
Chapter 13

Summary of Recent Studies of Follow-On Forces Attack

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Table

Summary of Recent Studies of Follow-On Forces Attack

Several recent studies have considered the broad technical, operational, and cost issues involved in attack of follow-on forces. These studies, summarized below, have provided essential background to this OTA assessment.¹ Some studies have attempted to analyze the effects of military improvements on a possible conventional conflict in Europe; these have been of particular interest to OTA.

Several conclusions about FOFA are common to most or all of these previous studies:

- *Current NATO conventional defense capabilities are not adequate.*
- *Improving capabilities for FOFA would make an important and substantial contribution to NATO conventional defense and to deterrence.*
- *Improved FOFA should be based on attack capabilities by both aircraft and ground-launched missiles. No study has argued for a "pure" ground- or air-based capability.*
- *Improvements in FOFA capabilities should be deployed throughout the Central Region. Improvements in the U.S. sector, if not reflected in related improvements for the other corps defending the Central Region, would not provide sufficient enhancement to NATO's capabilities.*
- *Critical technologies for improved FOFA are anti-armor munitions and stand-off target acquisition sensors. Of particular importance in the munitions area are sensor technology to guide munitions against individual vehicles, and improved lethality against armored vehicles. A stand-off sensor which several studies consider essential is the U.S. Joint Surveillance Tar-*

get Attack Radar System (Joint STARS), which is being developed to provide wide area surveillance and attack control capabilities against moving vehicles. Remotely piloted vehicle (RPV)-based sensors are also mentioned in several studies as capable of providing important capabilities.

- With improved sensors and munitions, *one approach to FOFA, preferred by nearly all the studies, is to attack enemy combat units after they have left assembly areas and are moving by road toward the Forward Line of Own Troops (FLOT).*² Another related approach is to *block chokepoints* such as river bridges just before moving units would use them, *and then attack the halted units.* A third approach advocated by some studies is to *create a barrier in the enemy rear by dropping the bridges* across a major river line such as the Elbe-Vltava or the Oder-Neisse. Other approaches seen as less attractive include: attack of roads to delay movement, attack of enemy command posts to disrupt operations, and attack of logistics.
- Nearly all of the studies conclude that *attacks of follow-on forces less than 100 to 150 kilometers from the FLOT should be emphasized.* This includes attacks of follow-on regiments and divisions moving forward from assembly areas. Attacks within this range will have the most immediate effect on the ability of NATO's front line forces to maintain a successful defense.
- Before enemy combat units can be attacked, they must be located by a situation assessment process that uses sensor data of many different types. This proc-

¹Earlier studies were reviewed by the Institute for Defense Analyses in a 1983 review summarized at the end of this chapter.

²Division assembly areas are expected to be located at depths of 70 to 150 kilometers, and regiment assembly areas at 30 to 70 kilometers.

ess operates on a time scale of several hours. The enemy units must be kept under surveillance until subsequent attacks can be made. To attack moving combat units, the attacking forces need target location and prediction information within minutes before the attack. *Command and control centers must be capable of performing both these situation assessment and attack control functions.*

Some divergent views emerge in these studies:

- One study argues against deep attack, which is interpreted to mean beyond artillery range. Attack of follow-on regi-

ments would fall within this range, and would be supported.

- Another study supports for very deep attack, using conventionally armed cruise missiles launched from B-52s over NATO airspace. This approach would attempt to slow the Soviet reinforcement of Warsaw Pact forces. The resulting capability would be useful only if there was not a long mobilization prior to war, and thus is seen as serving as a deterrent to a short-mobilization attack.

The individual studies reviewed by OTA are summarized below.

INSTITUTE FOR DEFENSE ANALYSES FOFA STUDY

The Institute for Defense Analyses (IDA) recently completed an extensive study of FOFA for the Office of the Secretary of Defense.³ The purpose of the project was "to provide an integrated conceptual structure for assessing NATO's defense requirements and the detailed technical/cost information necessary for organizing and managing Department of Defense (DoD)-wide efforts to create an effective follow-on force attack capability."⁴ The analysis considered weapon effects as well as unit-level operations (e.g., a tactical fighter wing attacking an enemy division), and used a full theater-level simulation (IDA's TACWAR model).

IDA finds that "The FOFA concept is technically feasible and potentially operational within the 1990s,"⁵ with a mix of sensor and weapons systems allowing considerable flexibility of employment. The cost, though high, is seen as much less than the cost of armored divisions providing equivalent capability to halt a Warsaw Pact attack.

More specifically, IDA finds that the primary technology requirement for FOFA is sensor systems capable of providing information for situation assessment, target acquisition, and attack control.⁶ Also, advances in anti-armor munition and terminal guidance technologies are considered essential. A new ground-launched missile system (e.g., the Army Tactical Missile System, or ATACMS) for FOFA should have a range of 150 to 200 kilometers, even if used to only 50 kilometers or so of depth, in order to provide sufficient stand-off from the FLOT and to provide cross-corps support. In the C³ area, IDA finds that "the situation assessment and attack control functions must be separated and the time for C² processes reduced"⁷ relative to current practice.

IDA estimates a "basic system cost" at about \$20 billion. This 15-year life cycle cost does not include weapons, which adds another \$10 billion to \$30 billion. The effectiveness of these systems, in various combinations and employment concepts, is assessed in terms of the average Warsaw Pact advance in 30 days of combat (as calculated in the TACWAR

³Institute for Defense Analyses, *Follow-On Force Attack* (Alexandria, VA: Institute for Defense Analyses, report R-302, April 1986). This report is in five volumes and is referred to hereinafter as the IDA FOFA Study.

⁴IDA FOFA Study, op. cit., vol. 1, p. iii.

⁵IDA FOFA Study, op. cit., vol. 1, p. ES-10.

⁶See app. 13-A (vol. 2), paragraph 3.

⁷IDA FOFA Study, op. cit., vol. 1, p. ES-15. See app. 13-A (vol. 2), paragraph 4.

model). Without FOFA this advance is typically 300 kilometers; with 30 billion to 50 billion dollars' worth of FOFA systems the advance could be reduced to less than 50 kilometers.⁹

IDA considers a broad range of options for attacking armor. The attack strategies deemed the best are to engage combat units (regiments and divisions) when they are moving forward from assembly areas. For regiments these moves are generally within about 30 kilometers of the FLOT; for divisions, between 30 and 90 kilometers of the FLOT. These units are detected and tracked by a situation assessment process using sensor data from many sources. Also, a capability to distinguish truck columns from armored columns within unit formations can reduce the weapons requirement by one half, and would thus be highly desirable. Attacking units in assembly areas is not deemed effective for the cost involved.

Other types of targets are also considered. Dropping the bridges across the Elbe and maintaining this barrier for 10 days or more has a good payoff, but substantial numbers of air sorties are needed and precision delivery is required. Attacking command posts (CPs) is unattractive, because no means of effectively targeting CPs is available and the delays produced, even if CPs were destroyed, do not noticeably affect the results of the theater simulation.

Emphasis is given to a ground-launched missile (ATACMS). Attacking at short range against regiments is compared to attacking deep against divisions. The shallow attack approach is more effective at slowing the enemy advance, but the deeper attack approach runs less risk of saturating the firing rate or target handling capacities. A Warsaw Pact advance

⁹IDA does not argue that attrition and FLOT movement are accurately reflected in an absolute sense in their model; rather, the model results should be used only to compare system alternatives within the assumed constraints.

can be halted with about 4,000 missiles used shallow or about 10,000 missiles used deep.⁹ "Some mix of each kind of attack should be planned so that commanders can make best use of the situation assessment they are presented with and their own concept of operation."⁰

Other weapons systems are also considered in this study. Penetrating tactical aircraft delivery of precision guided munitions is evaluated as an effective tactic, especially after a few days of ATACMS attacks on moving combat units, and especially with ATACMS also used to suppress enemy air defenses. According to IDA, using about 1,800 ATACMS missiles against enemy SAMs over 30 days of conflict can reduce aircraft attrition per sortie from about 13 percent to about 4 percent (for attacks out to about 100 kilometers beyond the FLOT) and from 2 to 1 percent for close air support. Upgraded artillery is also considered for FOFA, but has the disadvantage that large numbers of rounds must be procured and deployed across the whole front in order to have them available in sufficient quantity where and when needed. However, greatly expanded purchase of Multiple Launch Rocket System (MLRS) Terminally Guided Warhead (TGW) (50,000 to 100,000 rounds in NATO) and the use of large numbers of guided gun and mortar rounds¹¹ (200,000 to 400,000 rounds) can be highly effective against the enemy attack. In fact, upgrading the artillery with these anti-armor munitions appears to be among the least costly options considered, and can also improve the close-in combat capability of NATO forces.

⁹These numbers of weapons relate to usage across the entire Central Region.

¹⁰IDA FOFA Study, op. cit., vol. 1, p. ES-22.

¹¹Such rounds include the Sense and Destroy Armor (SADM) artillery round for 155mm and 8 inch howitzers, and the Guided Antiarmor Mortar Projectile (GAMP).

NATO DEFENCE RESEARCH GROUP PANEL REPORT

A panel of the NATO Defence Research Group produced a report in mid-1985 concerning the value and costs of various approaches to FOFA.¹² It draws heavily on analyses done

by IDA and by analysis agencies in the United Kingdom and NATO. The report of this panel is summarized in appendix 13-A (vol. 2), paragraphs 5 through 9.

¹²*An Analysis of the Relative Value of Attacks on Warsaw Pact Follow-On Forces in the NATO Central Region: Report by Panel VII/RSG.14 on the Value of Interdiction of Follow-On Forces and the Cost-Effectiveness of Possible Augmen-*

tions of the Current Capability, Defence Research Group, Panel on the Defence Applications of Operational Research, AC/243 D/1022, AC/243 (Panel VII) D/99, June 1985.

SHAPE STUDY

Personnel at the Supreme Headquarters Allied Powers Europe (SHAPE) have also been studying FOFA concepts and requirements.

A report of this work is summarized in appendix 13-A (vol. 2), paragraphs 10 through 16.

SHAPE TECHNICAL CENTRE STUDY

The SHAPE Technical Centre (STC) has been conducting a study of Follow-On Forces Attack in Allied Command Europe for their

sponsor, SHAPE. This effort has been reported recently,¹³ and is summarized in appendix 13-A (vol. 2), paragraphs 17 through 19.

¹³* Results from the STC FOFA Study (Project 84-2) With Particular Reference to the Central Region, Working Paper No.

2, Issue No. 2 (Draft), "SHAPE Technical Centre, STC 9980/OR/S.27/86, March 1986.

INDUSTRIEANLAGEN-BETRIEBSGESELLSCHAFT STUDIES

The Industrieanlagen-Betriebsgesellschaft mbH (IABG)¹⁴ of Munich, FRG, has studied alternatives for improving conventional defense, using analysis and simulations up to the theater level. Unclassified discussions of some of these studies were held with OTA personnel, and an unclassified paper by the study leader was made available to OTA.¹⁵ This paper concludes that "there are several reasons for not supporting the concept of combat in

depth."¹⁶ One area of concern is resources: the costs of systems will go up with effective range and required accuracy and survivability; and the "qualitative manpower requirement" will go up as systems become more complex. On both of these grounds, deep attack systems will divert resources from other important areas. In particular, the application of new technologies to improve close-in defense "can be done more efficiently, with less risk and for less cost than battle in depth."¹⁷

The notion of deep battle considered in this study is unclear, but it appears to emphasize attacks well beyond the range of current artillery weapons. Thus, it is not clear whether

¹⁴IABG is a major analytical establishment that works for the Ministry of Defense and for the military/aerospace interests of the FRG.

¹⁵"Zum Kampf in der Tiefe," Klaus Niemeyer, IABG M-SO-2125/13, December 1983. "This manuscript only reflects the personal opinion of the author and in no way represents the official views of The Industrieanlagen-Betriebsgesellschaft mbH (IABG) or the Federal German Ministry of Defence." However, it is consistent with other analytical work performed at IABG.

¹⁶"Zum Kampf in der Tiefe," p. 15.
"Ibid."

IABG studies would support an emphasis on FOFA at the nearest ranges (attacking follow-on regiments during their final move forward

within about 30 kilometers of the FLOT). It appears to OTA that this emphasis would be supported by IABG.

EUROPEAN SECURITY STUDY

The European Security Study (ESECS) sponsored by the American Academy of Arts and Sciences has published two reports on "Strengthening Conventional Deterrence in Europe."^{18 19} A capability for attack of follow-on forces is considered necessary (among other missions) for successful deterrence and defense. In the initial study (ESECS I) the emphasis for FOFA is on attack of fixed targets to delay and disrupt enemy formations. In ESECS II, attack of both chokepoints and units on the move is considered for FOFA, but the emphasis is still on delay and disruption rather than on attrition. The most effective and practicable NATO attacks would be from about 30 to 150 kilometers from the FLOT, but deeper attacks for special purposes (such as destroying rail and road bridges across the Oder-Neisse River line) could also be important.²⁰

Long-range conventional weapons systems are considered critical to a successful FOFA

¹⁸"Strengthening Conventional Deterrence in Europe: Proposals for the 1980s," Report of the European Security Study (ESECS) (New York: St. Martin's Press, 1983).

¹⁹"Strengthening Conventional Deterrence in Europe: A Program for the 1980s," European Security Study Report of the Special Panel (ESECS II), (Boulder, CO: Westview Press, 1985). The Special Panel consisted of General Andrew J. Goodpaster, General Franz-Joseph Schulze, Air Chief Marshal Sir Alasdair Steedman, and Dr. William J. Perry. The study was supported by the BDM Corp.

²⁰ESECS II, p. 71.

capability.²¹ The suggested (or "exemplary") program for modernization to improve FOFA capabilities includes ground-launched missiles with a range of perhaps 200 to 300 kilometers,²² and stand-off weapons for air delivery with ranges from about 10 to 150 kilometers. Both types of weapons would dispense anti-armor munitions such as Skeet. In addition, aircraft would have capabilities to deliver improved anti-armor mines (also using stand-off dispensers) and improved laser-guided weapons capable of destroying bridges. The ESECS II exemplary FOFA program procurement costs are estimated at \$5 billion (in fiscal 1984 dollars), and the program includes 1,800 ground-launched missiles, a total of 5,300 air-delivered dispensers of various types, and 400 laser-guided bombs. These weapons costs are in addition to surveillance and target acquisition system costs. The exemplary program to improve target acquisition capabilities (for both FOFA and close-in defense) includes procurement of five real-time stand-off imaging radars and 48 real-time RPV-based optical systems per corps, and associated ground stations and processing capabilities; it would cost NATO an estimated \$2.85 billion.

²¹ESECS 11, p. 70.

²²Specifically, the T-22 (Improved Lance) missile of the Corps Support Weapons System then in development by the U.S. Army is recommended. The current successor to this program is the ATACMS program.

U.S. ARMY STUDIES

The U.S. Army has recently completed studies supporting both development of doctrine for Deep Attack²³ and a proposed program for enhancing conventional defense capabilities²⁴ that is "consistent with U.S.

Army doctrine (AirLand Battle), NATO's FOFA sub-concept, and U.S. Army long-range plans and development processes."²⁵ The work on deep attack doctrine included simulations of corps operations with the CORBAN model

²³Corps Deep Operations, FC 100-15-1.

²⁴Analysis of US Army Conventional Capabilities, HQ U.S. Army DAMO/FD, May 20, 1986.

²⁵Analysis of US Army Conventional Capabilities, p. 1

developed by the Army.²⁶ The later study of Conventional Capabilities built on the corps-level simulation with theater-level studies using the Army's CEM simulation model and IDA's TACWAR simulation model.

The Deep Attack study focuses on the objective of disrupting the enemy's attack "tempo."²⁷ According to this new Army doctrine, attacks against follow-on forces should employ a "decide, detect, deliver" approach.²⁸ This approach has separate situation assessment/planning and target acquisition/engagement phases. Battle planning, including decisions to commit resources to deep attacks, is accomplished at the corps headquarters using Intelligence Preparation of the Battlefield (IPB) and fusion of data from a number of sources. The planning is oriented toward time blocks of 4 to 6 hours. Engagement opportunities are predicted some 12 to 36 hours ahead, and sensor and attack systems are tasked to coordinate operations for attacks in the appropriate time blocks.²⁹ Sensors are then focused to detect predicted enemy activity in the preplanned target area.

The detection of this activity, and its subsequent confirmation (if necessary), serves to trigger the planned attack process, using either ground-launched missiles or offensive air support (OAS) provided by tactical aircraft.³⁰

²⁶CORBAN was developed by the Training and Doctrine Command (TRADOC) Studies and Analysis Activity (TRASANA), supported by the BDM Corp.

²⁷*Corp Deep Operations*, FC 100-15-1, p. 2-13. See app. 13-A (vol. 2), paragraph 20 for certain details.

²⁸*Corp Deep Operations*, FC 100-15-1, p. B-2.

²⁹*Corp Deep Operations*, FC 100-15-1, p. B-6,8.

³⁰*Corp Deep Operations*, FC 100-15-1, p. B-9,10.

Appropriate sensors for this function include Joint STARS, PLSS, the Tactical Reconnaissance System (TRS), Guardrail Common Sensor system, and the corps Intelligence and Electronic Warfare (IEW) RPV system.³¹ Then, when the weapons are prepared and the target is properly oriented, the sensor provides final target location update to the attacking unit and the weapon is launched or released.³²

In its broader study of conventional enhancements, the Army found that a balanced investment in close and deep combat capabilities was optimal. The deep attack systems considered included the ATACMS, and Joint STARS and other sensors.³³ Improved anti-armor munitions for artillery and rocket systems, such as MLRS/TGW and SADARM, were included in close combat systems. This approach, of making current forces more capable, was considered preferable to other possible approaches, including increasing NATO's combat forces, creating barrier defenses in the FRG, deploying light infantry or militia-based area defenses, or maintaining a posture of counter-invasion to deter aggression. The conventional enhancements proposed by the Army involve accelerating the development and procurement of the indicated systems (and others) such that they can be fielded by 1993.³⁴

³¹*Corp Deep Operations*, FC 100-15-1, p. B-9.

³²Certain weapons and sensor requirements are summarized in app. 13-A (vol. 2), paragraph 21.

³³Other sensors included the Guardrail Common Sensor and the Unmanned Aerial Vehicle/Intelligence and Electronic Warfare (UAV/IEW). In addition, the Army component of the Joint Tactical Fusion program, the All Source Analysis System (ASAS) was listed as a deep battle system.

³⁴The enhancement program for FOFA is summarized in app. 13-A (vol. 2), paragraph 22.

RAND CORP. STUDIES

The Rand Corp. has several studies underway for the U.S. Air Force, considering various aspects of conventional defense of Europe. One such effort focuses on intelligence support for a range of operations concepts to support the defense of Europe.³⁵ The concepts consid-

ered include several ways of attacking follow-on forces.

Another Rand study is analyzing a concept for deep attack of Warsaw Pact follow-on forces using conventionally armed cruise missiles

for Effective Defense of Central Europe," briefed to OTA staff and FOFA Study Advisory Panel, June 18, 1986.

³⁵"A Critical Time Evaluation of USAF Intelligence Support

launched from B-52s.³⁶ Both studies have been presented to OTA in briefings, but reports have not yet been published. These studies assess the feasibility of several operations concepts and the value of carrying out such attacks against Warsaw Pact forces. The latter study includes a theater-level simulation to quantify the value of such attacks in terms of the overall ground war.

The first study finds several approaches attractive for attacking follow-on forces, because the United States is expected to have substantial end-to-end capability to attack worthwhile targets. These *attractive* approaches include:

- attack of second-echelon regiments moving to battle from their final assembly areas, which are 30 to 50 kilometers behind the FLOT;
- attack of maneuver elements of follow-on divisions moving forward on roads about 30 to 250 kilometers behind the FLOT; and
- attack of follow-on division elements queued up behind blocked chokepoints, 30 to 250 kilometers behind the FLOT.

Approaches that are considered *marginal or unattractive* include:

- attack of division elements while halted in assembly areas,
- attack of bridges to create a north-south barrier at major rivers, and
- attack of divisions moving toward assem-

³⁶¹⁴ "Interdiction of the Soviet Armies With B-52s," briefing by G.L. Donohue, Rand Corp., to OTA Staff, 19 August 1986.

bly areas on roads more than 250 kilometers beyond the IGB.³⁷

The second Rand study sets forth a concept for interdicting Soviet divisions moving by rail. The concept uses B-52s based in the United States to launch conventionally armed long-range cruise missiles from friendly airspace deep into the Warsaw Pact rear. These weapons deliver mines that will damage trains at given points in the rail net and cause links in the rail net to be closed for periods of time. Similar weapons are also used to drop key rail and road bridges. The total effect of these attacks is estimated to reduce by 50 percent the quantity of forces arriving at the FLOT during the 2 to 3 weeks of the attacks.

The resulting reduction in forces available to the enemy is analyzed in a theater-level simulation. Although the proposed improvement in capability is not sufficient to stabilize the FLOT near the IGB, it is seen as making an important contribution to NATO's defense. One limitation of this approach is that it would not be as effective if, prior to war, there were a Warsaw Pact mobilization long enough for follow-on Soviet armies to move forward to western Poland, Czechoslovakia, and East Germany. However, it is argued that this long mobilization scenario would be the best case for NATO. From this perspective, the proposed deep attack capability can be viewed as a deterrent against a short mobilization attack, which is seen as the greatest threat to NATO.

³⁷See app. 13-A (vol. 2), paragraph 24 for other approaches considered for FOFA.

EARLIER STUDIES

In late 1983 IDA published a review of earlier studies of issues relating to FOFA.³⁸

³⁸*Interdicting Warsaw Pact Second Echelon Forces-A Review of Selected Studies*, Institute for Defense Analyses, 1 DA Paper P-1 731, October 1983. Referred to below as IDA 1983 Review.

Of 77 studies surveyed at that time, 20 were selected for review and summary. These selected studies are listed in table 13-1. The resulting summary of results is discussed in appendix 13-A (vol. 2), paragraphs 25 through 30.

Table 13-1 .—Studies Reviewed by IDA in 1983

Date	Author	Title
<i>U.S. Air Force</i>		
1981	Scientific Advisory Board	Non-Nuclear Armament
1980	Direktorate of Aerospace Studies	Employment of Antiarmor Munitions Against 2nd Echelon Moving Armor
1979	Tactical Fighter Weapons Center	Joint Close Air Support/Battlefield Interdiction Mission Area Analysis
<i>U.S. Army</i>		
1982	CSWS Special Task Force	Corps Support Weapon System Cost and Operational Effectiveness Analysis (Preliminary)
1981	Field Artillery School	Fire Support Mission Area Analysis
1981	Concepts Analysis Agency	Forward of the FEBA Weapon System Cost Benefit Study, Phase I and Phase II
<i>Other U.S. Government Studies</i>		
1982	Joint Chiefs of Staff	JCS Interdiction Study
1979	General Accounting Office	Progress in Strengthening Interdiction Capabilities in the NATO Central Region
1976	Defense Science Board	Summer Study on Conventional Counter Force Against a Pact Attack
<i>NATO and European Organizations</i>		
1982	SHAPE (NATO)	SHAPE Study to Attack and Destroy Second Echelon Forces
1981	Defence Research Group (NATO)	Interdiction—An Aspect of Air Campaign in the 1990s
1981	Defence Research Group (NATO)	Implications of New Technologies for Land Operations in the NATO Central Region
1981	Defence Operational Analysis Establishment (U. K.)	UK Analyses Related to the Value of Attacks on Second Echelon Forces
1980	Advisory Group for Aerospace Research and Development (NATO)	Project 2,000 Overview
<i>Other Analytical Studies</i>		
1983	IDA	Indirect Fire Support, Phase I and II
1981	The Rand Corp.	Analysis of the Warsaw Pact Tactical Rear: Summary Report
1981	The Rand Corp.	Air Interdiction: Lessons from Past Campaigns
1981	The BDM Corp.	The Military Utility of Delaying and Disrupting Warsaw Pact Second Echelon Forces
1980	QUEST Research Corp.	Historical Effects of an Interdiction Campaign
1979	The BDM Corp.	Holding Pact Second Echelon Forces at Risk

SOURCE IDA 1983 Review, tables 1 and 2