
APPENDIXES

APPENDIX A. COMPOSITION OF THE U.S. ARMY

The following units, ranked in ascending order of size, constitute the subdivisions of the U.S. Army today.

Maneuver Platoon

The smallest standard fighting formation commanded by a commissioned officer. A tank platoon has about 20 personnel and five tanks; a mechanized infantry platoon has about 40 personnel, divided into three squads of 11 troops each, plus a headquarters element. Each squad is mounted in an armored personnel carrier.

Maneuver Company

The next largest standard fighting formation commanded by a commissioned officer. It consists of three maneuver platoons and support elements. Its strength varies from about 90 personnel and 17 tanks in a tank company to about 150 personnel and nine infantry carriers in a mechanized infantry company.

Maneuver Battalion

A maneuver battalion consists of three maneuver companies; a company-sized element to provide mortar and antitank fire support to the maneuver companies; and another company-sized element for command and control, maintenance support, medical support, food service, and supply. A tank battalion has about 550 personnel and 54 tanks. A mechanized infantry battalion has about 800 personnel.

Brigade

A command and control unit capable of controlling up to five maneuver battalions. Three or four battalions are normally assigned to it. A "mechanized" brigade has more mechanized infantry battalions than it has tank battalions.

Division

The standard elements of a division include command and control units; artillery battalions (500-600 personnel each); aviation elements; and engineer battalion (approximately 900 personnel); several other battalion-sized units that can provide medical, maintenance, supply, and other types of support; and three brigade headquarters. Maneuver battalions are

assigned to a division on the basis of the division's probable missions; as few as six or as many as 15 maneuver battalions could be assigned to a division. The missions of a division also determine the mix of tank battalions and mechanized infantry battalions. Armored divisions stationed in Europe have six tank battalions and five mechanized infantry battalions. Mechanized infantry divisions in Europe have six mechanized infantry battalions and five tank battalions.

Corps

This is a command and control unit that is staffed and equipped to control from two to five divisions. Artillery battalions, communications units, supply, medical, maintenance, engineer, and other support organizations are assigned to the corps to provide the added support structure each division needs to fight.

APPENDIX B. METHOD FOR ASSESSING THE IMPROVEMENTS IN FORCE CAPABILITIES

The methodology used in this analysis provides a static estimate of potential combat power based upon the mix, quantity, and performance characteristics of the various weapons systems. The Defense Department commonly uses this technique to measure ground force capabilities. As a baseline for the 1980 U.S. force capability, the CBO used the the 1976 Defense Department study ^{1/} and updated it to reflect recent force changes, such as the accelerated deployment of U.S. divisions to Europe.

U.S. WEAPONS CAPABILITY

Each of the weapons systems to be modernized--tanks, armored personnel carriers, field artillery, attack helicopters, and vehicle-mounted antitank weapons--is weighted based on its potential role in combat, using the tank as the standard. ^{2/} Table B-1 shows the various categories and their respective weights for the 1976 base case, and for the 1987 force. For 1976, the family of combat systems is weighted to the then-current main battle tank, the M60. For 1987, weapons are compared to the new M1. The changes shown in the 1987 weights relative to the 1976 base case reflect the anticipated advances in technology and doctrine: the FVS will add a 25-millimeter cannon and antitank missile, and the AH-64 will add a significant antitank capability.

Each category's contribution to total force-wide firepower is considered a function of its respective category weight and the number of effective weapons that existed in the force in the 1976 base case. (As a general rule, only the weapons in fighting units were counted.) The largest portion (more than 80 percent) of the firepower assets in the 1976 baseline force was represented by the categories of tank and artillery because of the sheer numbers fielded and the respective category weights.

For each weapons category, the increased effectiveness of each new system is examined. Similar weapons systems within a given category are

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1. See U.S. Department of Defense, Report to the Congress on U.S. Conventional Reinforcements for NATO (June 1976).
 2. Other categories of weapons not considered in this analysis include air defense artillery, mortars, and small arms and machine guns.

TABLE B-1. ANALYTICAL WEIGHTS FOR U.S. WEAPONS SYSTEMS

<u>Category</u>	<u>Baseline a/</u>		<u>1987</u>	
	<u>System</u>	<u>Weight</u>	<u>System</u>	<u>Weight</u>
Tanks	M-60	1.0	M1	1.0
Armored Personnel Carriers	M-113	0.1	FVS	0.35
Artillery	Self-Propelled	1.1	MLRS	1.1
Attack Helicopters	AH-1G	0.2	AH-64	0.5
Antitank Weapons (Vehicle Mounted)	TOW Mounted on Jeep	0.4	Improved TOW Vehicle	0.4

SOURCE: Congressional Budget Office.

- a. The 1976 base case includes the M60A1 tank, the M113 armored personnel carrier, which mounts a 50 caliber machine gun, and the AH-1G Cobra helicopter, which carries a 7.62-millimeter machine gun.

compared in terms of firepower, mobility, and survivability. ^{3/} Each new system was evaluated, usually against the weapon that was being replaced in the 1976 baseline force. ^{4/} In addition, any modifications to the weapons in the 1976 baseline force were assessed for their improvements in terms of force effectiveness. For example, the introduction of the thermal

3. Within each category of weapons, the performance characteristics are weighted differently. For example, the tank is weighted as follows: 45 percent firepower, 25 percent mobility, and 30 percent survivability. On the other hand, the category of field artillery receives 60 percent firepower, 25 percent mobility, and 15 percent survivability. The weights used in this analysis were compiled from Army data in Weapons Effectiveness Indices/Weighted Unit Values III.
4. In the case of the MLRS, for which there is no comparable weapon currently in the force, the baseline weapon that was used in the analysis was the eight-inch self-propelled howitzer.

imaging sight for night/poor weather combat on the M60A3 tank enhanced the firepower capabilities of the system relative to the baseline tank, the M60A1. In those instances in which the category weights changed, the improvements in the individual weapons systems' effectiveness were computed as part of the change in the category weights. In the case of the AH-64, the change in the category weight was a result of a TOW antitank missile's being mounted on the Cobra helicopter (AH-1G). Therefore, the improvements in performance characteristics in the AH-64 were measured against the Cobra-TOW helicopter. Table B-2 shows both the contribution by category to the total U.S. force capability and the improvements in effectiveness of the new systems over the 1976 baseline force used in this analysis.

TABLE B-2. U.S. WEAPONS EFFECTIVENESS IMPROVEMENTS

Weapons System Category	Percentage Change Improvement	Percentage Contribution to Total Firepower
Tanks		
M60A1 (baseline)	100	39
M60A3	108	
M-1	138	
Armored Personnel Carriers		
M113 (baseline)	100	4
FVS	350	
Artillery		
Self-propelled 8-inch (baseline)	100	48
MLRS	169	
Attack Helicopter		
AH-1G (baseline)	100	2
AH-1S	250	
AH-64	400	
Vehicle-Mounted Antitank Weapon		
Jeep-mounted TOW (baseline)	100	7
Improved TOW vehicle	150	

SOURCE: Congressional Budget Office.

Thus, the overall improvement in the force capability is a function of the improvements in the effectiveness of the new weapons systems, their contribution by category to the total force, and the percentage of the force that will be modernized. These changes are then applied to the baseline 1980 force. The results appear as changes to the overall force ratios.

THE MODERNIZATION OF THE WARSAW PACT FORCES

If the Warsaw Pact continues to produce equipment at recently observed rates, the majority of the existing force structure that could confront NATO will be modernized by the late 1980s. Table B-3 illustrates that percentage of the 120-division force (by type of system) that could be modernized through 1987. These efforts could increase the capability (measured in terms of firepower) of the Warsaw Pact by approximately 26 percent as compared with the 1980 force. Such increases in force capabilities could retain the Warsaw Pact advantages throughout the decade.

This estimate is derived from an analysis that quantifies the improvements to the 120-division Pact force as a function of the contribution of each weapons category, the performance characteristics of new weapons, and the quantities of those systems that will be fielded. This analysis also takes into account the recent reorganization of Soviet divisions that included the addition of 500 tanks and 1,500 pieces of artillery. ^{5/}

As a point of departure, the 1976 baseline force was used to estimate the contribution of each category of weapons to the total Warsaw Pact force. Again, it is assumed that the contribution to the force is a function of the respective category weights and the number of effective weapons. With the exception of the attack helicopter, the category weights that were used for the U.S. force in 1976 and 1987 were also applied to the Warsaw Pact. (In the 1976 baseline force, the Warsaw Pact had fielded an attack helicopter mounted with antitank missiles.) Table B-3 provides the estimates used in this analysis for the contribution of each category to the total force and the change in effectiveness of each weapons system.

This analysis shows that the majority of the improvements to Warsaw Pact capabilities will result from the continued fielding in relatively large numbers of tanks (principally, the T-72), and of the BMP armored personnel

5. See Richard Burt, "Soviets Said to Add to its Bloc Troops," The New York Times, June 8, 1980, page 4; and Anthony Cordesman, "NATO's Estimate of the Balance: The Meaning for U.S. Security Policy," Armed Forces Journal International (August 1982), pp. 48-58.

TABLE B-3. WARSAW PACT WEAPONS EFFECTIVENESS

Weapons System	Percentage Contribution in Total Firepower	Percent Change in Weapons System Effectiveness _{a/}
Tank	60	
T-72		19
T-80		27
Armored Personnel Carrier (BMP)	7	250
Artillery (Self-propelled)	33	36
Attack Helicopter _{b/}	0.3	41

SOURCE: Congressional Budget Office.

a/ The 1976 baseline includes the T-62 tank, the BTR-50 armored personnel carrier, towed artillery, and the HIND-A helicopter.

b/ There is no category weight change for Soviet helicopters, because in 1976, the Soviets had fielded an attack helicopter, the HIND-A, which carried four "Swatter" anti-tank missiles. See Jane's All the World's Aircraft 1980-81, pp. 202-203.

carrier. Relative to the baseline force (T-62), the improvements resulting from the fielding of the T-64 and T-72 are in the areas of increased firepower (incorporating an automatic loader with a 125-millimeter gun) and survivability (reportedly using better laminated armor). Further, the BMP offers significant enhancements through the incorporation of a 73-millimeter automatic-loaded gun that fires a rocket-assisted HEAT (High-Explosive Anti-Tank) round.

For the purposes of this analysis, it appears reasonable to assume that, for the next five years, the Warsaw Pact will continue to produce annually at roughly the same rates as have been in evidence over the past five years. The annual production rates used in this analysis include: 3,260 tanks, 2,500 BMP armored personnel carriers, 700 pieces of self-propelled

artillery, and 180 HIND Attack Helicopters. ^{6/} It is also assumed that the Pact will continue to introduce limited quantities of new systems during the period, such as the T-80 tank.

As in the case of the United States' force capabilities, the overall improvements in the Warsaw Pact force is a function of the improvements in the effectiveness of the new weapons systems, their contribution by category to the total force, and the percentage of the force that will be modernized. These changes are then applied to the baseline 1980 force and appear as changes to the overall force ratios.

Analytical Limitation of Force Ratios--Tactical Aircraft

The force ratios used to measure the relative military balance between NATO and the Warsaw Pact do not take into account the effects of either side's tactical air forces. Current analytical methods for assessing the impact of tactical air forces combined with ground forces rely on extremely large and complex computer models that seek to simulate the outcome of combat. In addition to their unwieldy size, these models are sensitive to modeling assumptions and, as such, are "scenario dependent" in of their results. As a substitute, this study considers the quantity and quality of the opposing air forces, as well as their vulnerability to the side's ground-based air defense systems, Table B-4

TABLE B-4. NATO AND WARSAW PACT TACTICAL AIRCRAFT, 1981

	NATO	Warsaw Pact
Fighter, Ground Attack	3,833	4,820
Interceptor	572	1,490

SOURCE: From International Institute for Strategic Studies, The Military Balance 1981-1982.

6. This information has been compiled from a variety of unclassified sources, including U.S. Department of Defense, Soviet Military Power (Fall 1981), p. 12-13; Jane's All the World's Aircraft 1980-1981, pp. 202-203; Jane's Armor and Artillery 1981-1982, pp. 403-405.

compares the air forces of NATO and the Warsaw Pact. Though the Pact has a significant advantage in fighter interceptors, there appears to be rough parity in the numbers of ground attack aircraft. It is generally accepted that NATO has qualitatively superior air forces; however, it is not clear that these qualitative advantages could overcome the Pact's numerical advantages in interceptors and air defense systems. Though such a comparison fails adequately to assess either the contribution of tactical air support or its effect on ground combat, it does indicate that tactical air support is unlikely to alter theater-wide comparisons used here to evaluate ground combat forces.

APPENDIX C. THE MODERNIZATION EFFORTS OF THE NON-U.S. NATO ALLIES

THE BRITISH CORPS

In peacetime, the British Army of the Rhine (BAOR) consists of 55,000 troops organized into four armored divisions, one field force, and one artillery division. Upon mobilization, the corps could grow to more than 120,000 personnel with the addition of reserve units. The British Army is currently equipped with 900 Chieftain tanks that mount a 120-millimeter gun. In addition to 100 pieces of 105-millimeter artillery, the Britons have recently begun the deployment of the FH-70 155-millimeter towed howitzer.

The planned improvements in armor and anti-armor capabilities include equipping four armored BAOR regiments with the new Challenger tank. Compared with the current Chieftain tank, which has been in service almost 20 years, this new design has several advantages: it incorporates a new power pack, Chobham-type armor, and a laser rangefinder. The British plan to upgrade the remaining Chieftain tanks by adding night sights. Anti-armor improvements include the arming of the Lynx helicopter with eight TOW anti-tank missiles; the Lynx currently is equipped with 2.75-inch rockets, twin 7.62-millimeter machine gun pods, and a 20-millimeter cannon. Finally, the British plan to continue to upgrade their inventory of self-propelled artillery through the procurement of additional U.S.-built M109 155-millimeter self-propelled howitzers, as well as the SP70 155-millimeter self-propelled howitzers.

THE WEST GERMAN CORPS

The West Germans have recently completed a major reorganization of their Army and are aggressively pursuing a modernization program for equipment.

The German Field Army has a personnel strength of 272,000, which is organized in three corps. ^{1/} The 12 divisions are divided into six armored, four armored infantry, one mountain and one airborne. The new organization now has 17 armored brigades (as compared with 16) and 15 armored infantry brigades (as compared with 12). At present, the German

1. In addition, the Territorial Army consists of 38,000 troops.

Army's tank inventory consists of 2,400 Leopard Is, 1,200 M48A2s, and 150 Leopard IIs. The main armored fighting vehicle is the Marder, with an inventory of more than 2,100. The German artillery consists of several types of self-propelled (such as more than 580 M109 155-millimeter howitzers) and towed pieces (such as 164 FH-70 155-millimeter howitzers). In addition, the Germans maintain more than 200 LARS 110-millimeter multiple rocket launchers.

Future plans include the additional procurement of the Leopard II that is armed with a 120-millimeter smooth-bore gun. By fiscal year 1987 funded delivery period, 76 percent of all armored battalions will be equipped with the Leopard II. The Germans also plan to buy more FH-70 155-millimeter towed howitzers and to replace their 175-millimeter guns with improved 203-millimeter howitzers.

THE DUTCH CORPS

The Dutch corps relies most heavily on reinforcement to bring its two active divisions up to full wartime strength. At present, there is one Dutch armored brigade stationed in Germany; five active brigades (one armored and four mechanized infantry) are located in the Netherlands. Four additional brigades also could be available upon a call-up of reserves.

The Dutch forces are now equipped with more than 450 Leopard I and approximately 340 Centurion tanks--a World War II tank armed with a 105-millimeter gun. The Dutch plan to replace the tank with the new Leopard II; they have already ordered more than 400 Leopard II main battle tanks. The modernization of the fleet of armored personnel carriers has been completed. The Dutch have fielded more than 850 U.S.-built Armored Infantry Fighting Vehicles (AIFV), which use a U.S. M113 chassis, incorporating a turret, and mounts a 25-millimeter cannon. In addition, the Dutch army has ordered more than 170 improved TOW vehicle kits that will be mounted on the AIFV. ^{2/}

The Dutch army is also modernizing its artillery assets. Most significant is the replacement and upgrading of AMX 105-millimeter and M107 203-millimeter artillery with M109 155-millimeter and M110A2 203-

2. The Dutch have an option to order an additional 170 Improved TOW Vehicle kits to be mounted on AIFVs. See "AUSA 79: Crash Programs to Counter Deployed Soviet Armor," International Defense Review, Volume 13, No. 1/1980, p. 121.

millimeter artillery, respectively. ^{3/} Furthermore, the Dutch plan to purchase almost 150 U.S.-made M198 155-millimeter towed howitzers.

THE BELGIAN CORPS

The Belgian corps appears to be the weakest on NATO's Central Front today. It contains 25,000 personnel organized into one armored and one mechanized infantry brigade. Since 1976, the size of the peacetime corps stationed in Germany has been reduced by 7,000 personnel, returning one mechanized infantry brigade and one division headquarters to Belgium. Upon mobilization, the Belgians could field a two-division combat force for the corps.

The major item of equipment to be modernized by the Belgians is the armored personnel carrier. To replace more than 1,000 obsolete vehicles (such as the M-75 and AMX-VCI), the Belgians have ordered more than 500 AIFVs; more than 500 M113 armored personnel carriers; and 80 BDX armored personnel carriers. The latter is a fully amphibious vehicle that can mount a turret and can fire the Milan antitank guided missile.

No current plans exist for the modernization of the tank fleet or the artillery inventory. The Belgian Army has more than 330 Leopard I tanks in its active units; the reserves maintain 55 M-47 tanks (1950s vintage). The Belgian army primarily relies upon the light 105-millimeter self-propelled artillery for direct support. These howitzers are 20 years old and have a lesser effective range and lower burst radius per projectile than the 155-millimeter howitzers that are standard throughout NATO's armies. ^{4/}

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3. Both the AMX 105-millimeter and the M107 175-millimeter howitzers represent 1950s technology.
 4. The 105-millimeter howitzer has an effective range of 11.5 kilometers and a burst radius of 35 meters; the 155-millimeter howitzer has an effective range of 18 kilometers and a burst radius of 50 meters.

**APPENDIX D. ESTIMATING ARMY FORCE STRUCTURE
REQUIREMENTS**

To modernize the force, the U.S. Army must provide materiel for the active and reserve combat forces as well as for the training base, the maintenance float, and the war reserve stocks. The actual requirements and the detailed break-out of the numbers of weapons needed to fill the structure are classified; thus, the CBO estimated the requirements based on unclassified information. All divisions are assumed to have three brigades (four divisions have a round-out brigade in the Reserve Component). Table D-1 provides the requirements for some major systems. The methodology and assumptions used to develop these estimates are provided in this appendix.

- o To estimate the requirements for the active combat forces in both the continental United States and Europe, the table of organization and equipment (TO&E) for the heavy division 86 configuration was used. The CBO assumed that all armored and mechanized infantry divisions (and brigades) would be configured under this organization as they received the new equipment. ^{1/}

**TABLE D-1. WEAPONS NEEDED TO FILL ASSUMED
U.S. FORCE STRUCTURE**

System	U.S. Army forces in Europe	Continental United States	Subtotal	Training Base
M1	1,656	1,814	3,470	176
FVS	1,864	2,305	4,169	208
AH-64	226	574	800	40

SOURCE: Congressional Budget Office.

1. Data provided by the Department of the Army.

- o To build the requirements for the training base, it is estimated that 5 percent of the weapons needed to fill the active combat units would be required. 2/
- o The maintenance float includes those weapon systems that constitute the operational ready float and the repair cycle float. It is assumed that 17 percent of the weapons systems that are needed to fill the active combat units and the training base would be required for the maintenance float. 3/
- o War reserve stocks are those items of equipment required to sustain combat until factories can provide replacements. The levels of war reserve stocks are based on war plans and deployment schedules, as well as various assumptions regarding the intensity of combat. (To estimate the inventory levels for the tank, it is assumed that 51 percent of the requirements for the Active combat force would satisfy inventory levels for 180 days. 4/ To estimate the levels for the FVS, it is assumed that 37

TABLE D-1. (Continued)

Maintenance Float	War Reserve Stocks	Subtotal	Corps + 4 POMCUS	Total
630	1,672	5,014	1,060	7,013
774	1,542	6,036	1,220	7,913
143	0	983	210	1,193

NOTE: Total requirements include 618 DIVAD guns, 333 MLRS, and 578 applications of AHIP.

2, 3, 4. See Department of Defense Appropriations for 1978, Hearings before the House Committee on Appropriations, Subcommittee on Defense, Part 3, 95th Congress, 1st Session, pp. 34-37.

percent of the requirements for the active force would satisfy levels for 180 days.) 5/

- o For the requirements of POMCUS stocks, it is assumed that a second set of equipment is required for all those active combat units assigned to the four division sets of POMCUS.
- o The requirements for corps assets are estimated based on the Army's standard troop list for a corps. 6/
- o Exceptions--Consistent with current Army plans, there are no war reserve stocks or POMCUS stocks for helicopters. The total requirements for DIVAD, AHIP, and MLRS were provided by the Department of the Army. No detailed breakout was estimated.

5. Based on Army data; see Army Modernization Information Memorandum, August 1, 1981, pp. 1-25 through 1-28.

6. See U.S. Army Armor Reference Data, Volume II, Nondivisional Organizations, U.S. Army Armor School, Fort Knox, Ky., 1979, pp. 487-489.

