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Interdiction and Conventional Strategy: Prevailing Perceptions

Ian O. Lesser

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PREFACE

This Note addresses the role of interdiction in conventional strategy from the perspective of numerous individuals in the United States and Europe who are, or have been, concerned with its application in theory and practice. It summarizes an informal survey of prevailing perceptions about interdiction and its effects, assumptions about the character of a potential war in Europe and the relationship between these two subjects. Although this is not a historical study—there is no attempt to reinterpret the interdiction experience or to repeat the many fine case studies in this area—historical images and the lessons of past campaigns provide the essential context for the views examined here. A critical question throughout is the continued relevance of enduring interdiction "images," such as those provided by the World War II Normandy experience, in today's strategic environment.

Most of the material for this study was obtained from interviews and roundtable discussions held in the spring of 1989 (all of the interviews were conducted on the understanding that comments would not be for specific attribution). Other research augments these discussions and is illustrative rather than exhaustive of the body of open-source literature on interdiction.

This study is a contribution to ongoing Project AIR FORCE Theater Forces Program work on interdiction, specifically the project entitled "Air Support of the NATO Campaign: Interdiction of Logistics, C^3 and LOCs," sponsored by the Deputy Chief of Staff, Plans and Operations, U.S. Air Force. It deals with perceptions and assumptions about interdiction across the spectrum of potential targets. The other objectives of this research are to (1) assess the implications for USAF operations of attacks against potential interdiction targets other than vehicles in divisions and bridges over major river barriers, including supply flows, logistics, and C^3 facilities, and other lines of communication (LOCs); (2) examine measures used to assess interdiction effectiveness in past campaigns; and (3) determine preferred interdiction concepts that involve attacks against follow-on forces, logistics, C^3, and LOCs.

The research presented here was completed in the spring of 1989. Since that time, developments in the Soviet Union and Eastern Europe have called into question many strategic and operational assumptions in Europe. Political turmoil in the Soviet Union,

prospective reductions in conventional forces, movement toward German reunification, and the de facto disintegration of the Warsaw Pact will certainly change the character of the Soviet military threat to Western Europe and the environment for interdiction in a European conflict, however unlikely. Even if the perceived relevance of interdiction to European security is declining, the problem of interdiction outside of Europe is likely to be of increasing concern. The observations will in many instances be useful, directly or indirectly, to the consideration of out-of-area interdiction.

SUMMARY

Perceptions about interdiction's role, effects, and relationship to conventional war continue to be shaped largely by images drawn from the Allied experience in Europe during World War II. The "lessons" from this period—including the importance of air superiority, sustained activity, good intelligence, and mutually supportive ground and air operations—are widely accepted. Interdiction, defined here as "the attack of the unengaged potential of enemy armies," is regarded as an inherently imperfect exercise; its utility and decisiveness will depend critically on the operational and strategic environment.

The conditions prevalent in the latter stages of World War II, particularly those associated with air interdiction in Italy and Normandy, are increasingly remote from the current and prospective environment for interdiction in Europe. Elements of change in this context include:

- Limited numbers of aircraft, with the prospect of further reductions as a result of "structural disarmament" and arms control;
- Strong opposing air forces, with the proliferation of sophisticated means for air defense and little prospect for its limitation; and a corresponding decline in the viability of armed reconnaissance;
- Increasing opportunities for adaptation in the enemy system of transport and supply;
- The need to place interdiction plans in the context of flexible response, together with the problem of planning for interdiction in a defensive alliance. With few exceptions, past interdiction successes have been in support of offensive operations.

More positively, one can also point to new areas of opportunity, including:

- New instruments for interdiction that can complement and facilitate the interdiction mission, together with prospective improvements in munitions;

- A growing capacity for night and all-weather operations, limiting these traditional sanctuaries from interdiction;
- Important advances in the collection and application of tactical and strategic intelligence for interdiction;
- New interdiction targets and vulnerabilities associated with the increasing sophistication and complexity of C^3 systems.

The effects of interdiction—destruction, delay and disruption, diversion and demoralization—are not accorded uniform prospects for success. There is widespread skepticism, given current munitions, about the prospects for imposing substantial destruction on tank forces, although attacks on infantry, artillery, air defense systems, and other supporting elements hold greater promise. Disruption, including but not limited to delay, is widely viewed as the critical interdiction effect, and one that will not necessarily require a great deal of destruction to impose. Diversion, including the strategic diversion of enemy resources in response to (or anticipation of) an interdiction campaign, is seen as an underrated effect, with an important deterrent dimension. Overwhelmingly, demoralization is regarded as a serendipitous effect of interdiction, critically dependent upon the prevailing morale and experience of enemy forces. **The effects of interdiction are likely to be interactive, divisible, and in some instances intangible.**

Interdiction target systems will also tend to be interactive, offering important opportunities for synergy. Attacks on C^3 may facilitate other interdiction activities; the restriction of supply may also interfere with enemy mobility, an objective of the highest priority for most observers. Assumptions about war duration will be critical to the identification of promising target systems, particularly in relation to strategic targets (targets relevant to the outcome of the war as a whole). The effect of attacks on a limited number of strategic targets may be immediate, despite their depth.

Broader strategic factors, including war duration, intensity, and phases, will shape the opportunities for interdiction. A war of high intensity and longer duration will favor a strategy of interdiction. Possession of the initiative on the ground will also increase the prospects for conducting a successful interdiction campaign.

The environment for interdiction is generally perceived to be in a state of flux. This perception is reinforced by the prospect of further force reductions through arms

control. An environment characterized by smaller conventional forces (ground and air) on the one hand and unconstrained surface-to-air defenses on the other is likely to make the interdiction mission at once more important and more difficult.

This analysis suggests several topics for future interdiction research, including the importance of considering (1) the relationship between air superiority and interdiction effectiveness; (2) longer war scenarios, and the attack of strategic targets; (3) operations beyond various types of defense along pistons, and interdiction in support of NATO counteroffensives; (4) a wider range of targets (e.g., transport, logistics, and C^3); (5) a wider range of effects, including diversion; (6) the enemy capacity for adaptation; (7) the coordinated use of aircraft and surface-to-surface missiles, and the use of mines as interdiction weapons; and (8) the role of interdiction outside the European theater.

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CONTENTS

I. INTRODUCTION

This study surveys perceptions about interdiction and its effects in high intensity conventional conflict and explores the relationship between these perceptions and assumptions about the nature of a potential conflict in Europe.[1] Although the analysis concentrates on current problems, it also addresses the historical bases of interdiction perceptions and the relevance of enduring images derived from historical experience, placing contemporary issues in historical perspective. The emphasis is largely but not exclusively on the role of airpower.

The concept of interdiction—in simple and idealized terms, the "isolation of the battlefield"—holds a place in strategic thought and practice that predates the advent of airpower; it has been viewed as a corollary or an alternative to the engagement of enemy forces in the field. Air power's central role in several of the most important campaigns of World War II has fueled a continuing debate about the lessons of this experience and their implications for contemporary planning. The effects of the strategic air war against Germany and Japan were, of course, made the subject of very prompt and detailed (but still controversial) analyses by the U.S. and U.K. bombing surveys. There has not been a similarly comprehensive official survey of the effects of tactical air power, including interdiction, on the ground war.[2]

The debate over interdiction has naturally concentrated on certain important campaigns, including the experience in North Africa; Operation STRANGLE in Italy; and the operations before, during, and after the Normandy landings. Subsequent conflicts in Korea and Vietnam were characterized by adversaries of unequal airpower engaged in dissimilar styles of warfare, and they were only occasionally amenable to traditional interdiction campaigns; certainly they did not seem to offer many lessons for deterrence and defense in Europe. As a consequence, prevailing perceptions about interdiction continue to be driven to a great extent by images derived from the latter

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[1]Examples of interdiction experience outside the European theater are also mentioned.

[2]Interdiction efforts were, of course, treated in the various official histories of the air war, and the U.S. Strategic Bombing Survey touched upon it tangentially in its investigation of attacks on transportation.

years of World War II. The current situation is thus analogous to the interwar period, with only limited clues to the way airpower could support ground operations against an adversary with similar or greater resources for attack and defense.[3]

To be sure, there is a good deal of consensus about the "lessons" of past campaigns and the basic requirements for successful interdiction. Increasingly, there is also an awareness of the need to view interdiction in the context of objectives on the ground and recognition of the extent to which the effectiveness of interdiction will be determined by broader operational and strategic factors. At the same time, developments in the areas of arms control, nuclear and conventional strategy, and technology are widely perceived as having thrown the European strategic environment, including the environment for interdiction, into a state of flux. It is in this context that this survey of the views of various individuals on the question of "what interdiction does" or "what interdiction can be expected to do in various circumstances" can contribute to informed debate on the role of interdiction in European security and assist in the conduct of more specific analyses (e.g., of the effect of attacks on mobility, command and control, and logistics).

This Note is based on the comments of some 50 people gathered in interviews and roundtable discussions held in the spring of 1989. The commentators included senior U.S. and Allied officers (serving and retired), policy analysts, and historians. The structure of this Note corresponds essentially to the pattern of interview questions and discussion.[4] Section II discusses interdiction as a strategic concept and the lessons of past experience. Section III addresses perceptions of the effects of interdiction (destruction, disruption and delay, diversion and demoralization) and preferred target systems. Section IV explores the interdiction environment, including assumptions about the likely nature of a conventional conflict in Europe (duration, scope, intensity, phases), interdiction in support of offensive and defensive operations, the prospects for airpower and alternative instruments, the contribution of interdiction to deterrence, and the implications of arms control for the future of interdiction. Section V offers overall observations and conclusions.

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[3]Overy, 1980, p. 9.

[4]See the appendix.

II. INTERDICTION AS A STRATEGIC CONCEPT

At least one prominent commentator has suggested that the term "interdiction" made its first appearance in a military context during the planning for tactical air operations against the German communications network in preparation for the Normandy invasion.[1] Regardless of the precise point at which interdiction came into common use as a military term of art, the concept—attacking the unengaged potential of enemy armies or the denial of things that might be of use to the enemy (e.g., time, a route, an area, forces, supplies, the means of mobility)—is as old as organized warfare and a corollary to the direct engagement of forces in the field. The traditional practices of siege and blockade fall into this category.

THE ISOLATION OF THE BATTLEFIELD

The tremendous expansion in the use of artillery during World War I encouraged the notion of the "isolation of the battlefield" through massed indirect fire and a corresponding expansion in the scale of the battle to embrace forces and materiel some distance behind the front.[2] Indeed, a version of this tradition continues in the harassment and interdiction fires of modern artillery and the increasing attention to ground-based weapons for the attack of follow-on forces. During World War I, sporadic efforts were made to mount what would later be termed air interdiction missions against troop concentrations and rail stations in the rear. What clearly differentiated the potential of airpower from other interdiction instruments in the eyes of such early theorists as Douhet, Mitchell, and Trenchard was not simply that isolation could be accomplished swiftly, suddenly, and at great range, but also that there was no need to occupy ground. It was possible to reach over enemy forces in the field to compel a decision (it was less

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[1]Before that, the term had mainly a legal or ecclesiastical connotation, implying the prohibition or denial of a given action. Solly Zuckerman recalls in his memoir that at the time of the planning for Normandy he "had never heard the term interdiction used before in a military context. . . . Gradually, the term interdiction caught on. At first I understood that it was being used to signify the destruction of bridges. But its meaning soon became more and more diffuse until it applied to almost anything." Zuckerman, 1978, p. 258.

[2]See Howard, 1986, p. 511; and Terraine, 1986, p. 12.

obvious that the ability to do this might not matter if one could not exploit the opportunity). Philosophically, the idea of airpower as an autonomous instrument would play a more important role in the development of the theory and doctrine of strategic bombing, much of which has been concerned with the interdiction of materiel at its source; but its influence on interdiction more narrowly defined should not be neglected.[3]

The widespread use of tactical airpower in an interdiction role in World War II provided the dominant historical images upon which current perceptions are based. Judgments about the current validity of the concept of the isolation of the battlefield or the extent to which interdiction can be decisive are most frequently made with the World War II experience very much in mind. The majority of those interviewed believed that although isolation might remain an intuitively useful notion, there was skepticism about the possibility of achieving anything like complete isolation. Many agreed that interdiction was "sold" as the isolation of the battlefield during World War II, although even under the most favorable conditions (e.g., in Normandy), interdiction was at best an imperfect exercise.[4] In this view, isolation might be a valid objective in the abstract, but an interdiction campaign need not be 100 percent effective to contribute to the outcome of a battle. A consensus view would be that airpower could achieve "isolation" in individual instances, within a limited space and time, but that a generalized isolation of the battlefield is now, and has always been, an impossible objective.

An alternative view holds that isolation is a misleading notion, because of its inherent impracticality as an objective and its failure to capture the essence of interdiction. Several commentators insisted that we should reject the notion of the isolation of the battlefield and look upon interdiction as a tool to "shape" the battlefield instead. Here, the aim is not simply to establish a gate to meter the flow of enemy forces and materiel to the front, but rather to degrade enemy forces selectively such that they will arrive in a state and place of our choosing. In this view, a parallel emphasis should be placed on the disruptive rather than the attritive effects of interdiction—if we cannot strangle, we should disrupt. The Follow-On Forces Attack (FOFA) mission, often

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[3]The possible synergies between strategic bombing and interdiction were evident as early as the Spanish Civil War. Commentators noted that the terror bombing of civilian centers could result in the flooding of refugees onto roads, blocking and delaying the arrival of forces at the front.

[4]It was suggested that the widespread use of the term "isolation" from 1943 onward was supported by the clearcut nature of the interdiction campaign in North Africa; it was easy to observe the effects of interdiction in the desert.

described as a variant or subset of interdiction, is similarly perceived as a means of shaping the battlefield.

Perhaps the most intriguing of the observations in this area transcends the question of isolation versus shaping to suggest that perhaps in the future there will not be a traditional battlefield to isolate at all, but simply great maneuver operations. In the context of the World War I origins of the notion of isolation, this transformation may already have been evident in the maneuver warfare of World War II. Indeed, interference with enemy mobility and thus the capacity for maneuver played a key role in the Allied interdiction campaigns in Italy and France.[5]

DEFINITIONAL ISSUES AND ORGANIZING PRINCIPLES

Beyond the definition of the air interdiction mission as incorporated in Air Force doctrine, a considerable range of opinion exists about what is and what is not interdiction.[6] There is, however, a distinct preference for broader interpretations, at least for conceptual rather than doctrinal purposes. A typical comment was that interdiction does not have an absolute meaning, except in terms of its effect on the enemy; only close air support (CAS)—the use of airpower in support of forces in contact—was widely viewed as being outside the realm of interdiction. *The practice of attacking the unengaged potential of enemy armies* is a broadly acceptable formulation that embraces such activities as the conventional strategic attack of infrastructure targets. A more restrictive definition refers to "any activity designed to slow or inhibit the flow of men or materiel from the source to the front, or laterally behind the front."[7] This interpretation, however, does not explicitly capture some of the more subtle and frequently cited aspects

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[5]See Sallagar, 1972. Sallagar's assessment that the denial of German mobility rather than the restriction of supply was the most important, if unintended, effect of STRANGLE is widely accepted. For a recent critique of this study, and a reappraisal of the effect on German supply, see Mark, 1988. See also USAF, 1969a. The dramatic constraints on German mobility are described in numerous German war memoirs, most notably in von Senger und Etterlin, 1953.

[6]AFM 1–1, 1984, defines the air interdiction mission as "air operations to delay, disrupt, divert or destroy an enemy's military potential before it can be brought to bear effectively against friendly forces . . . at such distances from friendly forces that detailed integration of specific actions with the fire and movement of friendly forces is normally not required."

[7]Warden, 1988, p. 84.

of interdiction—the interference with command and control, the imposition of decisionmaking costs, and (less clearly) demoralization.

The question of whether to include the attack of resources and war materiel at their sources of production (supply restriction at source) is controversial. The prevailing image here is the experience of strategic bombing against industrial targets in World War II, about which there is considerable skepticism (the attack of oil supply is an exception). A few observers believed that the interdiction mission was properly concerned with the attack of unengaged potential only after its production, but most were willing to treat such activities as interdiction of a very different sort. The critical distinction in this context is not necessarily close versus deep interdiction, but rather tactical versus strategic effects. On this point there was broad consensus, although it was observed that the question of range cannot be neglected to the extent that it influences the targets that can be attacked with effect. Moreover, the depth of an interdiction attack can also be expected to influence Soviet perceptions and the prospects for escalation.

Tactical interdiction implies target systems with direct and immediate consequences for the success of friendly ground forces. Strategic interdiction suggests target systems that are likely to have only an indirect and longer-term effect on the ground situation. The essential distinction is the delay between cause and effect, a distinction that will often, but not always, correspond to the depth of attack.[8] Thus, the attack of units moving to close with the forward line of own troops (FLOT) might influence the ground battle within hours; the attack of petroleum, oil, and lubricant (POL) logistics in the field might make itself felt within days. At the other end of the spectrum, the attack of industrial plant in Eastern Europe or the western Soviet Union might not have any noticeable effect for months or, possibly, years. Depending upon the operational circumstances, the attack of railways in Poland—a deep target—to interfere with the movement of follow-on forces and supplies, might be felt within a week. To take an extreme example, the destruction of space-related targets (such as satellite launch facilities) in the Soviet Union, a deep and strategic target by any measure, might produce an almost immediate effect on Soviet intelligence capabilities, blurring the distinction between what is tactical and what is strategic.

The experience with tactical and strategic target systems during World War II offered examples of the way distinctions between strategic and tactical bombing can

[8]See Dews, 1970.

diminish over time. The attack on German synthetic oil production as a strategic target became increasingly relevant to the shorter-term situation on the ground and in the air as the tactical supply of special petroleum products was sharply limited. Such cases did not change the general view of those concerned with the Allied ground offensive, for whom the attack of railheads seemed more urgent than, for example, the restriction of steel production, which would go into weapons only the following year.[9]

In general commentators held that tactical interdiction influences the battle, whereas strategic interdiction affects the outcome of the war.[10] A variation on this approach would distinguish between interdiction as a tactic (for example, battlefield air interdiction) and as a strategy.[11] Quite reasonably, most interviewees were unwilling to derive fixed priorities for interdiction on this basis, beyond the obvious and frequently mentioned need to stabilize the situation at the front (the close battle) first.

A dissenting and less pervasive view held that interdiction should be defined in narrower terms; it must have some fairly close cause-effect relationship to the ground battle, suggesting that it is really more tactical than strategic. In a similar manner, in relation to supply restriction, it was observed that interdiction implies placing near-term sustainability restrictions on the opponent, and thus strategic bombing in the classical World War II sense should not be regarded as interdiction.

The majority of those interviewed expressed some degree of dissatisfaction with the strict compartmentalization of ground support missions, including interdiction. One observer described the effort to define interdiction activities in terms of distance from the FLOT as a seriously flawed concept; another asserted that the location of the front is irrelevant to the definition of interdiction, or at least should be. It was suggested that the better approaches refrain from making sharp geographical distinctions between interdiction and close air support, as well as between air interdiction (AI) and battlefield air interdiction (BAI), although it was believed that the AI/BAI distinction probably lends itself more readily to geographical delineation.

The related problem of command in the context of interdiction tasks could, it was asserted, be resolved by reference to the central issue of the use of force. Thus, the

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[9]Kindleberger, 1978, p. 41.

[10]During World War II, Sir Frederick Sykes developed a similar concept of strategic interception, in which he asserted that the closer an attack to the front, the more it affects the battle; the further back one attacks, the more it affects the outcome of the war.

[11]For a related discussion of this distinction, see Freedman, 1987, pp. 34–35.

strategic use of force and AI should be associated with the theater commander or the Air Force component commander. FOFA activities and BAI might be focused at the Army Group and ATAF (Allied Tactical Air Force) level and CAS at the Corps level or below. Throughout, it was emphasized, the aim ought to be centralized planning and decentralized control. The absence of a rigid interpretation of how to approach these matters was, in at least one case, seen as beneficial and providing essential flexibility to the theater commander.

PERCEIVED LESSONS OF PAST CAMPAIGNS

Almost without exception, those interviewed demonstrated a consistent understanding of the lessons of past campaigns, particularly the factors that have influenced the prospects for successful interdiction. These may be summarized, in rough order of emphasis, as follows:

1. The possession of air superiority was widely regarded as a *sine qua non* for interdiction success as it is in the prominent literature on this subject.[12] During World War II, Allied interdiction efforts were rarely hindered by substantial enemy air activity. The campaign against the German transportation system before and during the Normandy invasion, for example, was carried out under circumstances of complete air superiority—the consequence of four years of air warfare and the progressive reduction of the German day fighter force. Rarely has air interdiction even been attempted in the absence of at least local air superiority.

2. Closely related to the need for air superiority was the assumption that an effective interdiction campaign requires sufficient air assets to generate substantial interdiction sorties. Commentators referred to the importance of concentration and mass in interdiction operations. Here again, the Normandy analogy is most frequently cited.[13] To the extent that resources

[12]See, for example, Dews and Kozaczka, 1981; Donohue, 1969; and Momyer, 1978.

[13]An often mentioned point was that there were more tactical aircraft over Normandy on D-Day than NATO now deploys in Europe. Roughly 11,000 sorties were flown on the day of the invasion alone. See USAF, 1969a, p. 12. With regard to the German experience, there were certainly cases, as at Smolensk, in which a minimum isolation of

must be diverted to other missions, including the suppression of ground-based defenses (as in Korea and Vietnam), the possibility of waging an effective and sustained campaign (not a one shot activity), interdiction will be reduced. The underlying conviction was that the use of airpower in "penny packets" constitutes little more than harassment and is likely to be a costly waste.

3. Adequate intelligence was routinely mentioned as essential for effective interdiction. Commentators stressed the importance of intelligence both before and during the campaign to assure that critical nodes associated with individual target systems can be identified and the effect of attacks promptly and accurately assessed. It was suggested that although systems for the collection of intelligence may have progressed enormously since World War II, the ability to sift, analyze, and disseminate the mass of interdiction-related information has not progressed to the same extent. The mixed results produced by the attack of different target systems (tactical and strategic) in previous campaigns suggested to many observers the great importance of accurate intelligence about an adversary's vulnerability—the broader issue of the comparative value of various target systems, apart from the identification of bottlenecks, choke-points, or critical nodes within individual systems.

4. Despite the inherent flexibility and potential for independent action of airpower, ultimately air interdiction is not an autonomous exercise, and its success will depend to a great extent on the nature of the ground situation and the interaction of air and ground operations. The ability to maintain sustained pressure in both spheres—to force an adversary to move, consume, and communicate—was believed to yield the best prospects for interdiction success. It was also recognized that such synergies were not adequately understood and planned for during World War II, although they were

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the battlefield was impossible and the air cordon could not prevent the Soviets from withdrawing. Most often, and particularly during the later stages of the war in the east, it was simply a matter of too few aircraft to run an effective interdiction campaign. This problem is discussed in Plocher, 1965.

achieved almost unwittingly on occasion.[14] As the experience in Korea and Vietnam also demonstrated, it is possible for an adversary to be an inherently low consumer, or to be engaged in a style of operations (or over terrain) that is not amenable to traditional interdiction. The concentration of the enemy's logistical system and the channelization of lines of communication (naturally or as a result of previous action) will create a more favorable environment for interdiction. So too, it is necessary to account for the relationship between interdiction tasks—for example, preventing forces from entering the battle, disruption, and the restriction of supply. In the case of Operation STRANGLE in Italy, these functions overlapped, but the effects of the campaign would have been more pronounced had the dynamic relationship between these effects been clearly understood.

5. The ability to operate at night could potentially increase interdiction effectiveness. During the principal interdiction campaigns of World War II, as well as in Korea and Vietnam, the inability to conduct large attacks at night allowed the enemy to compensate for a good many of the restrictions placed on his mobility during the day. In essence, night has always been the sanctuary from interdiction. The well-known comment that "in a battle of movement a commander who can only make the tactically essential moves by night resembles a chess player who for three of his opponent's moves has the right to only one" is revealing, but neglects the point that "one move" may be sufficient to negate the effects of interdiction at critical junctures.[15] One interviewee observed that interdiction has unfortunately "always been a snap-shot situation. You interdict when you are there, and when you are not there, the enemy moves. We saw this most clearly in Korea and Vietnam."

6. Finally, the effectiveness of interdiction will vary as the enemy reacts and adapts (or fails to do these things). In some instances, individual target systems may harden over time; in other cases the inability of the enemy to

[14]The unexpected effect of Allied interdiction on German mobility after the transition from STRANGLE to DIADEM in May 1944 provides an excellent example of this.

[15]Von Senger und Etterlin, 1964, p. 224. Von Senger, author of this frequently cited quotation, commanded the German forces at Cassino.

adapt may result in catastrophic attrition or cascading errors in decisionmaking. The essential point is that the process is dynamic.

The degree of consensus on the lessons of past campaigns is notable, not only as evidence of the pervasive influence of certain studies in this area, but also because these perceptions, and the historical examples upon which they are based, provide the standard against which the current environment for interdiction is judged. On balance, and on the basis of past experience, it is accepted that interdiction can be operationally decisive—not always, perhaps not often, but certainly on occasion. In the context of route interdiction and supply restriction, it was observed that the failure of forces and materiel to arrive on the scene has often been decisive. Two prominent—and entirely different—examples of such decisiveness are the inability of Axis forces in North Africa to sustain effective operations because of the interdiction of fuel and other supplies being shipped across the Mediterranean, and later, the critical delays encountered by the German divisions moving up to oppose the Normandy landings.[16]

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[16]The devastating Allied campaign against Rommel's lines of communication across the Mediterranean is discussed in Overy, 1980, p. 70. On the delay and disruption experienced by the Panzer Lehr division, among others, in its movement to the front west of Caen, see Rommel's assessment as quoted in USAF, 1969a. pp. 15–16.

III. INTERDICTION EFFECTS AND TARGET SYSTEMS

In the case of the very difficult journey of the Panzer Lehr division to the front at Normandy—a widely cited example of interdiction success—the dominant effects of interdiction were clearly the delay and disruption experienced en route. The attrition effect was small, the division's total order of battle reportedly being reduced by some 10 percent during the course of the movement. Former members of the division, interviewed about their experiences during the Normandy operations, could recall the "smashed railway junctions and bridges they passed on their way to the front, but very few remember their units suffering the actual loss of more than a few trucks."[1] This and other similar experiences suggest that the effects of interdiction—destruction, delay, disruption, diversion, and demoralization—are to some extent divisible. In the opinion of most observers, some minimum amount of destruction (bridges dropped, passes blocked, etc.) is necessary. Beyond this, however, it was held that considerable delay and disruption can be achieved without wreaking very much destruction on forces—hence the notion that these effects are "divisible."

The effects of interdiction on ground forces are multiple, complex, interrelated, highly dependent upon circumstances, and difficult to predict. In many cases the effects may overlap and be mutually reinforcing to such an extent that it is difficult to discuss one without the other.[2] Some observers find it useful to distinguish between primary effects (destruction) and secondary or tertiary effects (disruption, delay, diversion, demoralization). Although this approach is useful, it is not completely adequate. Destruction does not necessarily lead to the secondary effects mentioned; disruption, delay, and demoralization may occur in the absence of much damage. Diversion, at least in the strategic sense (the diversion of enemy effort to counter an actual or anticipated interdiction campaign), may come about independently of other effects. There is no clear step-by-step progression from one effect to the next. One can speak of first and second order effects, but only in terms of the primacy accorded to various effects by historians, planners, and commanders.

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[1]Hastings, 1984, p. 267.

[2]Dews and Kozaczka, 1981, p. 3.

MEASURES OF MERIT

Many commentators pointed to the potentially misleading nature of a focus on "the primary effect"—destruction.[3] Indeed, there is a natural tendency to focus on this aspect of interdiction, not least because it is amenable to measurement and the results can be expressed quantitatively: personnel killed or wounded, tanks and other vehicles destroyed, rail lines cut, tons of supplies destroyed or stranded, etc. This can be a useful exercise and provide a measure of destructive efficiency. As an overall measure of merit and as a final indicator of interdiction success or failure, it is generally perceived to be at best incomplete and at worst gravely flawed.[4] Similarly, there is a tendency to view the number of sorties that can be applied against a target as a measure of merit. This too is seen as inadequate.

The more intangible elements of interdiction require evidence. Disruption and demoralization play an undeniable role in war, but how can one measure this? As one observer noted, the attempt to quantify such effects indulges a strategically dangerous weakness in the U.S. military culture, allowing the desire for quantification to drive us away from things that are intuitively obvious to experienced officers. The example cited in this context was Rommel's assertions about the things he could not do as a consequence of Allied air action; these were not necessarily things that could be described numerically, or in terms of mere attrition.

At the tactical level, it was noted, it is natural to have a material or attrition-related frame of reference. At the operational and strategic levels, however, the emphasis must be on the effects of interdiction on the enemy—delay, disruption, diversion, demoralization, as well as outright destruction. The objective is a reduction in enemy capacity or, in a slightly different formulation, the neutralization of enemy functions. These may be achieved in various ways: directly, through attrition, through supply restriction, or through the interference with plans. Again, the danger of concentrating largely on the destruction of resources lies in the risk of being "efficiently ineffective," being "good at something that ultimately does not matter." The point of interdiction is not, for example, to destroy the most armor, but rather to destroy (or delay, or disrupt) the right armor in the right place at the right time. This is particularly important in an

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[3]Commentators variously refer to destruction, attrition, or damage in making this point.

[4]See Samuel, 1981, p. 38.

environment characterized by a scarcity of resources for interdiction and a surfeit of targets. Targeting priorities are necessarily situationally dependent. To the extent that attrition should be the aim, the concern should be to inflict catastrophic rather than linear attrition. This point is supported by the observation that all armies prepare for a certain amount of linear attrition; catastrophic attrition is less easily overcome.

Another question concerns the extent to which interdiction effects—clearly the preferred organizing principle in theory—can be a useful driving factor in interdiction planning. The recent emphasis on mission order tasking has naturally led to an increased emphasis on effects (delay, disrupt X army by X hours/days), but target type and location still represent competing drivers for interdiction planning. As one commentator suggested, "one can argue for effects as a driving factor in interdiction planning, but as a practical matter, the very large number of demands for support from land forces will dictate that [target] location will be the driver." Ultimately, however, it was acknowledged that the interdiction planner must look to effects, particularly if the goal is to enhance the scheme of maneuver or to shape rather than merely isolate the battlefield.[5] The dissatisfaction expressed over the tendency to divide up ground support missions (CAS/BAI/AI) according to location suggests that in this area doctrine and conceptual thinking seem to be moving in opposite directions.

If the question of effects is central, so too is the question of the overall strategic environment—the context for interdiction planning. This argues for a top-down approach, starting with the strategic level, rather than the reverse: What are the crucial effects and target systems? What is the best way to influence the enemy's system of war? The movement of the front is not the only or even the most important measure of merit. Halting operations and, ultimately, halting the enemy's conduct of the war are what matters.

DESTRUCTION

Of the various interdiction effects, destruction is both the most obvious and the most controversial. To a degree, the attrition of enemy forces and the destruction of natural and man-made targets (bridges, culverts, gorges, etc.) drive the other effects.

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[5]One observer noted that although "effects" should be the main planning concern, differing service time frames make this problematic: The army has a 96 hour planning horizon, whereas air planners tend to focus on the next 96 minutes.

There must be some minimum of destruction if one is to impose delay and disruption. Destruction might be seen as the primary means of bringing about the other, derivative effects of interdiction. But how much destruction is necessary? Indeed, is it possible to impose substantial delay, disruption, diversion, or demoralization without very much outright destruction? In the case of diversion and demoralization, the link to destruction is less clear, with the expectation of harm rather than harm itself playing the main role. Even here, however, it will be necessary to demonstrate a real capacity for destruction if these effects are to be sustained over time.

There is clear skepticism about NATO's current ability to destroy Warsaw Pact ground forces through interdiction. This is most apparent in relation to attacks on armor, where the limits on sorties available for interdiction, coupled with the absence of effective munitions for area attack, are seen as serious constraints. Moreover, improvements in Soviet top armor, delays in the development and deployment of new air-to-ground weapons, and the proliferation of ground defenses are cited as factors that are driving the air/armor balance further in the wrong direction. For some, the attrition of armored elements is more properly a task for ground forces in contact (armies are a better instrument for killing other armies) and CAS, rather than interdiction. In this view, the primary contribution of interdiction lies elsewhere, to include the creation of conditions (blockages, delay, confusion) favorable for the outright destruction of armor behind the front.[6]

Although few believe that interdiction will result in the large-scale destruction of Warsaw Pact tanks, the prospects for the attack of such essential supporting elements as armored infantry, artillery, surface-to-air systems, and trucks may be far better. The vulnerability of enemy personnel to air weapons also suggests that direct or collateral casualties may be at least as important as the destruction of vehicles and weapons. One observer noted that we tend to focus on the destruction of individual vehicles, and neglect the effects of conventional overpressure on supporting troops and equipment. Even in World War II, despite the often favorable conditions for air-ground operations, few tanks were destroyed by air attack. The bulk of the losses through interdiction fell

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[6]The carnage in the "Falaise pocket," following the Allied breakout from the western end of the Normandy beachhead, provided an example of what might occur under such conditions. A graphic account is given in a memo by Col. X. H. Price, Headquarters, 12th Army Group, War Department Observers Board, "Visit to the Falaise Pocket" (AGF Report No. 208, August 31, 1944).

upon animal and truck transport, and infantry.[7] In many cases, usable vehicles were simply abandoned in the face of constant air attack.

To the extent that destruction should be the aim of interdiction, it was believed that the most effective approach would be to strip away the supporting elements, principally artillery, air defenses, and infantry, without which the most difficult target—tanks—will be ineffective. The idea that this might be done selectively, again without widespread attrition, and in a way that can contribute to the scheme of maneuver of friendly ground forces suggests that the aim is as much disruption as destruction.

Some degree of outright destruction is obviously an objective in interdiction—the attrition of enemy forces clearly matters. This must be undertaken at some point to affect the enemy's offensive capability. An important question in this regard is where the destructive effect of interdiction will be most pronounced, close, or deep? As with attacks aimed at producing disruption (although for different reasons), it was argued that close attacks, where every kill counts and the effect is fairly immediate, are preferable. The difficulty of precisely locating and destroying forces further from the front might also suggest an emphasis on close interdiction. The promise of new technologies for the detection and attack of forces over the horizon has altered this perception. One interviewee noted that at sea, the muzzle-to-muzzle engagement went out a long time ago; why then should we assume that deeper attacks will be less effective in the ground-attack realm?

The difficulty of inflicting destruction with current weapons and the general interest in improving NATO's capacity for route interdiction have directed increasing attention on the potential contribution of scatterable mines to promote attrition and impose delay and disruption. It was also asserted that the widespread use of mines could have the very beneficial effect, from the NATO perspective, of promoting the separation of Warsaw Pact armor from its logistical support—the stripping off of supporting elements noted earlier. Despite marked enthusiasm in some quarters, however, few

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[7]Lieutenant General Heinz Gaedcke has described the small number of German tanks destroyed by Soviet aircraft and the much more substantial losses inflicted on trucks and equipment. See Gaedcke, 1979, p. 7. If generalized destruction and shock is the aim, weight of ordnance on target clearly matters. As one commentator suggested, bombing from 40,000 feet by six B-52s at night, without warning, will certainly make an impression on an enemy force. Heavier area attacks on forces in the field were launched in support of the Normandy breakout, with questionable effect and with several serious instances of short bombing.

observers were optimistic about the prospects for improvement in this area (mines were considered not very exciting and difficult to exercise with). In general, mine warfare advocates emphasize its disruptive rather than destructive potential.[8]

From the perspective of the Soviet planner and commander, destruction is the effect that one can most easily anticipate (for example, driving one division through the remnants of another). In contrast, the apparent Soviet emphasis on timing and tempo in armored operations makes compensating for delay and disruption a far more difficult and unpredictable exercise. The widespread skepticism among Allied observers about the destructive effect of interdiction (and about attrition as a priority for interdiction) flows not only from the perception that it is difficult to achieve, but also from the belief that it is not the area of greatest "payoff" or "leverage" in relation to Soviet strategy and operational style.

DELAY AND DISRUPTION

For most analysts of past experience and for contemporary planners, delay and disruption represent the essential "core" effects of interdiction; these are the areas in which the greatest benefits from interdiction are to be found. There is not, however, a precise or uniform understanding about how these effects should be defined or, indeed, whether they should be treated as separate phenomena. At one extreme, it is asserted that disruption simply equals delay and that the measure of disruption should be the forced deviation from timetables. Most observers would wish to define disruption in broader terms, to embrace the forced deviation from plans in terms of time, space, and character.

The formulation that "damage produces delay, which results in disruption" may be accurate in some instances, perhaps many, but most observers believe it does not adequately capture the full range of disruptive effects. The assumption here is that interdiction can (and should) impose decisionmaking costs on an enemy, by creating opportunities for the enemy to make wrong decisions and for the Allies to exploit favorable situations when the enemy plan is driven askew. To the extent one accepts the idea that the battle and campaign outcomes tend to be driven by the way forces are used, the question of decisionmaking success and failure looms large as does the utility of

[8]See, for example, Bingham, 1987.

trying to force bad choices on an enemy commander. As an example of this, the destruction of some (but not all) possible Soviet crossing points on the Elbe will require the adversary to make a decision that may affect the outcome of the subsequent engagement. In Napoleon's formulation, "a plan, like a tree, must have many branches if it is to bear fruit."[9] There must always be a range of viable alternatives for the use of force. An important aspect of interdiction concerns the limitation of these alternatives.

Another important aspect of disruption and delay is the promotion of uncertainty in the adversary's mind. With the growing capability for night interdiction, the perception of uncertainty about the likelihood of air attack and the effects of an attack once felt will increase simply because the difficulty of these judgments will be greater at night. In a sense, this reverses the traditional role of night as a sanctuary from interdiction. Despite NATO's growing capacity for night air interdiction, certain operational limitations will undoubtedly remain, leading to the suggestion that missile systems might be used primarily at night, in tandem with air interdiction during the day, thus maximizing the interdiction's overall disruptive effect.

Delay and disruption are perhaps best described as interactive effects. In the example of the Panzer Lehr division's difficult progress to the Normandy front, the effects of air interdiction included not only attrition and delay, but disruption per se. The forces that did finally arrive on the scene had to be committed to battle piecemeal rather than as a cohesive unit. The experience of past interdiction campaigns points to the importance of disrupting the movement of enemy forces in or behind the battle area, especially in support of a friendly offensive on the ground (forcing the enemy to move in response but restricting his ability to do so).[10]

It has often been noted that no plan survives contact with the enemy, that fog and friction are natural occurrences in war, and that all armies are vulnerable to the disruption of plans. Interdiction can certainly contribute to and exacerbate the tendency toward confusion, but in general effective disruption is viewed as a more specific, less haphazard exercise. A low level or dispersed interdiction effort—harassment—may be sufficient to produce some confusion, but that is unlikely to contribute decisively to the battle's outcome. Ideally, disruption should go beyond the imposition of confusion to impose costs directly relevant to the ground battle (e.g., forcing a poor decision with

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[9]Quoted in Simpkin, 1985, p. 63.

[10]This was also a lesson of the STRANGLE/DIADEM experience in Italy.

regard to route or timing). It may also involve selective attrition of supporting elements and building blocks in the Soviet all-arms formation.[11] Yet another possibility lies in the design of an interdiction campaign to further deception (and vice versa).[12] In its more sophisticated form, deception may be integrated into interdiction operations to manipulate and exploit enemy behavior, going considerably beyond merely insuring that an interdiction campaign does not reveal friendly plans. It is likely to have an operational or theater-level flavor.

One of the important levels at which the "close versus deep" debate is carried on concerns the range at which interdiction attacks should be focused if disruption is the primary aim. There is a consensus that, in principle, such attacks should be carried out closer rather than deeper, because that limits the options for enemy response and recovery. One assessment (provided to an interviewee by a Soviet planner) suggests that as one goes deeper with route attacks—for example, beyond 300 km—the disruptive effect will diminish. Such attacks will have much more pronounced effects closer to the front where the range of responses is narrowed. Too close, however, and the disruptive effect may be wasted (forces in contact are already disrupted). This suggests a critical band for interdiction with the aim of disruption en route, corresponding roughly to the BAI sphere. Ideally, one wants to impose disruption just before the enemy commits himself to contact, when most options are foreclosed. Moreover, because of the greater scope for assessment and adjustment, the deeper the target, the less the likelihood of considerable disruption without substantial attrition. At the point of contact, of course, destruction rather than disruption is imperative.

DIVERSION

The notion of diversion can be applied to interdiction in two quite different ways. First is diversion in the tactical sense: forced detours en route, resulting in a diversion or dispersion of effort. The effort required for the repair and reconstitution of units and systems subjected to interdiction attacks near the front also falls into this category. A second, broader effect might be termed "strategic diversion" and would embrace the

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[11]The tendency of forces to become separated from their logistical train in the wake of interdiction attacks was noted early in World War II. See Goutard, 1959, p. 199.

[12]The need to avoid revealing the location of the OVERLORD landings strongly influenced the design of the interdiction campaign preceding the invasion. See Rostow, 1981.

diversion of enemy effort in response to (or in anticipation of) an interdiction campaign. The latter may affect the allocation of military resources during peacetime as well as in war.

Tactical diversion can disrupt the system of logistic support far afield, even with alternative routes, because of overcrowding and other inefficiencies. In terms of the imposition of decisionmaking costs and promotion of uncertainty, the objectives here are akin to those discussed in relation to disruption. Indeed, tactical diversion might be regarded as a subcategory of disruption. This effect may even be felt in the absence of actual attacks but in an environment in which the enemy commander must fear and account for the threat of interdiction. Under such conditions, tactical movements are unlikely to be made with the freedom and efficiency that would be possible if the prospect of interdiction could be discounted. An inhibiting effect serves as a form of intrawar deterrence.

It was widely perceived that NATO's ability to threaten an interdiction campaign forces the Warsaw Pact to devote substantial resources to offsetting this threat. The diversion of effort can be considerable; perhaps one-third of Soviet military personnel are involved in air defense in some form (clearly home defense is as much of a concern as counterinterdiction here), and large numbers of troops are assigned to rail repair tasks.[13] Certainly, an important effect of the Allied strategic bombing campaigns in World War II was the enormous diversion of German productive capacity and manpower from offensive purposes to air defense. To this one might add the burden of repairs to industrial plant and railways. Although damage to the latter was easily repaired in individual instances, the cumulative and systemic costs were great.[14]

A belief in the diversion effect of interdiction is implicit in the idea that for NATO *not* to engage in interdiction (as a declaratory strategy as well as in practice) is to give the Soviets a free ride. The diversion effect may also be enhanced by diversifying the character of the interdiction campaign—engaging in some minimum number of attacks across a spectrum of ranges and target systems and using various interdiction instruments (air, ground-based missiles, artillery, special operations, etc.). Such an approach

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[13]Reportedly, some 30 percent of Egyptian forces were committed to air defense in the 1973 war.

[14]Albert Speer was very clear on this point, and many other observers have noted the effect. See, for example, Eaker, 1970, p. 3. Strategic diversion has also been mentioned as an example of the paradoxical logic of conflict; see Luttwak, 1989, p. 39.

maximizes enemy uncertainty. Unlike disruption, however, the diversion effect may well decline over time as the enemy learns how to anticipate and adapt.

DEMORALIZATION

Few observers are convinced that there will be any predictable demoralization effect as a result of interdiction attacks. Of course, air attacks can have a demoralizing effect on troops in the field under certain circumstances—for example against a backdrop of existing poor morale as in the use of Stuka dive-bombers equipped with sirens against French positions on the Meuse in 1940. Similar results were also realized in early German operations in the east. In both cases, the novelty of air attacks in support of ground operations played an important part. Those observers who could envision demoralization believed that it would be most pronounced early on and would decline as troops became accustomed to air attack. In effect, this target system, like others, tends to harden over time.

Just as forces in contact are inherently disrupted, they may also be inherently demoralized, in which case it is far from certain that the addition of air attack will contribute very much to the impression already being made by, for example, massed artillery. Indeed, commentators noted that at appropriate ranges artillery is preferable if demoralization is the aim. Behind the front, air attacks will be more noticeable, and to the extent that night operations are the norm, fatigue—a form of demoralization—is likely to be the overwhelming consideration.

Demoralization may be seen as a *serendipitous* effect; it is possible, but it cannot be relied upon. Nonetheless, certain forces, notably reserve and rear area units, may be more susceptible to demoralization than others. First-line Soviet divisions are unlikely to be seriously affected, but that may not be as true of other Warsaw Pact troops or even Soviet follow-on forces composed of category two and three divisions.[15] Overall, the critical determinants are likely to be culture, leadership, and the experience of enemy forces. The German experience is a prime example, especially after Normandy. Despite the absence of air cover, and in the face of an intensive interdiction campaign, the morale

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[15]Route discipline can be adversely affected by interdiction attacks; and as the Afghanistan experience demonstrated, crews are reluctant to remain in immobilized vehicles, even if those vehicles are otherwise serviceable.

of German forces remained quite good through the end of the war, even in an obviously hopeless strategic situation.

To the extent that it can be achieved, the demoralization of enemy forces might also result indirectly from interdiction. According to some interviewees, one of the most demoralizing experiences for troops in the field is to run out of critical supplies, especially ammunition. Attacks aimed at enemy logistics, if successful, might therefore produce an additional inhibiting effect.

Although the question of demoralization in relation to air or missile attacks on civilians is very different, and outside the scope of this study, World War II experience does provide some useful insights into the hardening of resolve under prolonged attack. More relevant is the tendency for "terror bombing," or the fear of such attacks, to produce refugee movements that can seriously complicate the movement of military forces and exacerbate the effects of route interdiction. It can also represent a means of interdiction in its own right.[16] In Europe, especially Western Europe, much of the refugee traffic would be in cars.

Several observers explicitly noted that human factors, including demoralization, have not been adequately addressed as a dimension of modern warfare in general. Although the planning of an interdiction campaign is unlikely to be driven by the desire to bring about demoralization, it may still be possible to achieve something in this area indirectly because questions of morale are woven into the broader issues of interdiction effects at many levels and across many possible target systems (forces, logistics, transport, command and control, etc.). Of the range of interdiction effects, however, demoralization is clearly perceived as the least predictable and the most contingent.

PROMISING AND LESS PROMISING TARGET SYSTEMS

Any discussion of the effects of interdiction must ultimately lead to the consideration of those targets, or more properly "target systems," whose attack can promote these effects.[17] To a great extent, assumptions about the feasibility and utility of attacks on various target systems tend to shape observers' perceptions about the possible (rather than ideal or desired) effects of interdiction.

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[16]As in the Spanish Civil War. Molnar and Colyer, 1988, p. 2.

[17]This discussion addresses "traditional" interdiction targets, not the attack of nuclear or chemical facilities, air and naval bases, or countervalue targets.

One of the intellectual legacies of the Strategic Bombing Survey, reinforced by the experience in Southeast Asia, is a marked skepticism about "panacea" targets. To be sure, there are clear views on promising and less promising target systems, but these are accompanied by considerable uncertainty, particularly in relation to the broader interdiction context. As an example, judgments about the worth of attacks on the Polish rail system, infrastructure targets in the Soviet Union, and even Warsaw Pact logistics closer to the front will turn critically on assumptions about war duration, pace, and intensity. Similarly, assessments of the worth of attacks on forces in transit tend to be driven in large measure by assumptions about the availability of new systems to locate and attack mobile targets over the horizon. The proliferation of ground-based air defenses (missiles and guns) and the virtual impossibility of conducting World War II-style armed reconnaissance make critical the distinction between pretargetable fixed sites (e.g., transport and command and control nodes) and mobile targets that will require near real-time intelligence. Similarly, a target-rich environment is unlikely to matter if NATO squanders aircraft in attacks on low-value targets. A commentator noted that in the modern environment, one is not target limited, but sortie limited.

FORCES

As already alluded to in the discussion of destruction as an interdiction effect, there is broad consensus on the extreme difficulty, given current technology and resources, of decisively attacking Warsaw Pact armor. For most observers, the only case that can readily be made (in cost-benefit terms) for interdiction attacks on armor is in an obvious breakthrough situation. In that case the stakes are very much higher, and the prospects for success may be greater; the armor will be more concentrated, it will be moving forward in a predictable manner, and the range will be fairly short. The ability of airpower to destroy tanks was never pronounced, even with the abundance of resources available for the task in the later interdiction campaigns of World War II. The prospects for a revolution in this field are unclear and will turn on the development of much more effective "smart" munitions for the attack of multiple targets. These weapons would need to be available in sufficient numbers to provide the necessary sustainability. The attack of individual vehicles with small numbers of valuable aircraft (and pilots) is widely perceived as an inadequate approach if vehicle attrition is the objective.

One commentator observed that we tend to underestimate what it actually takes for airpower to have an effect on the ground campaign, and that target planners, in particular, are often overly optimistic about the effort needed to stop a given threat. A Soviet motorized division will have thousands of vehicles spread over a large area. An extra squadron's worth of sorties will do very little in this context—it will require an entire ATAF. All of this argues for a concentration of effort in interdiction. This last point, together with the dangers of mere harassment, form a consistent theme of the discussions on destruction and forces.

There is clearly greater optimism about the prospects for and utility of attacks on other elements of the Soviet all-arms formation, including artillery, air defense systems, and infantry. Tanks alone cannot hold territory, and since a Warsaw Pact offensive in Europe is unlikely to be a simple punitive expedition, NATO must be concerned with ways of reducing the ground-holding ability of Warsaw Pact forces. Interdiction attacks can play a role in this regard, even if the prospects for the attrition of tank forces are poor. The contribution of interdiction to deterrence cannot be understood entirely (or even mainly) in terms of the capacity to stop armored forces, which may account for the consistent Soviet concern over NATO's ground attack capability and particularly FOFA.

MOBILITY

Mobility, interdiction, and strategy are all closely related elements. As one observer noted, the Soviets, Germans, and Israelis fight to move, and the British and Americans have traditionally done the reverse. Of the potential interdiction targets, those related to the movement of forces are most often viewed as promising, whether as impediments to tactical mobility or as obstacles to the deployment of forces within the European theater. This perception is supported by the fact that many of the most noteworthy interdiction successes in the past were decisive precisely because they denied the enemy the necessary mobility at critical junctures. The maritime interdiction campaign in support of Allied operations in North Africa, STRANGLE/DIADEM in Italy, the road and rail campaign in and around Normandy, the defense of the Pusan perimeter in Korea, and the Israeli interdiction campaign in the Golan in 1973 are all persuasive examples of the use of air interdiction to restrict mobility. These cases also highlight one of the most prominent of the perceived interdiction lessons—the synergistic effect of air interdiction coupled with ground operations that force the enemy to respond

by moving. In most cases, the interdictor will have to seize the initiative on the ground, by attacking or counterattacking. Of the examples mentioned, the only exception is provided by the Pusan experience.

The prospects for successful interference with mobility will be enhanced to the extent that geography or the nature of the transport infrastructure constrains the enemy's ability to exploit alternative routes and avoid blockages. In the past, the shortage of rolling stock— more important, trucks—has also increased the vulnerability to route interdiction.[18] The night has traditionally been the sanctuary from interdiction, often allowing a minimum (and in the absence of a parallel ground offense, sufficient) degree of mobility, but in the future, as the capacity for night interdiction expands, that is less likely to be the case.

The poor transport infrastructure in Eastern Europe is widely cited as a factor working in NATO's favor, along with the density of development on the western side of the border. Both of these factors suggest that considerable blockages and dislocation of enemy movement may be possible. The observations of one interviewee are worth quoting in detail on this point:

> When I visited East Germany recently to observe maneuvers, I was struck by how road-bound the Soviets would be. Moreover, the secondary roads were not of high quality, and they all go through villages with narrow, twisting streets. Rubble in the streets would clearly stop the flow of traffic, and only tracked vehicles would be able to go around the stoppage. . . . None of this would augur well for the timetables in a massive Soviet-style movement. Mass is the compensating factor, but the more the Soviets rely on mass to overcome friction, the greater the risk that when things go wrong—as they will—the problems will cascade and result in a disaster.

This optimistic view must be measured against past experience in this area, some of which is less encouraging. In their operations in the east, German forces typically tried to destroy road junctions by bombing or shelling buildings lining the roads in villages, collapsing them into the street. This was readily accomplished, but inevitably Soviet forces simply bypassed these obstructions by going into the fields.[19] Even though

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[18]In German operations during World War II, and in Korea. Axis forces also suffered from a critical shortage of shipping for resupply across the Mediterranean during the North African campaign.

[19]It has been asserted that the attack on Guernica, while an example of terror bombing, was also intended to block roads by collapsing buildings into the streets. If so, it could also be considered an early example of air interdiction.

naturally occurring narrow passes offer opportunities for the attack of concentrated and slowly moving forces, they are not easily "collapsed" with conventional weapons.

Rail transport has always been an important interdiction target. The first attempts at air interdiction during World War I were directed primarily against rail facilities behind the front, and the attack of the railway infrastructure including marshaling yards, bridges, and repair facilities, as well as rail lines and rolling stock— played an important role in the most prominent interdiction campaigns of World War II. The sheer concentration of the movement of troops and supplies by rail, together with the fact that from the Franco-Prussian War through World War II strategic mobility in Europe has been highly dependent on the availability of secure railways in the right places, has made rail-related targets an obvious priority for interdiction.[20] Despite the mechanization of modern armies, the Soviets still depend on only a few rail lines for the mass movement of forces from the western Soviet Union through Eastern Europe toward the German border. These lines, in turn, are characterized by a limited number of railheads, transshipment points, and bridges, all of which would be vulnerable to attack.

An essential question is the extent to which attacks on, for example, the Polish railways would be time-critical. Although such attacks, to be most effective, should be timed to produce the greatest dislocation of Warsaw Pact movement, some follow-on Soviet echelons could have passed through these choke points before a war has even begun. NATO cannot be expected to act preemptively to interfere with Soviet rail movements.[21] However, subsequent attacks would not be without effect. Soviet strategic reserves and supplies would still have to pass through, and, of course, the longer the conflict, the more important such movements would become.

The destruction of rail and road bridges in Italy and France certainly hindered the reinforcement, resupply, and finally the retreat of German forces in the latter stages of World War II. It did not, however, prevent such movements. Even under conditions of complete Allied air superiority, German forces still managed to retreat in fairly good order from Normandy and to hold out for nine months south of the River Po despite the

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[20]The importance of the railways for reinforcement persisted despite the growing motorization of forces before World War II. The Blitzkrieg of 1940 may have been led by armor moving on the roads, but it was still critically dependent upon the rails for logistic support and reinforcement. See Simpkin, 1985, pp. 34–35.

[21]One interviewee noted the possibility of mining the railways in Eastern Europe. The prospects for doing this preemptively, however, are poor.

destruction of all the fixed bridges for communication to the north. The Strategic Bombing Survey concluded that the Allied rail campaign did contribute to the collapse of the German war economy, although the campaign might have been more effective had there been better intelligence about critical nodes in the German transport system.

On the whole, the Allies could afford to pursue the attack on German transportation through the mass application of airpower, rather than through selective attacks. In the NATO context, the limited number of assets available for this interdiction task would make the identification of Soviet vulnerabilities essential.[22] One frequently mentioned possibility would be the destruction of electric power facilities associated with the all-electric railways in Poland. Signaling establishments (more difficult to repair than the rail lines themselves) would also offer worthwhile targets for a selective campaign against rail transportation.[23] The prospects for achieving a campaign or strategic effect through such attacks will turn on the possibility of inflicting a lot of damage quickly. An extended but incomplete campaign is less likely to result in a collapse of Warsaw Pact transport, as damage is progressively repaired and the target system as a whole hardens. The abundance of usable transport vehicles of all sorts in today's civilian economies, East and West, suggests that there may now be greater scope for adaptation to shortages of rolling stock and trucks, although that too will depend on the time available to press these resources into service.[24]

Overall, targets associated with the denial of mobility—certainly tactical mobility, and in a conventional campaign long enough to justify it, strategic mobility—are viewed as essential to the success of an interdiction campaign. If applied selectively and correctly to critical targets, NATO assets are also judged to be sufficient to make such attacks practical and worthwhile.

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[22]This approach is not new. The Stuka dive-bomber was originally developed for deep pinpoint attacks on infrastructure targets such as railroad switching equipment. The focus on the attack of select critical nodes then, as now, was a natural outgrowth of the need to economize on interdiction effort.

[23]Marshaling yards, a focus of heavy attacks during World War II, are widely viewed as a less promising target for the interdiction of rail traffic, particularly if resources are limited. See Dews, 1980.

[24]A modern version of "taxis on the Marne"?

LOGISTICS

As with the various interdiction effects discussed earlier, the target systems mentioned here may overlap, in the sense that attacks directed at one class of targets to produce a specific effect may have secondary or indirect consequences elsewhere. Attacks aimed at restricting enemy supply may also impede mobility and vice versa. The experience of Operation STRANGLE in Italy provides an excellent example of this.[25]

The interdiction of Warsaw Pact logistics is controversial in a manner that the interference with mobility is not. The critical issue is the extent to which Soviet forces will be vulnerable to supply restriction. The existence of substantial stocks in forward areas suggests to most observers that the Soviets are unlikely to be vulnerable on this score unless the war extends beyond 60 days or so, or proves far more material-intensive than expected. The general availability of ammunition is likely to be less important than the availability of specific critical munitions. The problem of supply is not necessarily one of adequacy in the aggregate, but rather getting the right thing at the right place at the right time.[26] Thus, very high rates of consumption of surface-to-air missiles or antitank munitions will strongly influence the utility of supply restriction through interdiction.

Targets cited in relation to the attack on Warsaw Pact logistics include forward supply depots and unprotected stocks in open parks, tank and helicopter refueling areas, and the infrastructure for the movement of POL (the "lifeblood" of modern mobile warfare). The attack on the Soviet POL supply is often emphasized as a priority for interdiction (as well as being an area where the Soviets may not have as much redundancy as elsewhere), with the experience of the restriction of Axis oil supply in World War II providing the dominant historical image.[27] Indeed, the denial of oil is widely accepted as one of the few—perhaps the only—truly successful example of resource restriction to emerge from the 1939–1945 experience.[28] As in the case of ammunition supply, the lesson here is that the attack on critical elements in the system of

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[25]See Sallagar, 1972. A more recent analysis also points to a considerable effect on German supply; see Mark, 1988.

[26]This was the real problem for the German logistic system in Italy. See USAF, 1969b, p. 23.

[27]McDow, 1985, p. 10.

[28]See Lesser, 1989.

supply, rather than a generalized and diffuse campaign of denial, holds the greatest potential for success.

If the restriction of Soviet POL supply is the aim, the network of field pipelines appear to be an obvious target, but most observers agree on the likely ineffectiveness of this approach. Small diameter pipelines are probably not as easy a target as they might seem and in any case might be easily repaired. Pumping stations and refueling points emerge as more promising targets. With good intelligence (and several experts believed that NATO's intelligence in this area was inadequate), these predominantly fixed targets might be attacked with effect by ground-based missiles as well as aircraft. The destruction of fuel trucks would also contribute to a campaign against Warsaw Pact POL supply, but as with vehicle attacks in general, the possibility of destroying large numbers of these with limited sorties is questionable.

In sum, the restriction of Warsaw Pact supply is seen as a potentially important dimension of an interdiction campaign, but its ultimate utility will depend on broader factors relating to the duration and character of the conflict. Certainly, there is little to support the notion that attacking logistics should be given a higher priority than restricting Soviet mobility in the design of an interdiction campaign. An essential question concerns the Soviet style of war and the logistic requirements associated with it. Here, one should be aware of the danger of assuming that a resource-intensive approach to warfare is equally central to NATO and Soviet strategy.

COMMAND, CONTROL, AND COMMUNICATIONS (C^3)

The emphasis placed on disruption as an effect leads naturally to an interest in Warsaw Pact C^3 as a potentially attractive target system for interdiction. In principle, the interdiction of C^3 may offer a range of benefits, both in its own right and to enhance the effectiveness of more traditional aspects of interdiction. If Soviet commands are driven out of fixed facilities by air or missile attack, they may have to rely to a greater extent on more vulnerable radio communications. Further, the more Soviet C^3 is thus degraded, the more difficult (and possibly more rigid) will be the allocation of reinforcements to exploit operational opportunities, precisely what allows the Soviets to offset tactical rigidity at lower levels. Finally, to the extent that Soviet operational flexibility can be reduced through attacks on C^3, the better the overall prospects for success of an

interdiction campaign, including the attack on follow-on forces, mobility, and logistics.[29] The attack on C^3 can also be expected to further the effectiveness of interdiction by hindering Soviet repair and reconstitution efforts.

Soviet C^3, particularly at the higher levels and at some distance from the front, is viewed as an attractive target exploiting perceived Soviet vulnerabilities. Opinion is far from uniform, however, on NATO's ability to carry out and exploit such attacks in practice. Something as large and amorphous as an army's decisionmaking structure will not be easily degraded in the absence of highly accurate intelligence about critical nodes that may prove difficult to find and destroy. Moreover, the Soviets are no doubt aware of both their own vulnerabilities and NATO's interest in exploiting them and will do their best to compensate with greater redundancy. The question of war duration is important here, as elsewhere, since systems for command and control can also be expected to harden over time.

More fundamentally, even if one assumes that the enemy is working to a highly coordinated plan, attacks on C^3 may not have a pronounced effect if these forces simply proceed "on automatic." Put another way, if Soviet forces are inherently inflexible (at least at lower levels), what will NATO have accomplished by putting a great deal of interdiction effort into inhibiting enemy flexibility? These points, taken together, do not necessarily suggest that attacks on C^3 should be dismissed as misguided—far from it—but they do argue for more critical examination of the dynamics of such attacks, particularly the synergies to be derived in tandem with attacks on mobility or supply.

STRATEGIC TARGETS

Although the topic of strategic bombing (in the World War II sense of the term) is beyond the scope of this study and outside the definition of interdiction as understood by most commentators, there is a gray area embracing targets of strategic importance but falling short of attacks on the Soviet war economy or national infrastructure. Such targets are strategic in the sense that they are relevant to the outcome of the war as a whole, but may have a more immediate effect than what is normally associated with strategic bombing. Their effect might be felt within weeks rather than months or years. Obviously, to the extent that prevailing assumptions about war duration are relaxed, and

[29]Luttwak, 1989, p. 46.

the possibility of a longer conventional war considered, the range of relevant strategic targets for interdiction will expand (this issue is addressed in greater detail in Sec. IV). The extent of Soviet mobilization is an additional consideration, as the greater the initial mobilization, the fewer the worthwhile (force) targets for attack in depth.

Potential strategic interdiction targets cut across the categories discussed earlier and may be associated with the restriction of strategic mobility, supply, or C^3I, and tend to be deep in Eastern Europe or the Western Soviet Union.[30] The ability to attack such targets with conventional weapons is widely held to be improving as a consequence of the growing accuracy of delivery systems (and the sophistication of intelligence gathering and targeting systems). In addition, the targets themselves are, in many cases, becoming more sophisticated and sensitive, and therefore more vulnerable to nonnuclear attack.[31]

Prominent examples of potentially worthwhile targets for strategic or deeper interdiction include the Polish rail system (and its supporting electric power net) mentioned earlier, and space and communication facilities in the Soviet Union. In the case of the latter, the target is clearly strategic in that it is relevant to the conduct of the war as a whole, yet the reduction in Soviet intelligence gathering and command capabilities might be felt in days or even hours. However, most attacks on deeper targets, and especially infrastructure, will take very much longer than the five to ten days that form the typical time horizon of air planners to make their effects felt on the ground campaign. This in itself is perceived as an obstacle to the incorporation of these targets into the planning of a tactical air campaign.

NATO's ability to conduct deeper interdiction operations will be constrained by the lack of sufficient numbers of suitable platforms, many of which will be dual-capable aircraft withheld for nuclear missions. Although attrition rates in deep interdiction are generally a concern, opinion is not uniform. An alternative to the "deeper is more costly"

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[30]Several commentators noted that the traditional distinctions among close, intermediate, and deep interdiction are highly artificial; more properly, these might be described as "regimes" within which interdiction occurs. The preferred distinctions are based on immediacy of effect. See Dews, 1970. One of the best (and rarely mentioned) examples of the effect of strategic interdiction on mobility can be found in the U.S. campaign against Japanese maritime communications in the Pacific. As a result of this campaign, the Japanese found it impossible to reinforce at critical points because of the interdiction of their transport and barge traffic.

[31]An extensive discussion of these questions is provided in Builder, 1985.

view suggests that whereas there will be a hard crust of formidable air defenses at the front designed to protect Warsaw Pact maneuver forces, further back there is likely to be less consistent coverage, particularly as defenses are degraded over time. Therefore, substantial opportunities for the evasion of defenses will offset the problem of longer exposure and facilitate strategic interdiction. The use of missile and cruise-missile systems as part of a deeper interdiction campaign (to the extent that such use is unconstrained by arms control) will contribute to NATO's capabilities in this area.

Overall, it is believed that there will probably be some limited number of deeper, strategic targets—many of which will be in the Soviet Union—that should be included in an Allied interdiction campaign, even in the face of competing demands for interdiction closer in. Moreover, threatening the attack of such high-value targets with various instruments from the early stages of a war will compel the Soviets to devote additional resources to defense and contribute to the diversion effect of interdiction.[32] The evident Soviet concern for homeland air defense can be expected to have considerable influence in this regard, but it also raises the question of the escalatory consequences of carrying a conventional interdiction campaign to Soviet territory. Here the perception of what constitutes a strategic attack becomes critical. Since the Soviets will not have the same opportunities for a conventional strategic response, they might choose (or threaten), for example, to respond with submarine-launched cruise missile attacks on U.S. bases or territory, an unpredictable cycle that goes beyond the dynamics of an interdiction campaign.

In sum, there will be benefits from selective interdiction attacks on strategic targets at depth, but there will also be constraints on these operations flowing from resource limitations, pressing demands for interdiction elsewhere, the potential costs of penetration, and escalatory considerations.[33]

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[32]In the view of one observer, we should start thinking about such operations sometime on the afternoon of the first day of a war.

[33]On the complementary aspects of tactical and strategic interdiction, see True, 1981.

IV. THE INTERDICTION ENVIRONMENT

One of the points to be made in relation to virtually all of the elements of the interdiction problem—concepts, effects, targets, and prospects—is the overwhelming importance of assumptions about the broader environment for interdiction. The strategic context is critical to an understanding of the potential role and character of interdiction. To a considerable degree, uncertainty about the prospects for effective interdiction in the European context stems from the perception that the environment is in a state of flux. The issues in this regard include assumptions about the nature of a conventional war in Europe in terms of duration, phases, pace, and intensity; the utility of interdiction in support of offensive and defensive operations; available means (airpower and other instruments, intelligence); and the contribution of interdiction to deterrence and the consequences of conventional force reductions.

THE CHARACTER OF A WAR IN EUROPE

A notable paradox is evident in the prevalence of perceptions about interdiction derived largely from the World War II experience coexisting, side by side, with the short-war assumptions inherent in NATO strategy. These historical images are quite durable, and their application in the NATO context requires, in the words of one observer, "fitting five years of strategy into 30, 60, or 90 days of war." This reality, once acknowledged, suggests either that the Normandy and STRANGLE images have lost their relevance or that prevailing short-war assumptions are unrealistic. For most observers, the truth lies somewhere in between. Elements of the previous experience (e.g., the importance of restrictions on mobility in support of an offensive on the ground) may retain their importance, even if the context of overwhelming air superiority and an abundance of available resources has changed completely.

To be sure, there are valid considerations of Alliance politics and declaratory strategy involved in the adherence to short-war assumptions in NATO. Yet the shift in emphasis away from the nuclear dimensions of strategy and the parallel tendency to take conventional defense in Europe more seriously have encouraged the perception that nuclear escalation is not necessarily automatic in the event of a Warsaw Pact offensive

and that a longer, conventional war cannot be ruled out. Indeed, European experience since 1914 suggests that short-war strategies do not necessarily result in short wars. The prolonged conflict in the Persian Gulf demonstrated that fact. From the Soviet perspective, the prospect of a long conventional war is extremely unattractive, not least because the correlation of forces will steadily worsen over time as the full military and economic potential of the Alliance is brought to bear. It is therefore in the Alliance's interest to consider longer-war strategies and requirements, including those related to interdiction.[1]

A longer war may be more amenable to a strategy of interdiction than a short war since it will ideally allow for the assertion of air superiority and the suppression of defenses, providing the necessary freedom of action for a comprehensive interdiction campaign.[2] A longer war will also broaden the range of targets for interdiction. Bridges across which initial echelons have already passed may not be worthwhile targets in a short war, whereas they would be if reinforcements and supplies continued to move across them to support a protracted conflict. At the other extreme, a conflict long enough to involve the mobilization of resources beyond forces and materiel in being raises the possibility of attacks on traditional economic and infrastructure targets familiar from the World War II experience. The longer the conflict, the greater the justifiable delay between interdiction cause and effect. Interdiction attacks on targets in Eastern Europe might also have implications (positive or negative) for coalition warfare and Warsaw Pact cohesion that would be more relevant to a longer conflict.

A prolonged stalemate characterized by positional warfare is unlikely to present as favorable an environment for interdiction. A war that resembles the 1914–1918 experience, or Korea in late 1952–1953, will present few opportunities for the restriction of mobility (although levels of consumption could be very high, increasing the value of supply restriction) and greater opportunities for adaptation and response within target systems.

The relaxation of short-war assumptions also encourages the consideration of *phases* in conventional war. In the prevailing view, the likely phases of a conventional

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[1]German planners placed little emphasis on strategic interdiction before 1940, as they assumed that campaigns would be too short to justify such attacks. Only in the unlikely event of a stalemate would attacks on infrastructure targets in the rear be contemplated. See Overy, 1980, p. 59.

[2]Again, this is the ideal case. The enemy will also seek to assert air superiority over time.

war in Europe (from the air perspective) would include an air superiority battle, together with some amount of critical interdiction (as competing needs for OCA operations and defense suppression allow); followed by a broad-based interdiction campaign in support of defensive operations; and finally, interdiction in support of a counteroffensive, including the attack of deeper strategic targets. Interdiction efforts in the early stages of a war will inevitably focus on the attack of unengaged potential near the front, including concentrations of forces and materiel, and the restriction of tactical mobility. The attack on infrastructure targets and finally economic and political targets in the rear is seen as a potentially important but subsequent task, appropriate to another phase of war. In the view of virtually all observers, the nature of attrition rates, for defensive systems as well as aircraft, particularly in the initial stages of a war, is a major area of uncertainty. A conflict fought with few aircraft and entirely with forces in being places a premium on the outcome of initial operations, with direct implications for the resources available to conduct interdiction operations over time.[3]

A conflict long enough to generate classical interdiction targets may also be long enough to expend existing stocks of "smart" and preferred munitions. The central question in this regard is the likely intensity of a European conflict and the associated rates of consumption. Just as previous wars have tended to overthrow prevailing assumptions about duration, estimates of consumption have most often fallen short of reality, demonstrated by the succession of "shell crises" and struggles for the production of materiel of all sorts from the Franco-Prussian War through World War II. For many observers, more recent experience—including the 1973, Falklands, and Iran-Iraq wars—reinforces the belief that modern warfare implies enormous rates of attrition and consumption. If half of one's inventory of weapons could be lost in less than three weeks, as in 1973, how would a longer war in Europe be sustained, and how should limited stocks of sophisticated interdiction munitions be used?[4]

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[3]The question of comparative attrition rates and the outcome of an initial air campaign is a complex one. Most commentators regarded this as a critical but highly elusive issue.

[4]The very high rates of expenditure of tanks, aircraft, and other weapons was a source of surprise and concern for both sides in 1973. See Carver, 1986, pp. 796–797. The problem of "armament in width" (limited numbers of many specialized weapons) versus "armament in depth" (fewer and perhaps less sophisticated weapon types, with greater sustainability) is in no sense new; it was central to the debate over German strategy and rearmament in the 1930s.

The prevailing view holds that high-value munitions should be husbanded for use at critical junctures, although the temptation to use them early on for interdiction operations will obviously be very strong. If, however, one assumes that ground-based defenses will be suppressed over time, traditional unguided munitions may be more useful later than earlier in an interdiction campaign. In that case, high-value munitions should be used early on, when air defenses are strongest and one-shot and standoff capabilities are at a premium.

The pace of operations will strongly influence the prospects for interdiction success. Rapid maneuver and expenditure of fuel and ammunition will produce stresses in the enemy's system of mobility and supply (and C^3), which may then be exploited through interdiction. Similarly, the pace of air operations, especially the ability to mount interdiction attacks at night, could greatly complicate enemy ground operations by closing this traditional window for the unimpeded movement of forces.

OFFENSIVE AND DEFENSIVE INTERDICTION

A widely acknowledged lesson from past experience is that interdiction will be most effective if the enemy urgently needs to move or he is a high consumer of resources. Mutually supportive air and ground operations permit the interdictor to create (or maximize) and exploit these conditions.[5] Yet the ability to bring about this important synergy and enhance the prospects for interdiction success is likely to be far greater when the interdictor is on the offensive, or at least possesses the initiative on the ground. Indeed, past campaigns reveal very few instances of successful interdiction in support of defensive operations (the defense of the Pusan perimeter is a commonly cited example).[6] In defensive, holding, or retreating postures, interdiction campaigns tend to be narrow in scope and more akin to close support; in support of the offensive, interdiction has tended to be wide ranging and comprehensive.[7] Successful deep interdiction, in particular, has been associated with aggressive action on the ground.

The current notion of using an interdiction campaign to shape or extend the battlefield, prevalent among ground force officers, represents one approach to the

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[5]Dews and Kozaczka, 1981, p. viii.

[6]A detailed account is provided in Futrell, 1983. Air operations in support of the defense of Hue provide another useful example.

[7]Donohue, 1969, p. S-6.

problem of air support for a (strategically) defensive posture. Here, the focus is on using interdiction (including the attack on follow-on forces and largely BAI) to create opportunities for seizing and retaining the initiative.[8] It is predicated, in large measure, on new technology, but it is made possible by the "rediscovery" of the offensive dimensions of warfare within the limits of Alliance politics and planning.

All of the interdiction images, such as those provided by Operation STRANGLE and Normandy, as well as other clear but less frequently cited examples of successful interdiction (such as the campaign against Japanese mobility in the Pacific and the Israeli air operations against the Sinai passes in 1967), derive from active and strategic offensives. The prominence of these images in the minds of contemporary planners is all the more surprising given the difficulty of reconciling this experience with the defensive character of NATO strategy, at least in the initial phases of a war.

In theory, interdiction should be able to contribute to defensive operations as long as the interdictor retains substantial freedom of action. One possible explanation for the lack of successful examples is that if one is on the defensive on the ground, one has probably lost the air war as well (or at least not yet won it); in the absence of freedom of action in the air, it is impossible to wage an effective interdiction campaign. Together with the inherent disadvantages of interdiction in support of the defensive, that helps to explain the German inability to carry out an effective interdiction campaign after the failure of their offensives in the east.[9] The perceived gap between the offensive and defensive potential of interdiction is consistent with, and reinforces, the lessons with regard to the synergy between air and ground operations, and the inherent difficulty of waging an interdiction campaign without air superiority.

AIRPOWER AND OTHER INSTRUMENTS

Uncertainty about the numbers and types of resources that will be available for the interdiction mission in the future is an important aspect of the general perception of flux in the interdiction environment. The prevailing images and lessons that shape the current debate are drawn almost exclusively from the experience of air interdiction, although interdiction as a strategic concept certainly predates the advent of airpower, and

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[8]See Starry, 1981, p. 38; and Dinges and Sinnreich, 1980, p. 15.

[9]For example, the German withdrawal from the Caucasus, including the defense of the Khuban bridgehead, was supported by air interdiction, but its effectiveness was limited by shortages of aircraft and fuel. See Plocher, 1965, Vol. III, pp. 26–50.

numerous alternative instruments have been used for interdictive purposes alongside aircraft. Artillery, naval gunfire, helicopters, mines, special and partisan operations, and ground forces themselves have all been used as means of interdiction in addition to fixed wing aircraft and ground-based missiles.[10] At the level of strategic interdiction and economic warfare, naval blockade has been the traditional instrument, reinforced by strategic bombing in more recent experience.

Current concerns looks to the manned penetrator and ground-based missile systems as instruments for interdiction. The numbers of aircraft available for interdiction and other missions are steadily declining, largely as a result of "structural" disarmament, while the effectiveness of anti-air defenses continues to increase. Even in Vietnam, armed reconnaissance in the traditional sense had become difficult, if not impossible. As a consequence of the proliferation of missile and gun defenses in Warsaw Pact and client inventories, the investment required to suppress and penetrate air defenses has grown enormously.[11] All of these factors taken together suggest to many observers that the prospects for waging a broad-based interdiction campaign with air power, at least in the initial phases of a war, have become less certain. Increasingly, it is believed that air interdiction will need to be a highly concentrated affair if all of the resources required for the penetration of enemy defenses are to be brought to bear at critical times and places.

The unacceptability of high attrition rates for limited numbers of sophisticated multirole aircraft (and their pilots) is seen by many observers as an argument for the wider use of unmanned systems to suppress defenses and thereby preserve airpower's interdiction role. In this view, drones and missiles should be considered as complementary to rather than competitive with manned aircraft. More broadly, the challenge is to reduce the risks associated with penetration while improving the ability to

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[10]The battleship Missouri reportedly destroyed an average of two bridges per day during operations off Korea, the equivalent effort of 60–70 aircraft sorties according to one analysis. Cited in "Reassessing the Battleship," *International Herald Tribune*, 24 April 1984, p. 3. Partisan activity in Russia and in France in the days before the Normandy invasion contributed to interdiction efforts. One commentator suggested that NATO explore the potential for "partisan interdiction" in Eastern Europe. Another unconventional form of interdiction can be seen in the numerous Israeli helicopter-borne raids on infrastructure and transport targets between 1967 and 1973. See Molnar and Colyer, 1988.

[11]Several observers expressed concern that tactical air arms control initiatives might result in a disproportionate reduction in electronic warfare platforms, increasingly vital to the conduct of the interdiction mission.

attack multiple targets on the ground. Accordingly, "the solution . . . must lie in tactics that hold aircraft outside the most effective defenses yet permit the use of multiple, highly accurate, and flexible weapons. A change from the past emphasis on platform performance therefore seems not only inevitable but imperative."[12] As the number of NATO platforms for ground attack continues to decline, perhaps even more steeply as a consequence of arms control and budgetary pressures, the importance of improved munitions—especially standoff weapons—as a means of preserving airpower's interdiction role will loom even larger.[13]

Pessimism about the extent and effectiveness of the resources that will be available for air interdiction is widely identified as a stimulus to the development of the Army Tactical Missile System (ATACMS) and other shorter-range ground-based systems to support FOFA.[14] There can be little doubt that ground-based weapons will play an increasingly important role in interdiction, yet there are also considerable uncertainties surrounding their development and employment, perhaps more than surround the future of the manned penetrator. In particular, there is little consensus that the precision and destructiveness of ATACMS will be as impressive as claimed. The variables in this regard are likely to be the effectiveness and vulnerability of the associated intelligence and targeting systems, as well as the destructiveness of the munitions to be delivered. Several observers voiced doubt that such systems as ATACMS will be able to provide flexible firepower along entire fronts, although this should be possible across Corps.[15] Such weapons as the Multiple-Launch Rocket System, capable of hitting targets within 35 km or so, are seen as less revolutionary and essentially akin to artillery. Perhaps the most pervasive concern is that ATACMS will prove too expensive to be procured in sufficient numbers to fully exploit its potential. To the extent that ground-based systems are able to play a greater role in interdiction, especially in FOFA, this may facilitate the concentration of aircraft for deeper attacks on both fixed and mobile targets.

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[12]Armitage and Mason, 1983, pp. 256–257.

[13]The same point might be made in relation to stealth technology.

[14]An interviewee noted that the Army exists in a culture that assumes air superiority. Moreover, except at the highest levels, airpower that is not visible to friendly troops on the ground is seen to be ineffective.

[15]If such flexibility is to be maximized, it was suggested that such long-range, scarce, and expensive weapons be controlled at levels above Corps (at the Army Group level).

One approach to exploiting the synergistic potential of air and missile systems could involve the wider use of missiles at night and in bad weather when aircraft will be less effective and uncertainty about the effects of an attack and the stress on enemy ground forces will be greatest. Missiles will also have obvious advantages for the most time-urgent interdiction missions; but that must be weighed against the disadvantages of a one-shot weapon system (an extreme example of armament in width) in a war of unpredictable duration.

Despite the problem of limited aircraft numbers, there is a clear perception that airpower will continue to possess unique advantages in the interdiction role, including range (and this is not simply a factor of distance to target) and flexibility of employment. Above all, airpower can, at least in theory, be applied across the entire front, or even shifted between fronts and theaters. As one observer noted, air has no flanks, the forward edge of the battle area has never been straight in the history of war, and airpower has no straight lines.

The perception that a conventional war in Europe will present a target-rich environment, in which the principal constraints on interdiction will flow from a shortage of platforms, suggests that NATO will easily make use of all the attack capability it can muster in both aircraft and missiles.[16] Moreover, a proliferation of instruments for interdiction (including special operations and mines) can serve as a hedge against uncertainties and will complicate the enemy's problems of defense and adaptation, all of which becomes more important at lower levels of armaments.

A final and pervasive concern that cuts across all of the instruments for interdiction is the accuracy and timeliness of the intelligence that will be available to support interdiction operations in the future. The problem of intelligence will exist at a variety of levels, from the identification of promising target systems to the rapid collection and assessment of information on mobile targets, and finally to the assessment of results. The World War II experience, especially with regard to strategic bombing, suggests the importance of good intelligence for the identification of critical nodes in the enemy system of transport and supply. As the ability to engage in armed reconnaissance and to attack targets of opportunity declines, interdiction intelligence becomes even more vital. Although the technology for the collection of intelligence has improved

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[16]Komer, 1984, p. 38.

enormously since 1945, many observers expressed concern that the ability of NATO air and ground forces to assess and use this information has not kept pace.

DETERRENCE AND THE IMPLICATIONS OF ARMS CONTROL

NATO's capacity for interdiction is widely acknowledged as an important aspect of deterrence in Europe. Here, the capacity for interdiction means the ability to identify and reach important targets, deliver effective weapons, and revisit targets as necessary. Moreover, the capacity for interdiction is not simply a question of numbers and types of weapons or numbers and types of aircraft but also a matter of operational factors, including sortie rates over time, and the willingness to pursue interdiction as a strategy. Finally, capacity is not a static measure and will be shaped by employment and attrition. The objective is to increase the perceived costs of aggression and create uncertainty about the outcome of a war, as much a psychological exercise as a technical one. These two aspects meet in the continuing Soviet concern about NATO's tactical airpower, new technologies for interdiction (part of the "revolution in warfare" as the Soviets have termed it), and FOFA and deep-strike as declaratory strategy. Moreover, a strategy of interdiction exploits Soviet sensitivities with regard to the vulnerability of maneuver forces and the air defense of Soviet territory. In this context, several commentators suggested that the Soviets take our capacity for interdiction more seriously than we do, and perhaps credit us with more capability than we really have.

Deterrence is largely a question of perception, and one could be self-deterred if one does not have confidence in the ability to perform essential missions, including interdiction. The United States and its allies have defined interdiction as an important undertaking based on our sense of history and our perception of the Soviet military style and strategic aims. Relinquishing the interdiction mission would not only weaken conventional deterrence but would also remove an important prenuclear instrument (at a time when the efficacy of nuclear deterrence is itself being subjected to question within the Alliance).[17]

There is general agreement that Soviet perceptions of NATO's capacity for interdiction (together with associated concerns about dual-capable aircraft) have served

[17]See Alberts, 1984. Conventional interdiction is accorded a much lower priority in French planning, where nuclear forces dominate the agenda. Here, the interdiction mission is not so much prenuclear as prestrategic.

as an impetus to conventional arms control. Reductions (and redeployment/restructuring) in Soviet ground forces as a consequence of unilateral and arms control initiatives are likely to have important consequences for interdiction opportunities and prospects. There is a broad consensus that the effects of interdiction will be more pronounced on thinner ground forces, first because of the additional premium that would be placed on concentration to achieve promising force ratios for attack, thereby creating better opportunities for the interdictor. Second, with fewer forces at their disposal, Soviet commanders will have greater difficulty in concealing centers of effort, again facilitating the task of the interdictor with limited resources. Third, the withdrawal of Soviet forces to positions farther back in Eastern Europe and the Soviet Union will impose longer transit distances and deployment times, creating additional opportunities for deep interdiction.

All of these developments should, in principle, result in increased opportunities for interdiction. In reality, these advantages are unlikely to be realized so simply. First, tactical air reductions will inevitably accompany reductions in ground forces, while ground-based defenses are unlikely to be similarly constrained, further complicating the task of planning and executing an interdiction campaign. Second, smaller Soviet forces post-CFE will be utilizing the same structure for mobility and logistics that had previously supported much larger elements. Presumably, that will increase system capacity and efficiency, thus complicating the task of the interdictor.[18] Finally, longer transit distances for Soviet forces will not provide better opportunities for the interdictor in practice, unless NATO is prepared to act preemptively to interfere with these movements (e.g., over the Polish rails), and that is most unlikely.

In sum, the capacity for interdiction continues to influence both Soviet and Allied deterrent perceptions and lowers the nuclear threshold, an increasingly important objective for the Alliance. As a consequence of conventional force reductions, interdiction is likely to become more important but also more difficult as the numbers of tactical aircraft are limited and anti-air systems continue to improve.

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[18]The enemy may need to concentrate a smaller force for maximum effect, negating the potential value of excess capacity in the logistic network.

V. OBSERVATIONS AND CONCLUSIONS

Viewed in the aggregate, the preceding discussion of prevailing perceptions about interdiction and developments in the strategic environment suggests the following points:

1. *There is broad consensus on the lessons of past interdiction campaigns.* These include the importance of air superiority, adequate resources for a sustained campaign, good strategic and tactical intelligence, mutually supportive air and ground operations, and the capacity for night interdiction. The essentially *dynamic* nature of interdiction attack and response is also recognized. Interdiction is generally regarded as an inherently imperfect exercise.

2. *The historical images upon which prevailing perceptions are based are drawn overwhelmingly from European campaigns of World War II.* The enduring influence of the Normandy and Italian (STRANGLE and DIADEM) experience is remarkable and provides the basis for the lessons cited above. Subsequent interdiction campaigns in Korea, Vietnam, and several more recent regional conflicts are either infrequently mentioned or regarded as less relevant to the question of protracted, high-intensity conflict between sophisticated adversaries.

3. *There is broad awareness of the increasing gap between the strategic and operational conditions prevalent during the latter stages of World War II and today's environment for interdiction in Europe.* Elements of change—all of which may challenge the continued relevance of traditional interdiction images—include:

- More capable aircraft and munitions, but far fewer and liable to further reductions as a result of structural disarmament and arms control;
- The proliferation of increasingly sophisticated means of air defense, with little prospect for limitation;
- The demise of armed reconnaissance as a viable approach to interdiction;
- Increasing prospects for adaptation in the enemy system of transport and supply, using resources drawn from the civilian economy;
- The advent of nuclear weapons and the corresponding need to place interdiction plans in the context of flexible response, together with *the*

continuing difficulty of considering interdiction in support of offensive operations in a defensive alliance.

Corresponding trends that may suggest new opportunities for interdiction in the future include:

- New instruments for interdiction (and the support of interdiction), such as ground-based missile systems and drones, that can complement and facilitate the role of the manned penetrator, together with prospective improvements in standoff and wide-area attack munitions;
- The growing capacity for night and all-weather air operations, limiting the traditional sanctuary from interdiction;
- Continued progress in interdiction-related intelligence and targeting;
- New targets and vulnerabilities arising from the increasing centralization and sophistication of C^3.

4. *The effects of interdiction will be interactive, divisible, and in some instances intangible.* More specifically:

- The prospects for the large-scale *destruction* of forces, particularly tank forces, through interdiction are considered poor in the absence of improved munitions;
- *Disruption*, including but not limited to *delay*, is viewed as the most important (and most readily achieved) interdiction effect; it may be brought about even in the absence of substantial destruction and can make itself felt through the imposition of decisionmaking costs on the enemy;
- *Diversion*, together with disruption, is perceived as an important effect. In its strategic dimension—compelling the diversion of enemy resources to counter an expected or actual interdiction campaign—it is perceived as a vital and underrated effect with important implications for deterrence;
- Overwhelmingly, *demoralization* is regarded as a serendipitous effect of interdiction, the prospects for which will depend heavily on the morale and experience of enemy troops.

5. *Targets associated with the interference of enemy mobility are accorded the highest priority by most observers.* The worth of attacks on logistics and C^3 is less clear and will depend critically on a host of broader factors. Consistent with the prevailing pessimism about destruction as an interdiction effect, tank forces are not regarded as a promising target, although more vulnerable supporting elements, such as artillery, air defenses, and infantry, may be. The attack on most strategic targets—those that will affect the outcome of the war—will turn critically on assumptions about war duration, although the effect of attacks on a limited number of deep targets may be more immediate. Target systems are *interactive* (e.g., attacks on C^3 may increase the effectiveness of other interdiction activities, the restriction of supply may also interfere with enemy mobility), and unless their collapse is brought about early on, they will tend to harden over time.

6. *Ultimately, broader strategic factors will determine what can and cannot be done with interdiction.* A war of longer rather than shorter duration, characterized by rapid pace and high intensity, will offer more promising opportunities for interdiction. The question of phases in war is also critical. History offers few examples of successful interdiction in support of defensive operations. The best opportunities for mutually supportive ground and air operations arise in the offensive phases of war. At a minimum, possession of the initiative is perceived as vital to interdiction success.

7. *The environment for interdiction is widely perceived to be in a state of flux.* Some of the main elements of uncertainty for the future include:

- The reassessment of traditional assumptions about war duration and phases, and the manner in which this may or may not be accommodated in NATO strategy;
- The prospective balance of technology for the attack and defense of interdiction targets;
- The implications of unilateral and arms control reductions for interdiction. *An environment characterized by smaller conventional forces and unconstrained air defenses is one in which interdiction in Europe is likely to be both more important and more difficult.*

VI. FINDINGS FOR INTERDICTION RESEARCH

The foregoing analysis suggests several points relevant to interdiction research, specifically factors that should be embraced in interdiction modeling and analysis.

- *The influence of air superiority.* The demonstrated importance of air superiority as a determinant of interdiction effectiveness suggests that we need to develop methods for measuring this in terms of attainment, maintenance, or erosion over time. The absence of air superiority implies that substantial effort would have to be devoted to air base attack, defense suppression, and escort. Moreover, the effectiveness of individual interdiction sorties would be reduced as a result of suboptimal attack profiles and the difficulty of carrying out armed reconnaissance. All of this needs to be more adequately captured in our modeling and analyses.
- *Longer-war scenarios.* Closely related to the question of air superiority is the critical issue of war duration. The extension of the analytical time frame from a few weeks to many months would permit consideration of attacks against strategic targets and would encourage the consideration of interdiction in other than a purely defensive mode.
- *Other modes of ground combat.* Wars of longer duration will be particularly important if the effects of interdiction on ground combat are to be explored in relation to, for example, counterattacks and counterenvelopments—that is, in support of the sort of offensive operations that have historically provided the most promising environment for interdiction. In the context of modeling, NATO forces should be able to carry out operations beyond various types of defense along "pistons," and should be able to mount a counteroffensive in an appropriate phase of war.
- *A wider range of targets.* Efforts to explore the effects of interdiction on target systems other than follow-on forces are clearly consistent with prevailing perceptions and should be continued and expanded. Specific targets of this sort would include the enemy transport system (rail, roads and

bridges, rolling stock), logistics (especially POL, ammunition, and resupply traffic), and command posts and communication facilities.

- *A wider range of effects.* Perceptions of the relative values of various interdiction effects suggest that it would be most useful to explore the effect of
  - — casualties apart from damage to vehicles and weapons;
  - — an imbalance in combined arms formations as a result of the selective attrition of elements that support enemy tank forces (including artillery, infantry, air defense systems);
  - — the diversion of enemy resources to air defense, rail and road repair, and additional redundancy in logistics (supplies and transport) in response to an interdiction campaign.
- *Sensitivity to uncertainties in decisionmaking and adaptation.* Factors that should be considered include the ability of the enemy to develop and employ effective countermeasures, the dynamics of recovery and reconstitution, and the residual capability for the conduct of planned operations following attacks during road marches.
- *Other factors to be considered in interdiction modeling and analyses include* the coordinated use of aircraft and surface-to-surface missiles, the use of mines as interdiction weapons, and the quality of intelligence information.
- *Interdiction in other theaters.* Although conventional force reductions can greatly reduce the prospect of war with the Soviet Union in Europe, the risk of conflict (of varying magnitudes) with regional out-of-area adversaries will persist. The question of the utility of interdiction as an instrument in relation to crises outside of the European theater warrants further study. The character of interdiction in this context would very likely involve the conduct of operations at long range with small numbers of aircraft, in an environment characterized by fewer (but not necessarily less sophisticated) defenses than in Europe, and with a premium on the attack on political and economic targets rather than armor and other force elements.

Appendix

QUESTIONS FOR DISCUSSION[1]

1. How should interdiction be defined? Is the notion of the "isolation of the battlefield" a valid one? What should be the organizing principle—target type (systems), location, effects?

2. What is the role of conventional air interdiction (or the capacity to threaten an interdiction campaign) in deterrence? What does the "capacity" for air interdiction mean (numbers and types of aircraft? numbers and types of weapons)?

3. What assumptions can be made about interdiction and its influence on enemy decisionmaking? What are the variables in this context (restriction of supply? constraints on mobility? diversion of resources or attention? interference with command and control)?

4. How might "disruption" and "demoralization" be defined? To what extent have disruption and demoralization as a result of interdiction had decisive effects apart from damage, delay, or supply restriction (e.g., in World War II, Korea, Middle East)? In general, are the effects of interdiction divisible?

5. Are perceptions about interdiction consistent with assumptions about the likely nature of a conventional conflict in Europe?

- Duration and likelihood of escalation
- Phases
- Pace and intensity (e.g., capacity for night operations)
- Worth of conventional attack on "strategic" targets
- Balance between offense and defense

6. What are the current and prospective areas of uncertainty in assessing the effects of interdiction on the ground battle?

7. What aspects of the historical experience are most instructive in relation to the above questions?

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[1]These questions formed the starting point for discussions in the United States and Europe in the spring of 1989.

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