to Germany. Overseas sales before German, British, Italian, or Spanish EFA operations also seem unlikely.

IMPLICATIONS FOR THE NATO ALLIANCE

The way German military planners react to future financial shortfalls has implications for NATO planners and NATO strategy. Perhaps most important, German decisions to greatly diminish their military capabilities may lead to similar actions by the Low Countries and Denmark. A German decision to cut active personnel and readiness would mean almost certain changes in NATO's strategy.

As noted earlier, there are apparently no formal discussions within the MoD indicating plans to abandon the capability to perform specific missions. However, given the potential magnitude of funding shortfalls (particularly those in the high requirement-low resource scenario) and the continued rapid changes in the East, abandoning or curtailing mission commitments may have to be examined.

Bundeswehr 2000 modernization goals seem impossible to achieve over the coming 15 years. Reductions in modernization requirements, as outlined in CFE I, greatly reduce projected shortfalls and make modernization goals more realistic; however, CFE I modernization goals are attainable only if defense spending remains flat or increases slightly. Political pressures on spending, exacerbated by spending requirements of nondefense federal expenditure categories, may make flat budgets difficult to achieve. These potentially large defense budget shortfalls will probably accelerate the internal German debate on the role of NATO, its strategy, and the legitimacy and missions of the Bundeswehr. In the end, deeper cuts through subsequent CFE talks may be required to achieve Germany's modernization goals.

Appendix A

GERMAN FEDERAL BUDGET EXPENDITURES

The German federal budget contains 26 expenditure categories.[1] (It excludes off-budget social security expenditures financed by payroll deductions, which are greater than the on-budget expenditures described here.) Labor and Social Affairs; Transportation; Defense; Youth, Women, and Medical Research; and the federal debt account for 80 percent of all expenditures. Table A.1 describes the 1988 federal budget.[2]

In the discussion of nondefense expenditures in Sec. III, category 11 (Labor and Social Affairs) expenditures include assistance to war victims, unemployment compensation, and various on-budget social security assistance schemes. Category 15 (Youth, Women, Family, and Health) includes youth support as well as modest expenditures on medical research activities.

LABOR AND SOCIAL AFFAIRS

The Labor and Social Affairs category contains 13 separate expenditures. In 1988, these totaled nearly DM 61 billion or about one-fourth of all on-budget federal expenditures. Assistance to war victims, unemployment compensation, and on-budget social security assistance account for virtually all such expenditures. Table A.2 describes the 1988 expenditure composition of Einzelplan 11. Pensions and medical and accident insurance account for two-thirds of total labor and social affairs expenditures. Approximately 60 percent of all on-budget social security expenditures (DM 24 billion) are earmarked for pensioners.[3] This payment represents the use of general government revenues to reduce or eliminate the pension fund shortfall. Assistance to war victims and unemployment compensation constitute about 12 percent and 20 percent, respectively, of total labor and social affairs spending. Less than 2 percent of all spending is accounted for by other minor administrative functions.

[1]This number has varied slightly over time.

[2]The introduction and elimination of various categories since 1965 explain the inconsistent numbering in this table.

[3]Based on conversations with German embassy officials.

Table A.1

GERMAN FEDERAL BUDGET
EXPENDITURES, 1988
(Millions of DM)

Category	Expenditure
1. President	22
2. Parliament	589
3. Federal Council	15
4. Chancellor	535
5. Foreign Ministry	2,654
6. Interior Affairs	3,956
7. Justice	454
8. Finance	3,735
9. Economics	6,386
10. Nutrition, Agriculture, and Forestry	8,555
11. Labor and Social Affairs	60,956
12. Transport	25,828
13. Postal Services and Communications	22
14. Defense	51,404
15. Youth, Women, Family, and Health	19,382
16. Environment and Reactor Safety[a]	495
19. Constitutional Protection	14
20. Accounting Office	52
23. Economic Cooperation	6,848
25. Urban Planning	6,137
27. Intra-German Relations	1,101
30. Research and Technology	7,564
31. Education and Research	3,458
32. Federal Debt	35,879
33. Federal Employee Pensions[b]	10,212
35. Wartime Host Nation Support	1,810
36. Civil Defense	883
60. General Administration	16,413
Total	274,864

[a]Established in 1987.

[b]Includes some widows' benefits.

Table A.2

1988 EINZELPLAN 11 EXPENDITURES
(Millions of DM)

Category	Expenditure
Assistance to war victims	12,234
Unemployment compensation	8,137
Social Security, including pensions, medical, accident insurance	39,503
Other	732
Total	60,696

Future labor and social expenditures may be estimated based on notional changes in pension contributions and benefits, demographic changes, expected changes in health care costs, and assumptions about cost-of-living adjustments.

War Victims

Expenditures for war victims, currently about DM 12 billion annually, should decline over the next two decades. Assuming that the beneficiaries of these expenditures are age 45 or greater,[4] war victim benefits should decrease from 1990 to 2005 by about 35 percent based on the decline in eligible beneficiaries from about 15 million in 1989 to slightly less than 10 million in 2005.

Pensions

Pension expenditures in Einzelplan 11 represent on-budget government expenditures necessary to eliminate or greatly reduce the off-budget pension fund deficit. In 1988, for example, on-budget pension expenditures increased to DM 24 billion or about 6 percent of aggregate off-budget pension expenditures. Such expenditures may increase in the future as the off-budget pension fund deficit increases.

The pension fund deficit may grow with the number of eligible pensioners and as the number of workers contributing to the pension fund decreases. Citizens in Germany are eligible for pension benefits if they

[4]It is unclear whether beneficiaries are only surviving adult Germans from the World War II era or whether children of these survivors also receive benefits. This assumption limits beneficiaries to Germans who lived during the war.

have contributed to the pension fund and have reached retirement age.[5] The minimum retirement ages are 60 for women and 65 for men, although men can choose an adjusted retirement plan at age 63. The population age 65 or greater, illustrated in Table A.3, provides a useful surrogate measure for eligible pensioners. The number of eligible pensioners is expected to increase approximately 12 percent from 1990 to 2005.

The number of potential workers age 15–64 who contribute to the social security pension fund will drop considerably between 1990 and 2005.[6] Table A.4 illustrates changes in the 15–64 age cohort from 1990

Table A.3

PENSION AGE POPULATION
(Thousands)

Year	Pensioners[a]
1990	8,950
1995	9,477
2000	9,942
2005	10,050

[a]Author's estimates.

Table A.4

WORKING AGE POPULATION
(Thousands)

Year	Population age 15–64
1989	42,200[a]
1995	41,005
2000	40,070
2005	38,750[a]

[a]Author's estimate.

[5]This contribution to the pension fund must exceed a minimum level; however, workers must apparently contribute for at least 25 years if they are to be eligible. Presse- und Informationsamt der Bundesregierung, 1980.

[6]It is unclear whether the decline in workers will affect on-budget pension expenditures; however, it will undoubtedly affect off-budget receipts unless pension taxes are increased.

to 2005. The number of workers will decrease 8 percent between 1990 and 2005.

This increase in the number of eligible pensioners and decrease in the number of eligible workers may lead to larger off-budget pension fund deficits and require larger on-budget pension expenditures. Of course, the German federal government will almost certainly attempt to limit on-budget pension expenditures by decreasing pension benefits and increasing contributions from workers. However, the magnitude may be limited by political considerations.

It is difficult to forecast potential off-budget pension fund shortfalls and likely on-budget pension expenditures since changes in pension benefits and pension contributions per worker may vary greatly. Table A.5 describes two notional on-budget pension expenditures forecasts. Both are based on demographic factors noted above; however, the first assumes 8 percent decreases in pension benefits and 8 percent increases in worker contribution requirements between 1990 and 2000. The second assumes unchanged benefits and contributions per pensioner and worker, respectively. Pension benefits and pension contributions per worker are also assumed to increase at a rate of 2 percent per year in each case. This increase reflects cost-of-living and general economic condition increases. Forecast on-budget pension expenditures vary greatly with assumptions. In case 1, the average annual increase is small. However, this case assumes both increased fund contributions per worker and decreased benefits per pensioner. In case 2, the average annual increase is large, particularly between 1990 and 1995. This assumes unchanged contributions per worker and benefits per pensioner. On-budget pension expenditures may grow at a high rate in the next 15 years unless large changes in benefits and contributions are made. These large increases, representing more than the current defense budget, may create pressures to reduce defense and other federal government expenditures.

Table A.5

ON-BUDGET PENSION EXPENDITURE FORECAST
(Billions of DM 1987)

Expenditure	1990	1995	2000	2005
Case 1	24	29	31	41
Average annual increase (%)		4.2	1.3	6.5
Case 2	24	52	82	97
Average annual increase (%)		23.4	11.3	3.8

Employment Compensation and Accident and Medical Insurance

Expenditures for unemployment compensation and accident and medical insurance are estimated to remain at 1988 levels and are adjusted only to compensate for increases in real wage earnings. These have been estimated at 2 percent per year, which represents an annual increase just less than estimated real wage increases. Miscellaneous expenditures, which account for about 2 percent of total expenditures, are estimated to remain constant in real terms.

Table A.6 describes projected labor and social affairs expenditures to the year 2005. Annual increases are estimated at greater than expected GDP growth (and likely government expenditure growth) in all time periods.

WOMEN, YOUTH, FAMILY, AND HEALTH RESEARCH

Women, youth, family and health research contains eight categories and constitutes about 8 percent of federal on-budget expenditures. In 1988, expenditure in this area totaled nearly DM 20 billion. The majority of this expenditure appears related to the number of children in Germany, as Table A.7 illustrates.

Expenditures totaled approximately DM 16 billion or 83 percent of all Einzelplan 15 expenditures. The federal government pays children allowances to families based on the number of children in the family. Tax-free monthly allowances range from DM 50 for the first child to DM 200 for three or more children. Payments may remain in effect in some cases up to the child's age 29. Other expenditures, dominated by

Table A.6

LABOR AND SOCIAL AFFAIRS EXPENDITURE FORECAST
(DM millions)

Expenditure	1990	1995	2000	2005
War victims	11,990	10,730	9,600	8,600
Pensions	24,000	52,000	82,000	97,000
Other social	40,235	44,420	49,000	54,150
Total	76,225	107,150	140,600	159,750
Average annual increase (%)		7.0	5.6	2.6

Table A.7

1988 EINZELPLAN 15 EXPENDITURES
(DM millions)

Category	Expenditure
Children allowance	12,835
Education allowance	3,150
Other	3,397
Total	19,382

civil service for young men who do not serve in the military, make up the remaining expenditure of more than DM 3 billion.

Future women, youth, family, and health expenditures may be estimated using a simple model based on demographic changes, expected real increases in benefits, and changes in education allowances planned for the 1990s. Expected real increases in benefits are estimated at 2 percent per year. These changes are estimated to increase education allowance expenditures per child approximately 17 percent over current levels.[7]

Table A.8 indicates the changing composition of German youth to the year 2005 and the corresponding increases in expected federal on-budget women, youth, family, and health research expenditures. Children age 0 to 17 inclusive are included in the estimates of German

Table A.8

YOUTH POPULATION AND EINZELPLAN 15
FORECAST EXPENDITURES
(Population in thousands: expenditure
in millions of DM)

Category	1990	1995	2000	2005
Youth population (age 0–17)	11,029	11,243	11,318	10,500
Expenditures	19,400	21,840	24,280	24,700
Average annual increase (%)		2.4	2.1	.3

[7]Bundesminister für Arbeit und Sozialordnung, 1988, p. 2.

youth.[8] Table A.8 indicates the anticipated slight increase in the number of children between 1990 and 2000 and the subsequent decrease from 2000 to 2005. This translates into modest increases in expected expenditures in the 1990s, followed by flat expenditures in the early 2000s.

[8]Ideally, children age 0 to 22 might be more appropriate since many children who attend universities live at home and therefore receive the benefit. Data limitations require this perhaps less accurate measure.

Appendix B

THE DEFENSE BUDGET MODEL

THE BUDGET MODEL

A residual defense budgetary model estimates resources for the production of major equipment, forecasting a range of aggregate defense budgets from 1990 to 2005 and subtracting estimated expenditures for all nonmajor equipment production (personnel, minor equipment, and operations expenditures). The residual amount represents available resources for the production of major equipment. These resources are compared with a range of estimated major equipment production requirements to determine equipment production shortfalls.

DEFENSE BUDGET SHORTFALLS

The middle-case major equipment production shortfall of DM 117 billion represents the difference between major equipment production resources and requirements. This, however, understates additional increases in aggregate defense spending necessary to eliminate variable expenditure categories (maintenance, development, minor equipment production, and operations) in the budget model. Increases in aggregate defense spending do not translate into equal increases in major equipment production resources. For example, a DM 1 billion increase in aggregate defense spending translates into about a DM 727 million increase in major equipment production resources. Defense budget shortfalls represent aggregate defense budget increases necessary to eliminate major equipment shortfalls and to pay for all variable operations expenditures.

This estimation of defense budget shortfalls includes required increases for all variable expenditure categories (operations, development, maintenance, and minor equipment) and may overestimate defense budget shortfalls. For example, while maintenance and operations appear directly related to major production expenditures, it is less clear, in theory at least, that development and minor equipment expenditures are related to major production expenditures. This, however, is not reflected in historical data used to construct the budget model.

Aggregate defense budget shortfalls are calculated by substituting variables in the budget model to determine the relationship between major equipment resources M ($L_r + A_r + S_r$) and the aggregate defense budget, B. Substitution of variables leads to $M = .727 \times B$ – exogenous expenditures. (In the middle case, exogenous expenditures equal DM 545 billion.) $\partial M/\partial B$ equals .727; to eliminate a DM 1 billion equipment production shortfall, B must increase by 1/.224, or DM 1.38 billion. Aggregate defense budget shortfalls are about 38 percent greater than major equipment production shortfalls.

Appendix C

HISTORICAL EXPENDITURE DATA

Table C.1 contains planned German Einzelplan 14 expenditure data from 1965–1989. (Planned and actual expenditures show very minor differences.) All data are expressed in millions of current DM. Blank spaces indicate no reported expenditure for a given year.

Table C.1

GERMAN DEFENSE SPENDING STATISTICS, 1965–1989

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
1. Bundesminister	105	128	199	181	210	241	265	302	340	1264	390	408	424	442
-personnel	84	102	174	156	194	221	244	277	314	1233	359	371	388	404
2. General authority and administration	1575	1328	2844	1702	704	704	967	1219	1472	308	309	305	385	373
3. Military personnel	2478	2808	3207	3327	3418	3867	4535	5244	5432	5584	6951	6808	7081	7957
-Careerists	1970	2180	2446	2636	2651	3027	3539	4239	4404	4440	5710	5491	5763	6063
-Conscripts	243	316	298	291	299	372	489	493	468	500	575	636	661	631
Total personnel costs	2273	2556	2935	3078	3232	3673	4338	5024	5188	3597	6618	6467	6744	7001
4. Civilian personnel	1564	1847	2011	2070	2090	2411	2814	3303	3677	3737	4492	4736	4921	5120
-Personnel	1502	1780	1936	1989	2021	2333	2725	3193	3553	3597	4342	4578	4759	4955
5. Education	33	31	28	30	34	47	67	76	95	92	127	189	190	214
6. Religious affairs	13	16	17	16	17	20	23	26	27	29	33	34	35	36
7. Rights protection	2	2	3	3	3	3	4	4	5	5	6	6	6	6
8. Public health	201	183	174	164	182	202	229	247	287	312	333	338	361	373
10. Food	287	297	288	274	298	412	399	375	389	420	426	500	562	561
11. Clothing	254	191	237	211	134	141	179	257	313	415	409	323	249	331
12. Construction	3385	2990	3035	2760	2572	2499	2652	2870	3026	3468	3664	3637	3835	4020
13. Engineering	125	89	86	62	62	93	93	86	80	83	94	93	111	113
14. Communications	671	575	649	702	716	757	793	809	810	882	1013	1043	1082	1138
15. Land production	3605	2879	2874	2375	2275	2159	2432	2769	2953	3547	3737	4459	4521	5298
-Trucks	500	370	246	140	200	220	206	85	94	143	295	552	470	630
-Armored vehicles	650	700	994	720	550	380	575	774	889	840	850	1053	1030	1360
-Autos	108	70	0	0	0	0	0	0	0	0	0	0	0	0
-Tracked vehicles	6	1	0	3	1	5	8	4	0	0	0	0	0	0
-Munitions	1000	600	500	450	500	630	625	626	670	899	965	1099	1119	1250
-Other land production	320	156	170	110	270	200	260	221	216	553	514	530	550	580
-Maintenance	978	934	918	919	698	666	698	996	1008	1037	1043	1141	1261	1388

Table C.1—continued

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
16. NBC	40	36	40	37	37	52	37	30	31	34	36	45	52	57
17. Quartermaster	258	227	237	263	328	288	285	277	305	457	644	569	583	612
18. Sea production	623	596	631	535	517	565	599	809	900	910	894	944	945	1081
-Ship production	508	473	493	370	357	381	400	492	545	570	555	595	500	650
-Maintenance	103	112	130	160	155	180	195	310	347	330	330	340	436	420
-Miscellaneous operations	12	11	8	5	5	4	4	7	8	10	9	9	9	11
19. Air production	2134	1663	1768	2091	2507	1985	2144	2266	2395	3037	2945	2718	2736	2972
-Aircraft production	1216	825	925	1233	1650	1150	1220	1030	948	1264	1125	725	57[a]	505
-Security devices	21	15	73	103	103	80	100	140	70	0	0	0	0	
-Airport expenses	112	68	0	0	0	0	0	0	0	0	0	0	0	
-Maintenance	770	740	750	737	740	740	810	1074	1323	1400	1330	1150	1125	1120
-Tornado	0	0	0	0	0	0	0	0	30	106	160	410	790	1100
-Alphajet	0	0	0	0	0	0	0	0	240	300	400	210	210	
-Miscellaneous operations	15	15	20	18	14	15	14	22	24	27	30	33	33	37
20. R&D	677	584	915	932	1065	1146	1414	1343	1340	1402	1422	1547	1594	1707
-Research	75	91	99	100	39	93	89	73	65	68	64	60	60	65
—Nonaircraft development	602	493	816	832	905	928	990	848	812	870	853	885	910	992
—Aircraft development	250	250	250	250	250	250	250	299	370	376	354	390	410	415
-Tornado	0	0	0	0	0	0	0	299	370	376	354	390	410	415
—EFA	0	0	0	0	0	0	0	0	0	0	0	0	0	0
--Miscellaneous Operations	0	0	0	0	121	125	335	123	93	88	151	212	214	235
Procurement office	246	285	317	337	320	405	483	572	627	635	774	782	798	828
-Personnel	179	221	250	263	279	332	391	475	535	540	673	681	707	0
22. NATO membership	0	0	0	0	295	249	269	245	260	393	428	429	382	359
23. Social security	636	948	946	913	918	977	1133	1371	1660	1862	1870	1964	2026	1983

Table C.1--continued

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1. Bundesminister	461	530	552	564	779	823	799	602	582	611	642
-personnel	422	442	463	472	486	479	486	518	536	554	592
2. General authority and administration	363	314	436	557	593	562	569	616	430	408	366
3. Military personnel	7337	8514	8770	9163	9582	9673	10233	10481	11263	11571	12202
-Careerists	6617	7103	7334	7614	7972	8071	8497	8688	9121	9428	9942
-Conscripts	692	735	724	831	852	837	925	913	998	994	1108
Total personnel costs	7616	8149	8390	8786	9190	9268	9806	10009	10571	10897	11535
4. Civilian personnel	5337	5615	5961	6238	6429	6417	6621	6880	7087	7331	7580
-Personnel	5162	5437	5780	6055	6241	6224	6416	6630	6883	7110	7342
5. Education	252	269	272	277	287	285	297	320	321	350	364
6. Religious affairs	37	38	39	42	43	43	44	47	49	50	52
7. Rights protection	6	7	7	7	7	7	7	8	8	7	7
8. Public health	376	404	427	461	463	481	496	544	544	575	588
10. Food	544	545	543	576	585	578	578	599	597	606	668
11. Clothing	394	413	433	456	473	436	452	513	642	634	620
12. Construction	3882	4638	4701	4877	5036	5179	5474	5503	5541	5142	5183
13. Engineering	120	112	102	102	96	98	96	99	102	106	108
14. Communications	1210	1180	1109	1037	1155	1330	1461	1601	1756	1862	1941
15. Land production	5813	5976	5976	6411	6841	7743	8068	7704	7574	7666	7843
-Trucks	790	650	620	375	480	730	950	950	880	700	550
-Armored vehicles	1460	1550	1610	2100	2030	2450	2100	1750	1120	1315	1315
-Autos	0	0	0	0	0	0	0	0	68	50	60
-Tracked vehicles	0	0	0	0	0	0	0	0	0	0	0
-Munitions	1360	1590	1485	1600	1800	2100	2425	2325	2350	2325	2500
-Other land production	600	550	560	520	580	500	699	825	1250	1288	1320
-Maintenance	1510	1545	1610	1721	1853	1861	1791	1751	1800	1878	1988

Table C.1—continued

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
16. NBC	63	65	68	74	80	93	112	126	112	107	107
17. Quartermaster	600	905	975	852	1130	1100	1037	1089	702	773	778
18. Sea production	1098	1270	1282	1333	1272	1267	1381	1361	1559	1742	1892
-Ship production	680	810	815	840	760	750	840	830	1027	1200	1300
-Maintenance	103	112	130	160	155	180	195	310	347	330	330
-Miscellaneous operations	12	11	8	5	5	4	4	7	8	10	9
19. Air production	2996	3454	5496	5576	5606	5330	4688	4677	4608	4213	3879
-Aircraft production	600	515	535	650	580	500	500	585	680	680	810
-Security devices	0	0	0	0	0	0	0	0	0	0	0
-Airport expenses	0	0	0	0	0	0	0	0	0	0	0
-Maintenance	1120	1130	1260	1222	1290	1314	1240	1320	1500	1650	1750
-Tornado	800	1200	3065	3110	3550	3350	2810	2600	2350	1820	1250
-Alphajet	440	570	590	545	130	110	80	110	14	0	0
-Miscellaneous operations	36	39	46	49	56	56	58	62	64	63	69
20. R&D	1816	1696	1533	1660	1825	1927	2498	2580	2787	2736	3040
-Research	68	68	60	57	59	67	73	75	79	81	84
—Nonaircraft development	1102	1070	910	900	1030	1280	1540	1665	1840	1730	1825
—Aircraft development	390	278	310	437	450	257	500	472	490	528	730
-Tornado	390	278	310	437	450	257	320	222	180	178	160
—EFA	0	0	0	0	0	0	180	250	310	350	570
—Miscellaneous Operations	256	280	253	266	286	323	385	368	378	397	401
Procurement office	859	884	939	983	1019	1021	1046	1086	1127	1156	1195
-Personnel	0	0	0	0	0	0	0	0	0	0	0
22. NATO membership	443	517	748	1456	1746	1760	1279	1156	1245	1174	1386
23. Social security	2037	2171	2351	2131	2229	2349	2432	2554	2392	2585	2861

BIBLIOGRAPHY

Air Actualité, "Matériels," No. 409, April 1988, p. 48.

Amme, Lothar, "Luftverteidigung," *Wehrtechnik*, September 1988, pp. 69–81.

Army Gazette, "West German Army Officials See Forces Shrinking in 90s," February 20, 1987, p. 4.

Asmus, Ronald D., "West German NATO Policy: The Next Five Years," The RAND Corporation, N-2953-AF, November 1989.

Aviation Advisory Service, *Milavnews*, Vol. 18, NL-207/1/79, 1979, p. 10.

Aviation Advisory Service, *Milavnews*, Vol. 21, NL-248/6/82, 1982a, p. 15.

Aviation Advisory Service, *Milavnews*, Vol. 21, NL-254/12/82, 1982b, p. 13.

Aviation Advisory Service, *Milavnews*, Vol. 26, NL-313/11/87, 1987, p. 7.

Aviation Advisory Service, *Milavnews*, Vol. 27, NL-320–6/88, 1988, p. 7

Aviation Week and Space Technology, "Programs Will Extend Lives of T-37s, T-38s Until USAF Buys Replacements," September 5, 1988, pp. 185–186.

Bild Zeitung, "Umfrage: Mehrheit für NATO," October 26, 1989.

Bundeshaushaltsplan 1965–1989, Einzelpläne 11 (Bundesminister für Arbeit und Sozialordnung [Labor and Social Affairs]; 14 Bundesminister der Verteidigung [Defense]; 15, Bundesminister für Jugend, Familie, Frauen, und Gesundheit [Youth, Women, Family, and Health].

Bundesminister für Arbeit und Sozialordnung, "informationen über den diskussions- und referentenentwurf," November 1988.

Clark, Graham, "West Germany's Armys Procurement Head Rejects EFA Cost-Cutting Proposals," *Defense News*, February 8, 1988, p. 3.

Csoboth, Istvan, "Die Heeresfliegertruppe und ihre Weiterentwicklung in der Heeresstruktur 2000," *Wehrtechnik*, August 1988, pp. 51–54.

Current News, "European Media," September 22, 1987a, p. 12.

Current News, "European Media," September 25, 1987b, p. 2.

Davis, P. K., et al., "Variables Affecting Central-Region Stability: The 'Operational Minimum' and Other Issues at Low Force Levels," The RAND Corporation, N-2976-USDP, September 1989.

Dean, Jonathan, "Conventional Talks: A Good First Round," *The Bulletin of the Atomic Scientists*, October 1989, pp. 26–31.

de Briganti, Giovanni, "W. Germany Will Buy Dual-Role Helicopter," *Defense News*, May 23, 1988, pp. 3–4.

de Briganti, Giovanni, and Theresa Hitchens, "NATO Frigate Project Sinks Under Withdrawals," *Defense News*, Vol. 4, No. 41, October 9, 1989, pp. 1, 66.

Defense and Economy World Report, No. 1036, March 2, 1987, p. 5812.

Defense Marketing Service, *Market Intelligence Reports*, 1989, Defense Marketing Service, Greenwich, Connecticut, 1989.

Defense News, "W. German Parliamentary Committees OK Purchase of 200 European Fighter Aircraft," May 9, 1988, p. 4

Dews, E., G. K. Smith, A. Barbour, E. Harris, M. Hesse, *Acquisition Policy Effectiveness: Department of Defense Experience in the 1970s*, The RAND Corporation, R-2516-DR&E, October 1979.

Don, Bruce, "Allies and Adversaries: Policy Insights Into Strategic Defense Relationships," The RAND Corporation, P-7242, 1986.

The Economist, "Germany Roars into the 1990s," September 30, 1989, pp. 67–68.

The Economist, "Not much room for manœuvre," December 10, 1988, p. 58.

Flight International, "Straight and Level," August 26, 1989, p. 26.

Flume, Wolfgang, "Brief aus Bonn," *Wehrtechnik*, August 1988a, p. 9.

Flume, Wolfgang, "Fregatte 123," *Wehrtechnik*, August 1988b, pp. 85–93.

Flume, Wolfgang, "Heeresstruktur 2000," *Wehrtechnik*, April 1988c, pp. 49–57.

Flume, Wolfgang, "The NATO Helicopter 90: a Quadri-lateral Programme," *Military Technology*, July 1988d, pp. 66–70.

Flume, Wolfgang, "Der NATO-Hubschrauber 90," *Wehrtechnik*, December 1987, p. 64.

Flume, Wolfgang, "Zur Panzerentwicklung in Deutschland," *Wehrtechnik*, August 1988e, pp. 20–29.

Forecast Associates, *Aircraft Forecast*, Forecast Associates, Newtown, Connecticut, 1989.

Foreign Broadcast Information Service, "Bundeswehr To Be Reduced to 380,000 Men," Daily Report, WEU-89-227, November 28, 1989a, p. 4.

Foreign Broadcast Information Service, "Defense Minister Talks on Bundeswehr Plan," Daily Report, WEU-89-236, December 11, 1989b, pp. 7–10.

Foreign Broadcast Information Service, "Stoltenberg Addresses Bundestag on Armed Forces," Daily Report, WEU-89-235, December 8, 1989c, pp. 9–14.

Foreign Broadcast Information Service, "Stoltenberg to Announce Military Cuts," Daily Report, WEU-89-234, December 7, 1989d, p. 5.

Foreign Broadcast Information Service, "Stoltenberg Rejects Criticism of Bundeswehr," Daily Report, WEU-89-235, November 28, 1989e, p. 5.

Foss, Christopher, "SAMs boost West German air defence," *Jane's Defence Weekly*, September 19, 1987, p. 570.

Frankfurter Allgemeine Zeitung, Bonn Reagiert mit Zurückhaltung auf Abrüstungsforderungen," January 8, 1990a, p. 1.

Frankfurter Allgemeine Zeitung, "Die Bundeswehr soll auf 420 000 Soldaten verkleinert werden," October 30, 1989a.

Frankfurter Allgemeine Zeitung, "Der DDR-Ministerrrate beschließt Verkürzung des Wehrdienstes," January 5, 1990b, p. 1.

Frankfurter Allgemeine Zeitung, "Der "Jäger 90" vor dem Scheitern," December 29, 1989b, p. 2.

Frankfurter Allgemeine Zeitung, "Die Präsenz der amerikanischen Streitkräfte im Urteil der Bevölkerung," October 11, 1989c.

Frankfurter Allgemeine Zeitung, "Reduzierung der Bundeswehr um 70 000 Mann," December 2, 1989d, p. 4.

Frankfurter Allgemeine Zeitung, "Es soll bei 15 Monaten Wehrpflicht bleiben," December 6, 1989e, p. 5.

Geisenheyner, Stephan, "W. German defence budget proposals under scrutiny," *Jane's Defence Weekly*, October 3, 1987a, p. 727.

Geisenheyner, Stephan, "W. Germany pushes to fill 155 mm howitzer gap," *Jane's Defence Weekly*, December 12, 1987b, p. 1352.

Gerster, Florian, "Misere der Bundeswehrplanung," *Das Parlament*, Nr. 6–7, February 3–10, 1989, p. 6.

Gordon, Michael R., "U.S. to Offer Soviets a Compromise for Cutting Aircraft in Europe Under New Treaty," *New York Times*, February 6, 1990.

Haasler, Brigadegeneral Ruprecht, "Die gepanzerten Fahrzeuge des Heeres," *Wehrtechnik*, August 1988a, p. 30.

Haasler, Brigadegeneral Ruprecht, "Die Heeresstruktur 2000," *Soldat und Technik*, August 1988b, pp. 455–459.

Hartig, Hans Christian, "Preissteigerung und Kostenaufwuch Risiken für die Bundeswehrplanung," *Wehrtechnik*, January 1988, pp. 39–45.

Hatch, Paul, "Air Forces of the World," *Air Pictorial*, June 1988, pp. 212–213.

Honeck, Heinz, "NATO-Hubschrauber 90," *Wehrtechnik*, August 1988, pp. 64–65.

Hubatshek, Gerhard, "Radical Plans for W German Army," *Jane's Defence Weekly*, March 26, 1988, pp. 574–576.

International Defense Review, "Germany's 1989 defense budget," August 1988, p. 882.

International Institute for Strategic Studies, *The Military Balance 1989*, IISS, London, 1988.

Jane's All the World's Aircraft, Jane's Publishing Company, London, 1988.

Jane's Armour and Artillery, Jane's Publishing Company, London, 1988.

Jane's Defence Weekly, "Germans Make Plans to Draft More Troops," January 26, 1987a, p. 12.

Jane's Defence Weekly, "Luftwaffe looking at ground-attack EFA," August 1, 1987b, p. 183.

Jane's Defence Weekly, "W German plan for air cavalry brigade," August 15, 1987c, p. 258.

Jane's Defence Weekly, "W Germany gives $156.9m go-ahead to EASysLuft," June 25, 1988a, p. 1270.

Jane's Defence Weekly, "W Germany to limit exercises," December 23, 1988b, p. 1446.

Jane's Fighting Ships, Jane's Publishing Company, New York, 1988.

Jungkurth, Horst, "Die Luftwaffe heute und morgen," *Wehrtechnik*, September, 1988, p. 20.

Kuebart, Jorg, "Das Luftflottenkommando," *Wehrtechnik*, September 1988, pp. 25–33.

Lenorovitz, Jeffrey M., "First Development Payment Received for European TRIGAT Antitank Weapon," *Aviation Week and Space Technology*, September 26, 1988, p. 29.

Lewis, Paul, "West and Soviets Agree with 2 Germanys on Rapid Schedule for Unification Talks; Gorbachev Accepts Bush's Troop Ceiling," *New York Times*, February 14, 1990, pp. A1, A8.

Marquitan, Hubert F., "Das Lufttransportkommando," *Wehrtechnik*, July 1988, pp. 36–41.

Mechtersheimer, Alfred, "Zwölf Monate mehr als genug," *Das Parlament*, No. 6–7, February 3–10, 1989, p. 6.

Military Technology, "Military Almanac," January 1989.

Ministry of Defense (German), "Daten und Fakten," 1987.

Ministry of Defense (German), "Die neue 'Konzeption Reservisten,'" July 1988.

Der Mittler-Brief, "Die Konzept Reservisten," Nr. 4, 1987.

Mordoff, Keith F., "Eurocopter Completes Preliminary Plans for French/German Antitank Helicopter," *Aviation Week and Space Technology*, June 6, 1988, p. 95.

Mordoff, Keith F., "Germany Backs Development of PAH-2 Combat Helicopter," *Aviation Week and Space Technology*, November 16, 1987a, p. 28.

Mordoff, Keith F., "West Germany Releases Funds for EFA Development," *Aviation Week and Space Technology*, September 28, 1987b, p. 26.

Nation, Joseph, *British Military Modernization Requirements, Resources, and Conventional Arms Control*, The RAND Corporation, R-3734-A/AF, January 1990.

The NATO Report, "Bonn Budget Review," January 11, 1988, p. 9.

Naumann, Major General Klaus, "The Restructured Bundeswehr," *NATO's Sixteen Nations*, Vol. 34, No. 6, October 1989, pp. 31–35.

Perry, R. L., Giles Smith, Alvin J. Harman, and Susan Henrichsen, *System Acquisition Strategies*, The RAND Corporation, R-733-PR/ARPA, June 1971.

Presse- und Informationsamt der Bundesregierung, "Der Auftrag der Bundeswehr in der parlamentarischen Demokratie," Nr. 82, August 30, 1989, pp. 721–724.

Presse- und Informationsamt der Bundesregierung, "Der deutsche Verteidigungsbeitrag in der NATO," June 1988a.

Presse- und Informationsamt der Bundesregierung, "Social Security For All," (Bonn: 1980).

Presse- und Informationsamt der Bundesregierung, "Wehrdienst—Kriegsdienstverweigerung—Zivildienst," July 1988b.

Presse- und Informationsamt der Bundesregierung, "Die Zukunft der Bundeswehr," April 1988c.

Sandler, Todd, and James C. Murdoch, "Defense Burdens and Prospects for the Northern Allies," in David B. H. Denoon, *Constraints on Strategy: The Economics of Western Security*, Pergamon-Brassey's, New York, 1986.

Schneider, Wolfgang, "German Army procurement programs for the 1990s," *International Defense Review*, December 1986, p. 1759.

Schulte, Heinz, "West Germany to cut armed forces by 70 000," *Jane's Defence Weekly*, December 16, 1989, p. 1325.

Smith, J. P., and F. Welch, "No Time to be Young: The Economic Prospects for Large Cohorts in the United States," *Population and Development Review*, March 7, 1981, pp. 71–83.

Der Spiegel, "Der Jäger 90 ist zu teuer," Vol. 43, No. 49, Decmeber 4, 1989, pp. 96–97.

Der Spiegel, "Jammernder Woerner," Vol. 41, No. 29, July 13, 1987, pp. 24–25.

Süddeutsche Zeitung, "36 000 Soldaten weniger," October 30, 1989, p. 1.

Tan, Hong, and Michael Ward, *Forecasting the Wages of Young Men*, The RAND Corporation, R-3115-ARMY, May 1985.

Thelen, Friedrich, "W. Germany to Scratch Programs for EFA," *Defense News*, May 30, 1988, pp. 1, 28.

Thomson, J. A. and N. Gantz, *Conventional Arms Control Revisited: Objectives in the New Phase*, The RAND Corporation, N-2697, December 1987.

Tuohy, William, "W. German Forces Get Top Rating," *Los Angeles Times*, January 1, 1987, p. 1.

Wehrdienst, "Eine erste Orientierung zum Rüstungsgeschäft des kommenden Jahres liefert das Bundesverteidigungsministerium (BMVg) seinen Lieferanten," No. 1142, September 12, 1988a.

Wehrdienst, "PPE-Production und Auslieferung," September 12, 1988b.

Wehrtechnik, "Die Ausbuildung im Heer," April 1988a, pp. 78–86.

Wehrtechnik, "Erster ABC-Spuerpanzer Fuchs wurde an das Heer übergeben," May 1988b, pp. 110–113.

Wehrtechnik, "Die gepanzerten Fahrzeuge des Heeres," August 1988c, pp. 30–38.

Wehrtechnik, "Der Jäger 90," May 1988d, pp. 24–32.

Wehrtechnik, "Kampftruppen," April 1988e, pp. 66–76.

Wehrtechnik, "Die Rüstung des Heeres," April 1988f, p. 89.

Wehrtechnik, "Verteidigungshaushalt 1989: Trendwende," September 1988g, pp. 16–17.

Wehrtechnik, "Die wichtigsten Programme der deutschen Luftfahrtindustrie," May 1988h, pp. 33–69.

Wehrtechnik, "Das Ziel muss sein, heutige Fähigkeiten zu erhalten," April 1988i, pp. 46–48.

Welch, Finis, "Effects of Cohort Size on Earnings: The Baby Boom Babies' Financial Bust," *Journal of Political Economy*, Vol. 87, 1979, pp. S65–S96.

Welt am Sonntag," Umfrage über die Bundeswehr," October 29, 1989.

Wibel, Detlef, "Die Rüstung der Luftwaffe—heute und morgen," *Wehrtechnik*, September 1988, pp. 18–24.

Widman, Miriam, "Germany Fights Overcrowding in Classrooms," *International Herald Tribune*, February 18–19, 1989, p. 10.

World Weapons Review, "Germany May Have to Cancel 100 Programs for the Sake of EFA," June 8, 1988, p. 13.

Zeilinger, Jürgen, "PAH-2 und Kampfwertsteigerung PAH-1," Wehrtechnik, August 1988, pp. 66–68.