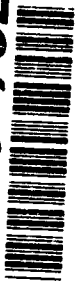


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NEW APPROACHES TO PLANNING FOR EMERGING LONG TERM THREATS (U)

Volume I: Text

Authors:

Stephen D. Biddle, *Project Leader*
Julia L. Klare
John C. F. Tillson
Robert A. Zirkle

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Contributors:

Bohdan Balko	Irvin W. Kay
Barbara A. Bicksler	Robbin F. Laird
Jeffrey H. Grotte	Richard R. Legault
H. Marshall Hoyler	Karl H. Lowe
Jack L. Kangas	Victor A. Utgoff

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INSTITUTE FOR DEFENSE ANALYSES
1801 N. Beauregard Street, Alexandria, Virginia 22311-1772

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INSTITUTE FOR DEFENSE ANALYSES

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Task T-K6-1194

PREFACE

This briefing provides the results of a quick-response study performed by the Institute for Defense Analyses for the Office of the Assistant Deputy Under Secretary of Defense for Policy Planning under task "New Approaches to Meet Emerging Long-Term Threats." The briefing is presented in two volumes: an unclassified main briefing, and a classified second volume of technical appendices.

The study was motivated by concern that with the end of the cold war, challenges to U.S. security may be changing in ways that current U.S. military capabilities are ill-suited to meet -- and that the nature of the defense *planning* problem may be changing in ways that the existing PPBS system is ill-suited to meet. In particular, the combination of slower modernization rates (which means longer-term implications for current program decisions) and a rapidly changing threat environment have made longer range planning both more important and more difficult. Given this, IDA developed an analytical approach for conducting longer term planning under such conditions, and provided a "proof of principle" for that approach via a series of illustrative analyses.

The resulting approach begins by projecting a set of new military-operational challenges created by new forms of conflict or emerging strategies for aggression. These projected challenges are then compared with the capabilities of programmed forces, and shortcomings, or "critical mission areas" are identified. Options for improving capabilities in these critical mission areas are then developed and assessed, and implications for programmed forces are derived.

Perhaps the most significant finding of the study is the utility of a "critical mission" approach to long range planning. Centering the analysis on a set of critical military missions (as opposed to, e.g., technological or geo-political projections) insulates the analysis to a degree from the uncertainties associated with changing international political alignments; helps focus attention on the policy problem to be solved; facilitates cross-system and cross-service analysis; makes it easier to integrate the unusually wide range of disciplinary perspectives required to evaluate the unusually diverse range of analytical issues raised by long range planning; and facilitates the integration of technological and doctrinal change into operational concepts for the use of new systems. In addition, although not intended to provide definitive programmatic recommendations, the analyses

conducted to demonstrate the approach suggested a number of possible avenues for improving long term military capabilities. These include survivability enhancements for dismounted personnel; development of armed, unmanned, airborne recce systems; non-lethal incapacitation technologies; command disablement for PGMs; foliage penetrating radar; and agent defeat systems for biological and chemical weapons.

The work benefited from the contributions of many individuals. In addition to the authors and principal contributors listed on the cover, Mr. Theophilos Gemelas provided valuable assistance in compiling literature relevant to future threats; Ms. Erika Tildon provided essential graphics and clerical support; Ms. Eileen Doherty edited the document; and Ms. Barbara Varvaglione provided timely and efficient production assistance. The briefing was reviewed by Mr. Michael Donley, Dr. Phillip Gould, and Dr. David Sparrow of the IDA staff.

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EXECUTIVE SUMMARY

Purpose

End of the cold war makes long-range planning more important — and more difficult

- Slower modernization rate — longer term consequences for today's decisions; reduced flexibility for rapid response to unanticipated challenges
- Rapidly changing threat environment

How can effective planning be conducted in such an environment?

Purpose of IDA task is to demonstrate an approach

- Develop a framework of essential analytical tasks
- Conduct illustrative analyses to see whether completion of tasks yields useful insights
- Provide "proof of principle" — not definitive answers

Slide ES-1: Purpose

This briefing summarizes the findings of a quick-response IDA study of new approaches to planning for emerging long-term threats. The study was motivated by concern that, with the end of the cold war, challenges to U.S. security may be changing in ways that current U.S. military capabilities are ill-suited to meet — and that the nature of the defense *planning* problem may be changing in ways that the existing PPBS system is ill-suited to meet.

In particular, in the post cold war world, the time horizon required for effective planning has lengthened. With reduced budgets and without a Soviet threat to drive system obsolescence, modernization rates have fallen dramatically. With systems remaining in service for longer periods of time, we will be living with the consequences of today's decision making for longer periods of time: as late as 2011, for example, more than 70 percent of the systems available to the U.S. military will have been ordered during the period covered by the FY1994-99 FYDP or before. And with slower system turn-over and lower acquisition rates, our ability to procure new systems in response to unanticipated threats will be weakened. The end of the cold war thus puts a premium on our ability to anticipate defense needs farther into the future, and to reflect that anticipation in current defense programming and budgeting.

At the same time, the end of the cold war makes effective long-range planning more difficult. During the cold war, the Soviet threat was relatively consistent and predictable. Today, challenges to U.S. security interests, while less cataclysmic, are much more diverse and harder to anticipate. Few predicted the problems posed by such contingencies as Bosnia or Somalia, for example, and still fewer anticipated them early enough to have developed programs for more effective responses. The variability and uncertainty of the post cold war international environment thus poses unique challenges for planning, and especially for long-range planning, where a long time horizon permits change to accumulate and increases the range of potential outcomes to be anticipated.

How can effective planning be conducted in such an environment? The purpose of this study was to help answer this question by developing an analytical approach for conducting such planning and, if possible, by demonstrating its feasibility. To this end, IDA has described a series of analytical tasks and a framework by which to organize those tasks into a long-range planning process. To determine if this framework can yield useful insights, a series of illustrative analyses were performed using the approach developed here, and their results are summarized below. As a quick-reaction effort, these analyses are not meant to be definitive in themselves — rather their purpose is to provide a vehicle for exploring the feasibility of the approach, for suggesting useful avenues for more detailed follow-on analyses, and for suggesting strengths, weaknesses, and potential improvements in that approach as a basis for possible modification of the PPBS process.

Approach: Rationale

Key Issue: Coping with long-term uncertainty, variability

- The longer the time horizon, the wider the range of possible security challenges, technological opportunities, organizational/doctrinal innovations
- Too many foreseeable possibilities to assess each comprehensively
- Possibility of unforeseen — and unforeseeable — conditions
- Implies need to:
 1. Identify patterns — where possible, group classes of possibilities together by reference to underlying similarities
 2. Winnow possibilities — identify subsets with special importance for planning

Slide ES-2: Rationale for Approach

In doing this, a key issue was the need to cope with the uncertainty and variability of the long-term future. In the short term, security challenges, technological opportunities, military organizations and doctrines are all relatively static. But the longer the planning horizon, the greater the magnitude of possible change — and this is exacerbated by the uncertainties of the post cold war international environment. Simply to project all plausible variations of current, observable trends in international politics, technological change, and doctrinal or organizational innovation yields a set of combinations too large to assess each in any detail. And current trends may not reveal all future possibilities. Given a long-time horizon, issues and problems that have not yet become visible may yet present important national security concerns.

To some degree this is an unavoidable problem — no analytical approach can prevent surprises or anticipate the unforeseeable. But for a long-range planning system to be useful it must at least reduce the odds of gross mismatches between forces and challenges. To do this requires an ability to make sense of the complexity of future possibilities.

To this end, we have pursued two general "design criteria" for coping with the uncertainty and complexity of long-range planning.

First, where possible, the approach should identify underlying similarities among classes of possibilities that permit them to be addressed as a group for planning purposes. The more the set of possibilities can be consolidated without masking important differences, the more tractable the analytical problem becomes. And the identification of patterns may itself suggest the existence of unforeseen possibilities by extrapolation, reducing somewhat the risk of surprise in long-term projection.

Second, a usable approach requires a means of winnowing the large set of future possibilities into a smaller subset, with particular importance for long-range planning. By excluding topics or possibilities with limited leverage on near term programming, analytical effort can be concentrated and the magnitude of the analytical effort required can be reduced; without this, the burden of comprehensive assessment could easily become overwhelming.

Approach: Rationale (continued)

Strategy

1. Organize future contingencies by the patterns of military operating environment they pose
 - Allows large numbers of possibilities to be grouped together by similarity of underlying military problems
2. Winnow list of military operating environments by focusing on "critical long-term challenges,"
 - i.e., military operating environments that:
 - i. pose problems significantly different from those addressed by cold war planning;
 - ii. are associated with threats to important U.S. interests, or opportunities to advance emerging U.S. interests; and
 - iii. could plausibly be present in 2011
3. Winnow set of potential technologies, doctrines, and organizations by focusing on "critical military mission areas"
 - i.e., military tasks required to meet critical long-term challenges, but for which programmed forces are ill-suited

Slide ES-3: Rationale for Approach (concluded)

Given this, the strategy adopted for coping with the uncertainties of long-range planning has three main themes. First, it groups together classes of potential future contingencies by reference to the different military operating environments they pose. Variations in future international political alignments could produce an enormous number of potential flashpoints around the world, but the number of basic variants in the military character of the ensuing conflict

is much smaller. Many states in Eastern Europe, the former Soviet Union, Africa, South Asia and elsewhere face ethnic conflicts that eventually could produce open warfare. But, while the locations and identities of the combatants differ widely, the military operating environment created by ethnic conflict in the second and third world poses a number of important similarities across the entire set — including close intermingling of civilian and military personnel, slow operating tempos, or relatively low capitalization of armies. Of course, this is not to say that there are no militarily relevant differences between individual ethnic conflicts; rather, as a class, the traits they share are more important for planning long-term military capabilities than are the differences among them (and that individual exceptions may best be approached as variants of a general class rather than as *sui generis* occurrences).

Second, this approach reduces the set of potential military operating environments to be considered by focusing on a subset with three important properties. First, the subset must pose military problems significantly different from those addressed by cold war planning. Large-scale mechanized land warfare, for example, is excluded — not because it is unimportant, but because the heavy cold war emphasis on mechanized warfare makes it likely that its needs are relatively well-represented in existing programming. (Note that with the passage of time, the relevance of the cold war's planning emphases will diminish — as will the utility of this criterion as a means of winnowing potential security challenges. The general point is that the approach should strive to focus attention on that subset of the range of future possibilities with the greatest leverage for planning; over time, the specific criteria that best serve this aim may change.) Second, the subset must be associated with threats to important U.S. interests, or opportunities to advance emerging U.S. interests of substantial importance. And third, the subset must plausibly be present in 2011 — that is, two planning cycles beyond the current FYDP. Note that this does not mean that challenges arising before 2011 are excluded; nor does it exclude problems existing today (so long as these have emerged since the end of the cold war). Rather, our intention is to focus on challenges that could reasonably be expected either to emerge some time between today and about 2011, or to persist until that time absent some change in U.S. policy. In combination, these three criteria help focus the analysis on problems that are likeliest to be of special importance for long-range planning — that is, problems that are relatively unlikely to have received extensive attention in the development of the existing defense program; that affect important U.S. interests; and that are appropriately matters of long-term concern. The subset of potential military operating environments that fit these criteria will be referred to as "critical long-term security challenges."

Finally, the approach restricts the set of potential technologies and organizational or doctrinal innovations to be considered by focusing on what might be termed "critical military mission areas." These are those military tasks that are required to meet the critical long-term

security challenges defined above, but for which currently programmed forces are ill-suited. For example, this approach would exclude technologies intended to improve the ability of U.S. fighter aircraft to maintain "no-fly zones" in the airspace above ethnic conflicts — not because the mission is unimportant, or unrelated to post cold war challenges, or because individual technologies are not promising — but because currently programmed forces are already relatively well-suited to such a task. By concentrating the analysis on emerging missions for which programmed forces are inadequate, the approach is thus intended to focus attention on areas where long-range planning can make the greatest difference.

Approach: Key Tasks

1. Identify critical long-term security challenges
2. Project programmed forces
3. Compare forces with challenges — identify critical military mission areas
4. Develop options to provide critical mission capabilities
5. Assess options
6. Recommend changes in programmed forces to implement best options

Slide ES-4: Key Tasks of Approach

This slide describes the specific analytical tasks required to implement the strategy given above. First, a set of critical long-term security challenges must be identified. The strategy described above implies a two-part process for doing this: creation of an initial (broad) list of possible future military operating environments, and winnowing that list by applying the selection criteria described above. No rigorous method exists for creating a definitive initial list, although an extensive catalogue of future possibilities can readily be compiled from the existing literature. For the illustrative analyses described below, an initial list was developed through a series of internal and external discussions with academic, government and intelligence community personnel. These discussions, however, were intended only to identify the existing body of opinion, not to provide a novel methodological contribution in themselves — the purpose of the approach developed here is to help cope with the wide variance typical of such predictions, not to specify a method for creating them per se.

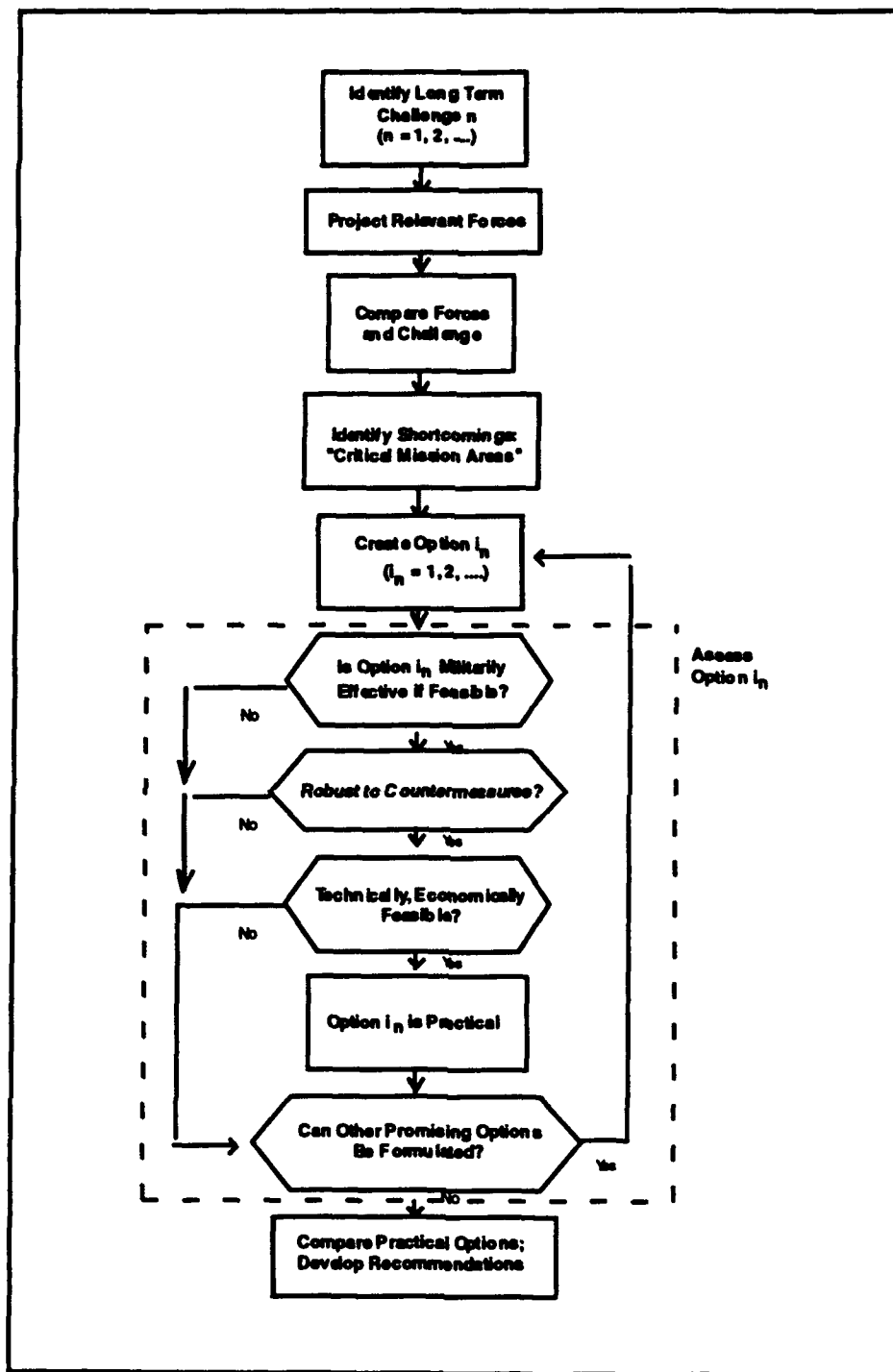
Second, the forces available to respond to these challenges must be projected from current program guidance. Methodologies for such projection are available in the existing literature (although such projections are not currently provided as a formal element of the PPBS management process); this study has not attempted to extend or modify existing techniques for such projections.

Third, these forces must be evaluated in the context of the critical long-term challenges and any shortcomings identified. These shortcomings represent the critical military mission areas around which the development of options for improvement are to be focused. Specific analytical techniques for identifying shortcomings must be selected on the basis of the particular challenges and forces being considered; the inherent variety of either in a long run context will require a corresponding variety in analytical method.

Fourth, options must be developed to remedy the identified shortcomings and provide the indicated critical mission capabilities. To develop any given option entails identifying a set of technological, doctrinal and/or organizational innovations that seem likely to provide the needed capability. Although an option need not involve changes in all three dimensions, wherever possible it is useful to describe options in terms of operational concepts integrating technologies with the doctrinal and organizational context required to use them effectively.

Fifth, the options must be assessed. Typically, to develop meaningful options will require an iterative process of development (task four), assessment (task five), and revision — the aim is to maximize the chance of finding an effective capability (rather than to assess any particular proposal per se), and to do this will often require multiple passes and multiple revisions. Note that this in turn requires that assessments must often be partial in nature. To maximize the number of iterations that can be accomplished within any given resource level, options found to be unsuitable to the given mission will be discarded or modified without comprehensive assessment. Many options will thus be discarded quite quickly after an initial analysis finds important weaknesses; others will receive more thoroughgoing consideration; but only those showing the greatest promise will be evaluated comprehensively. Those (relatively few) assessments which require comprehensiveness, however, must consider a wide range of properties — including the option's robustness against countermeasures, its consistency with treaty obligations, opportunity costs imposed on organizations and materiel, technical risk, development and acquisition costs, and the degree to which the option reduces the policy risks associated with the use of force, or increases the likelihood of success. Finally, the remaining set of apparently-effective options must then be compared to determine their relative cost-effectiveness by these criteria.

Given the results of these tasks, recommendations must be made to change programmed forces (if necessary) to implement the most cost-effective options that emerge.



Slide ES-5: Flow Chart

This slide organizes the analytical tasks described above into a flow chart algorithmically describing the process of an illustrative analysis. Note that the chart assumes that resource limitations will mandate a partial consideration of future challenges and potential responses; the process is formulated as one of a set of "case studies" of individual challenges and associated responses. Note also that the algorithmic representation here will rarely be followed in as mechanical or deterministic a way as the flow chart suggests; for any given case study, some steps may be treated implicitly or dispensed with quickly. By depicting the process as a whole, however, the flow chart describes the logical elements of the analysis — even if it may not necessarily provide a literal description of any given case study.

The process begins by identifying a critical long-term challenge; projecting programmed forces relevant to that challenge; comparing the capabilities of those forces to the nature of the challenge; identifying shortcomings in those capabilities, or "critical mission areas," against which to plan options for improvement; identifying an option (that is, a combination of technology, doctrine and organization); and assessing whether that option provides a practical source of the military capabilities called for by the critical mission area (that is, whether the option is militarily effective if feasible, robust against countermeasures, and technically and economically feasible). If at any point in that assessment the option is found to be impractical in some key respect, further assessment is halted, and either the option is modified or an entirely different option is considered, and assessed in turn. When the set of reasonably promising options has been exhausted, any practical options that emerged are then compared, and the best of these is recommended for programming consideration (or if no practical options have emerged, this is noted and recommendations developed for more fundamental research to identify more practical alternatives for the longer term).

Case Studies

1. Incremental Aggression and Discriminate Military Capability
2. Incremental Aggression and Coercion of Hostile Leadership
3. Weapons of Mass Destruction (WMD) Proliferation and Counteroffensive Action against Proliferation Sites

Slide ES-6: Case Studies

To test the feasibility of this approach, three case studies were performed, each of which considered a single critical long-term challenge, the critical military missions the challenge implied, and the associated options for providing the indicated capabilities. In particular, the three cases selected considered two critical mission areas deriving from the challenge of incremental aggression — that is, discriminate military operations and coercion of hostile leadership — and one deriving from the challenge of WMD (Weapons of Mass Destruction) proliferation — that is, counteroffensive action against proliferation targets.

As for the first two of these, a strategy of "incremental aggression" calls for an invader to divide the intended conquest into pieces, each of which is small enough to stay below the provocation threshold for outside intervention, but many of which, taken together, may eventually produce large gains. Of course, incremental aggression per se is not new — Hitler's acquisitions of the Sudetenland, Austria, and Czechoslovakia, for example, followed such a design. The end of the cold war, however, creates circumstances ideally suited for such a strategy.

In particular, the end of the cold war has made it possible for many regional powers to pursue territorial ambitions that were once suppressed by a risk-averse Soviet patron. But few of these states can ever hope to defeat a massive intervention by the United States — *if* the U.S. chooses to commit enough of its full military power. Under such conditions, the issue is not whether or not the U.S. is *able* to roll back a regional aggressor, but rather whether or not the U.S. will *choose* to do so given the relative costs and benefits of the intervention. Given this, the purpose of an incremental aggression strategy is to influence that choice by keeping the magnitude of the provocation ambiguous, thus altering the perceived costs and benefits of outside intervention. And while such a strategy can influence the choices of an individual state, it can have an especially powerful effect on the collective decision making of multinational coalitions. An

ambiguous provocation often will be interpreted differently by different individuals or governments; thus the greater the number of independent decision makers involved, the greater the opportunity for discord and the lesser the likelihood of a unified response. Inasmuch as the United States continues to stress the importance of multilateral action for U.S. involvement, strategies that keep provocations ambiguous could provide particularly effective vehicles for aggression in the post cold war era. (Note that at least two variants to a strategy of incremental aggression can be identified: a "slow and continuous" form, and a "fast and discrete" form. In the former, ambiguity is obtained by keeping any given day's gains small; in the latter, by causing an early and seemingly final halt after a short initial advance. Although both are important, we have concentrated on the former here.)

In general terms, programmed forces could respond to such a threat in at least two broad ways: they could attempt to defeat (or contain) the aggressor's military forces, and they could be used to coerce the aggressor's political leadership. Of these, the first case study focused on the first — defeating an incremental aggressor's military forces — while the second response — coercing the aggressor's political leadership — was the focus of the second case study.

The other critical challenge considered in was that of WMD proliferation. (Note that a more complete list of challenges, including many not addressed in the case studies, is given in slide 9 of volume 1 of this report.) While proliferation is hardly a new problem, it is one whose context and salience have changed dramatically with the end of the cold war. During the cold war, the Soviet threat tended to overshadow proliferation as an issue for defense planning. But with the end of the cold war, WMD proliferation has emerged as a central issue for national security policy generally, and for planning in particular.

Proliferation potentially threatens a wide range of U.S. national security interests, including the security of important allies; the stability of regions, such as the Mideast, with vital economic consequences for the United States; the safety of U.S. forces overseas; and even the lives and property of U.S. citizens on American soil (especially in the form of terrorist or subnational acquisition of WMD). With respect to the threat to U.S. forces in particular, acquisition of WMD, such as incremental aggression, offers a means by which hostile states could pursue aggressive ambitions in the face of superior U.S. conventional military power. For many potential aggressors, the futility of taking on the United States where it is strongest — i.e., conventional mechanized warfare — was demonstrated vividly by the Iraqi defeat in Operation Desert Storm. Few potential opponents seem to have responded to that event by trying to compete with the United States in conventional mechanized capability. Rather, most seem to have concluded that ways must be found to *avoid* U.S. strengths — and for those who can afford them, weapons of mass destruction offer one of the most potentially powerful.

In general, the United States can respond to the threat of WMD proliferation in at least three ways. We have long attempted, for example, to prevent hostile states from obtaining WMD in the first place by denying them access to essential equipment, materials and expertise through export controls, international monitoring and inspections, trade sanctions, and active tracking and interdiction of shipments. Alternatively, we can improve the ability of our forces to operate in a WMD environment by, for example, providing protective equipment, decontamination and monitoring systems, hardening existing materiel, or modifying doctrine, procedures or force dispositions to reduce vulnerability to attack. Likewise we could attempt to eliminate a hostile state's WMD (or capacity to develop or use WMD) by direct attack. Of course, these are not mutually exclusive — we have, and will continue to, pursue all three. Although all are important, we will focus here on the third — direct counteroffensive action against an opponent's WMD capabilities.

Of course, many other cases could have been considered (and may be pursued in subsequent efforts); the three addressed here are intended only to be broadly representative of the larger universe of potential cases, and to raise a variety of analytical issues germane to the approach and its validity. In particular, these case studies were intended neither to provide definitive analyses of particular programs nor to exhaust the range of potentially useful applications.

Conclusions and Implications

Case studies suggest approach is feasible and provides potentially useful insights

Cases illustrative of 3 classes of potential outcome

- **Incremental Aggression and Discriminate Military Capability:**
 - Projected capabilities have significant shortcomings
 - Improvement may be possible by adapting/combining relatively mature technologies
- **Incremental Aggression and Leadership Coercion:**
 - Projected capabilities have significant shortcomings
 - Improvement unlikely without reconsidering underlying phenomena
— may need to revisit goals/means, seek other solutions
- **WMD Proliferation and Counteroffensive Action:**
 - Projected capabilities have significant shortcomings
 - Improvement possible but may require extensive effort, provide only partial solution

Slide ES-7: Conclusions and Implications

The main conclusion we derived from these case studies is that the approach developed here is feasible, and can enhance long-range planning in the face of an uncertain environment. Of course, the demonstration provided was necessarily partial in nature — only three cases were considered, and none of the assessments was exhaustive (none, for example, included formal, detailed program projections or cost estimates for options). The approach would thus benefit from further testing and a more extensive treatment of some of the cases addressed here. Nevertheless, enough of the principal elements were exercised to constitute a reasonable first test, and no fatal flaws were encountered in the process. The study thus can be said to have provided the "proof of principle" called for in the objectives for the task.

In addition to testing the feasibility of the steps making up the approach, the three case studies also illustrated three broad classes of outcome the approach can produce. In each case, significant shortcomings were identified in projected capabilities. In the first (incremental aggression and discriminate military capability), these shortcomings related to the limited capabilities of programmed airpower to find and destroy the concealed, intermingled targets typical of incremental aggression, and to do so without causing unacceptable collateral damage in the process. The analysis, however, identified a set of relatively mature technologies and relatively modest doctrinal modifications that might be adaptable to the mission of finding and killing such targets. While none of these improvements will eliminate the inherent casualty risks of operating in an incremental aggression environment, they nevertheless offer some potential for meaningful risk reduction that would not be available from projected capabilities alone (for a list of some of the more promising possibilities, see slide ES-8 below, and slides 12-25 in the main body of text).

In the second case study (incremental aggression and leadership coercion), the analysis again identified significant shortcomings in projected capabilities. These shortcomings involved a variety of drawbacks associated with economic sanctions, arms embargoes and arms transfers (e.g., the difficulty of obtaining international consensus, the difficulty of plugging leaks, and the tendency of sanctions and arms transfers to conflict with humanitarian interests); and the shortcomings associated with direct leadership targeting (e.g., uncertain legality and ethics, limited capability, and difficulty in ensuring that successors will be an improvement). But unlike the first case study, the second failed to identify any options that, given the current state of knowledge, could meaningfully improve projected capabilities to perform the identified mission. Given the nature of the target regimes and the means available to them for resisting coercive pressure, foreseeable options appear to work best against regime types least likely to threaten U.S. interests, and are least effective against the repressive authoritarian states that pose the greatest threat. This suggests that if capabilities are to be improved, we must either reconsider the nature of the mission itself (for example, by emphasizing discriminate military capability rather than leadership coercion, for dealing with incremental aggressors), or reconsider the underlying phenomena. As for the latter, the analysis suggests that the threat of regime change offers the most important potential source of coercive leverage; and while the current state of knowledge provides few viable options for creating such a threat against repressive authoritarian regimes, that state of knowledge is very limited. (It is, however, amenable to improvement given systematic analysis.) Basic research on the dynamics of regime change in authoritarian states might suggest new capabilities in this area — but absent productive results from such research, available options show limited potential (for a more detailed discussion, see slides 27-34 in the main body of the text).

In the third case study, WMD proliferation and counteroffensive action, the analysis suggests that for the subset of counteroffensive actions considered (i.e., peacetime operations against national WMD research/production/storage facilities), the mission as formulated is extremely demanding. The target facilities often are large, dispersed and well defended; the activities at such facilities are often ambiguous (and largely opaque to U.S. intelligence); and the WMD materials themselves pose substantial risk of toxic agent release (and potentially, of large-scale civilian fatalities where such facilities are located near urban areas) in the event of attack. Moreover, the materials themselves are very difficult to neutralize — for programmed forces, counteroffensive action is unlikely to be able to remove an existing inventory, limiting us to delaying initial acquisition for states that do not currently possess such materials, or to preventing states that have already acquired some from manufacturing more (and/or delaying access or further processing). Projected forces thus, again, have significant shortcomings in the mission considered here. In the third case study, however, to accomplish the indicated mission would probably require extensive development of new capabilities, and even then the result may provide only part of the stated objectives. Pending consideration of alternative forms of counteroffensive action (e.g., operations against delivery systems or supporting infrastructure), or alternative responses to WMD proliferation (e.g., defenses against WMD attack), it is difficult to determine the relative costs (both monetary and political) and benefits of the indicated improvements. But without such improvements, it seems unlikely that projected forces will provide the capability to perform the mission as formulated within the planning horizon for the study (for a more detailed treatment, see slides 36-51 in the main body of text).

Conclusions and Implications (continued)

Implications for development areas warranting further consideration:

- Survivability enhancements for dismounted personnel
- Close up armed airborne recce, C3 for integration with cueing radars
- Non-lethal incapacitation, command disablement for PGMs, FOPEN radar, unmanned sensors
- Fire support, defense suppression improvements for SOF direct action
- Improved WMD materials search techniques
- Insertion/extraction methods for larger forces
- Improved WMD agent neutralization/collateral damage containment technology

Slide ES-8: Conclusions and Implications (continued)

In addition to testing the approach, the case studies also suggested some possibilities for development areas that may warrant further consideration. For defeating military targets associated with incremental aggression, for example, these included survivability enhancements for dismounted personnel; armed, penetrating airborne reconnaissance and C3 for integrating this with radar systems for cueing; non-lethal incapacitation technologies; command disablement for PGMs; foliage-penetrating (FOPEN) radar; and improved unmanned sensors. For striking proliferation targets, these included fire support and rapid defense suppression improvements to support SOF direct action missions; improved procedures and technologies to search large facilities for WMD materials; improved insertion and extraction methods for large forces; and more effective methods for WMD agent neutralization without large-scale agent release. Of course, in no instance has this initial analysis provided a definitive case for the feasibility or effectiveness of a specific system, but it has suggested some potentially promising directions for development along lines often different from those pursued most thoroughly during the cold war. More extensive analysis is required, however, to make more definitive any programmatic recommendations from this preliminary work.

Conclusions and Implications (concluded)

Lessons learned for approach:

- Utility of mission focus
- Utility of multiple iteration, variable-length assessment
- Variable resource requirements of individual case studies
- Parallel vs. sequential process organization — utility of mostly-sequential design
- Skill requirements, team organization — need for interdisciplinary team; the tighter the deadline, the greater the need

Issues for further research:

- Fitting this approach into PPBS context
- Implications of comprehensive (vice case study) scope

Slide ES-9: Conclusions and Implications (concluded)

Finally, the testing process has generated some "lessons learned" for developing effective approaches to long-range planning, and identified some issues for further research. In particular, the first "lesson learned" regards the utility of a mission focus for long-range planning. That is, the approach developed here identifies missions and seeks capabilities to perform them, rather than, for example, identifying long-range technological developments or weapons concepts and evaluating them. This strategy has at least four advantages here. First, it helps focus attention on the policy problem to be solved by the analysis. Second, it facilitates cross-system and cross-Service analysis. Third, it facilitates the integration of technological and doctrinal change into operational concepts for the use of new systems. And fourth, a mission focus makes it easier to integrate the unusually wide range of disciplinary perspectives required to evaluate the unusually diverse range of analytical issues raised by long-range planning.

A second "lesson learned" regards the utility of a multiple-iteration approach with variable length analyses in any given iteration. Long-range planning requires conceptual development to identify technological and tactical opportunities, to integrate those into options, and to anticipate

countermeasures to those options. To do this, it is important to be able to create, modify or discard alternatives quickly and to re-start assessments in mid-stream as difficult problems and new opportunities are discovered. Without a predetermined set of options to be compared, this ability to modify and revisit is crucial to avoid artificially restricting the set of alternatives (i.e., by prematurely freezing the specification of an option in order to permit a more complete assessment) or investing unnecessary analytical effort in flawed alternatives. As a result, the attention given to individual options or technologies must be allowed to vary widely, and it must be anticipated that many cycles of proposal, assessment, and revision will be necessary to produce the best possible option set.

A third lesson follows directly from the second — that is, that the resource requirements of individual challenge-option case studies are likely to vary widely. Since the length and types of analyses to be performed will vary widely from option to option and from case to case, so too the levels of effort, analytical skills, and overall resources required will vary accordingly.

A fourth lesson concerns the relative balance of parallel and sequential processes in the approach, and the utility of an essentially sequential design. The flow chart in slide ES-5 above depicts an *entirely* sequential design — at no point are any two tasks performed simultaneously. Of course, performing several tasks in parallel would save time; it has been suggested, for example, that the *identification of challenges and the projection of programmed forces* or the assessment of several options could be performed simultaneously to reduce the duration of any given planning exercise. The advantages of a sequential approach, however, are two-fold. First, it provides maximum opportunity to use the winnowing strategies outlined above to reduce the scale of the effort required in subsequent tasks. If challenge identification and program projection are performed in parallel, for example, the entire defense program must be projected two FYDP cycles forward — even if the case studies involve only a fraction of the 2011 programmed force. If program projection follows challenge identification, projections can be limited to those forces relevant to the challenges selected for further analysis. Some time may be lost, but the scale of the required analytical effort is reduced substantially. Second, a sequential approach maximizes the opportunity for serendipitous insights to be exploited in related analyses. If, for example, a series of related options are all susceptible to an unanticipated common flaw, conducting option analyses sequentially allows the flaw to be discovered, once, in the first analysis, permitting the remainder of the related set to be discarded without absorbing further effort. Were the analyses to be conducted in parallel, on the other hand, each would absorb comparable effort prior to the discovery of the common flaw, reducing the resources available for investigating alternative possibilities accordingly.

A final lesson concerns team skills and organization for conducting such analyses. While we have focused on outlining an approach rather than staffing it, one useful lesson to emerge is the need for an interdisciplinary analytical team — and the close relationship between the range of skills required and the time available for carrying out the analysis. In particular, the shorter the time available, the greater the need to incorporate a wider range of specialists in the analytical team. For the case studies considered here, perhaps the most important specialist skills include technology assessment (and in particular, the availability of a dedicated representative from the technical community who is both aware of the relevant policy issues and knows where to go to find technical information or expert specialists), simulation (both the construction of simple analytical models and the adaptation of more sophisticated, off-the-shelf simulations to particular needs), cost analysis, and military operations and logistics. Of course, where time permits, these skills can be sought from outside the assigned analytical team — but such a process can be very time consuming. Under such circumstances, there is no substitute for immediately available, thoroughly briefed, dedicated specialists within the analytical team — even where those specialty skills are only intermittently required.

The testing process also suggested at least two significant issues for further research with respect to the approach itself. First, the analytical framework described here was developed and tested by a non-governmental organization. The issue of fitting this approach into the governmental PPBS context merits explicit consideration. For example, the iterative concept development process of proposal, assessment, and revision described above could prove difficult to implement effectively and objectively in a PPBS environment, where the proposals at stake carry important budgetary consequences for the participants. The particular issue of structuring such a process, as well as the broader questions of adapting this framework to a different organizational context, or of integrating governmental and non-governmental analytical input, thus warrant further consideration.

Second, the analytical framework described here assumes a selective, case study approach to long-range planning. This has the advantage of focusing available analytic resources, but it has the disadvantage of making it difficult to assess opportunity costs or relative priorities across a wider set of challenges and potential responses. A more comprehensive planning process could overcome these disadvantages, but the analytical implications of providing a comprehensive assessment warrant careful consideration.

Purpose

End of the cold war makes long-range planning more important — and more difficult

- Slower modernization rate — longer term consequences for today's decisions; reduced flexibility for rapid response to unanticipated challenges
- Rapidly changing threat environment

How can effective planning be conducted in such an environment?

Purpose of IDA task is to demonstrate an approach

- Develop a framework of essential analytical tasks
- Conduct illustrative analyses to see if completion of tasks yields useful insights
- Provide "proof of principle" — not definitive answers

Slide 1: Purpose

This briefing summarizes the findings of a quick-response IDA study of new approaches to planning for emerging long-term threats. The study was motivated by concern that, with the end of the cold war, challenges to U.S. security may be changing in ways that current U.S. military capabilities are ill-suited to meet — and that the nature of the defense *planning* problem may be changing in ways that the existing PPBS system is ill-suited to meet.

In particular, in the post cold war world, the time horizon required for effective planning has lengthened. With reduced budgets and without a Soviet threat to drive system obsolescence, modernization rates have fallen dramatically. With systems remaining in service for longer periods of time, we will be living with the consequences of today's decision making for longer periods of time: as late as 2011, for example, more than 70 percent of the systems available to the U.S. military will have been ordered during the period covered by the FY1994-99 FYDP or before.¹

¹ USD(P)/Policy Planning, Joint Staff/J-5, *Long Range Defense Planning*, briefing slides, November 18, 1993, slide 8.

And with slower system turn-over and lower acquisition rates, our ability to procure new systems in response to unanticipated threats will be weakened.² The end of the cold war thus puts a premium on our ability to anticipate defense needs farther into the future, and to reflect that anticipation in current defense programming and budgeting.

At the same time, the end of the cold war makes effective long-range planning more difficult. During the cold war, the Soviet threat was relatively consistent and predictable. Today, challenges to U.S. security interests, while less cataclysmic, are much more diverse and harder to anticipate. Few predicted the problems posed by contingencies like Bosnia or Somalia, for example, and still fewer anticipated them early enough to have developed programs for more effective responses. The variability and uncertainty of the post cold war international environment thus poses unique challenges for planning, and especially for long-range planning, where a long time horizon permits change to accumulate and increases the range of potential outcomes to be anticipated.

How can effective planning be conducted in such an environment? The purpose of this study was to help answer this question by developing an analytical approach for conducting such planning and, if possible, by demonstrating its feasibility. To this end, IDA has described a series of analytical tasks and a framework by which to organize those tasks into a long-range planning process. To determine if this framework can yield useful insights, a series of illustrative analyses were performed using the approach developed here, and their results are summarized below. As a quick-reaction effort, these analyses are not meant to be definitive in themselves — rather their purpose is to provide a vehicle for exploring the feasibility of the approach, for suggesting useful avenues for more detailed follow-on analyses, and for suggesting strengths, weaknesses, and potential improvements in that approach as a basis for possible modification of the PPBS process.

² Of course, if the threat is serious enough, acquisition budgets may increase to provide the wherewithal for a timelier response -- but with the end of the cold war, few threats are likely to be serious enough in themselves to spur such reactions. While Bosnia and Somalia were largely unanticipated threats, they have not caused significant increases in the defense budget. Similarly, most future threats will need to be countered with forces in hand.

OUTLINE

- I. Analytical Approach**
- II. Illustrations**
 - A. Identification of Critical Long-Term Security Challenges**
 - B. Analyses of Capability Shortcomings and Options for Response**
 - 1. Incremental Aggression and Discriminate Military Capability**
 - 2. Incremental Aggression and Coercion of Hostile Leadership**
 - 3. Weapons of Mass Destruction (WMD) Proliferation and Counteroffensive Action against Proliferation Sites**
- III. Conclusions and Implications**

Slide 2: Outline

The briefing is organized in three main parts. First, the analytical approach is described. Second (and comprising the bulk of the briefing), the approach is demonstrated in a series of illustrative analyses, including the identification of a set of critical long-term security challenges, and the development and evaluation of a series of options for responding to a selected subset of those challenges. Finally, conclusions and policy implications flowing from the analyses are presented.

I. ANALYTICAL APPROACH

Slide 3

We will begin by describing the approach developed here — in particular, by laying out the rationale for the particular choices made in developing that approach, describing the analytical tasks comprising it, and finally linking those tasks into a framework for planning.

Approach: Rationale

Provide orderly, systematic means of comparing long-term security challenges with programmed capabilities, facilitating program modifications to overcome identified shortcomings

Key Issue: Coping with long-term uncertainty, variability

- The longer the time horizon, the wider the range of possible security challenges, technological opportunities, organizational/doctrinal innovations
- Too many foreseeable possibilities to assess each comprehensively
- Possibility of unforeseen — and unforeseeable — conditions
- Implies the need to:
 1. Identify patterns — where possible, group classes of possibilities together by reference to underlying similarities
 2. Winnow possibilities — identify subsets with special importance for planning

Slide 4: Rationale for Approach

Our basic task was to develop an orderly, systematic means of comparing long-term security challenges with the projected capabilities of programmed forces; identifying shortcomings between capabilities and challenges; and facilitating program modifications to overcome those shortcomings.

In doing this, a key issue was the need to cope with the uncertainty and variability of the long-term future. In the short term, security challenges, technological opportunities, military organizations and doctrines are all relatively static. But the longer the planning horizon, the greater the magnitude of possible change — and this is exacerbated by the uncertainties of the post cold war international environment. Simply to project all plausible variations of current, observable

trends in international politics, technological change, and doctrinal or organizational innovation yields a set of combinations too large to assess each in any detail. And current trends may not reveal all future possibilities. Given a long-time horizon, issues and problems that have not yet become visible may yet present important national security concerns.

To some degree this is an unavoidable problem — no analytical approach can prevent surprises or anticipate the unforeseeable. But for a long-range planning system to be useful it must at least reduce the odds of gross mismatches between forces and challenges. To do this requires an ability to make sense of the complexity of future possibilities.

To this end, we have pursued two general "design criteria" for coping with the uncertainty and complexity of long-range planning.

First, where possible, the approach should identify underlying similarities among classes of possibilities that permit them to be addressed as a group for planning purposes. The more the set of possibilities can be consolidated without masking important differences, the more tractable the analytical problem becomes. And the identification of patterns may itself suggest the existence of unforeseen possibilities by extrapolation, reducing somewhat the risk of surprise in long-term projection.

Second, a usable approach requires a means of winnowing the large set of future possibilities into a smaller subset, with particular importance for long-range planning. By excluding topics or possibilities with limited leverage on near term programming, analytical effort can be concentrated and the magnitude of the analytical effort required can be reduced; without this, the burden of comprehensive assessment could easily become overwhelming.³

³ In addition to the two "design criteria" given here, flexibility or adaptability of planned forces often is suggested as a means of hedging against uncertainty. Note, however, that the design criteria given above refer to the design of an analytical approach for conducting planning -- not to the design of the forces being planned. More broadly, to plan for flexible forces it is first necessary to know something about the range of tasks across which they must be flexible. Clearly, narrow force specialization on single tasks poses difficulties in an uncertain threat environment, but beyond this it is difficult to provide guidance without reference to cases. Are heavy forces that sacrifice mobility in exchange for survivability against a wider range of weapons more or less "flexible" than lighter forces with greater mobility but less survivability? To answer the question it is first necessary to know something about the range of future security challenges each would be called upon to meet. Flexibility is thus difficult to design for as a scenario-independent force planning goal. Given this, we will approach flexibility here as a second order issue: a useful criterion for assessing the benefits of a system or organization, but one that can best be evaluated in the context of some given set of missions or tasks.

Approach: Rationale (continued)

Strategy

1. Organize future contingencies by the patterns of military operating environment they pose
 - Allows large numbers of possibilities to be grouped together by similarity of underlying military problems
2. Winnow list of military operating environments by focusing on "critical long-term challenges,"
 - i.e., military operating environments that:
 - i. pose problems significantly different from those addressed by cold war planning;
 - ii. are associated with threats to important U.S. interests, or opportunities to advance emerging U.S. interests; and
 - iii. could plausibly be present in 2011
3. Winnow set of potential technologies, doctrines, and organizations by focusing on "critical military mission areas"
 - i.e., military tasks required to meet critical long-term challenges, but for which programmed forces are ill-suited

Slide 5: Rationale for Approach (concluded)

In particular, the strategy adopted for coping with the uncertainties of long-range planning has three main themes. First, it groups together classes of potential future contingencies by reference to the different military operating environments they pose. Variations in future international political alignments could produce an enormous number of potential flashpoints

around the world, but the number of basic variants in the military character of the ensuing conflict is much smaller. Many states in Eastern Europe, the former Soviet Union, Africa, South Asia and elsewhere face ethnic conflicts that eventually could produce open warfare. But, while the locations and identities of the combatants differ widely, the military operating environment created by ethnic conflict in the second and third world poses a number of important similarities across the entire set — including close intermingling of civilian and military personnel, slow operating tempos, or relatively low capitalization of armies.⁴ Of course, this is not to say that there are no militarily relevant differences between individual ethnic conflicts; rather, as a class, the traits they share are more important for planning long-term military capabilities than are the differences among them (and that individual exceptions may best be approached as variants of a general class rather than as *sui generis* occurrences).

Second, this approach reduces the set of potential military operating environments to be considered by focusing on a subset with three important properties. First, the subset must pose military problems significantly different from those addressed by cold war planning. Large-scale mechanized land warfare, for example, is excluded — not because it is unimportant, but because the heavy cold war emphasis on mechanized warfare makes it likely that its needs are relatively well-represented in existing programming.⁵ Second, the subset must be associated with threats to important U.S. interests, or opportunities to advance emerging U.S. interests of substantial importance. And third, the subset must plausibly be present in 2011 — that is, two planning cycles beyond the current FYDP. This does not mean that challenges arising before 2011 are excluded, nor does it exclude problems existing today (as long as these have emerged since the end of the cold war). Rather, our intention is to focus on challenges that reasonably could be expected either to emerge some time between today and about 2011, or to persist until that time absent some change in U.S. policy. In combination, these three criteria help focus the analysis on those problems that are most likely to be of special importance for long-range planning — problems that are relatively unlikely to have received extensive attention in the development of the existing defense program, that affect important U.S. interests, and that appropriately are matters of long-term concern. The subset of potential military operating environments that fit these criteria will be referred to as "critical long-term security challenges."

⁴ For a (winnowed) list of different military operating environments, see slide nine below.

⁵ Note that with the passage of time, the relevance of the cold war's planning emphases will diminish -- as will the utility of this criterion as a means of winnowing potential security challenges. The general point is that the approach should strive to focus attention on that subset of the range of future possibilities with the greatest leverage for planning; over time, the specific criteria that best serve this aim may change.

Finally, the approach restricts the set of potential technologies and organizational or doctrinal innovations to be considered by focusing on what might be termed "critical military mission areas." These are those military tasks that are required to meet the critical long-term security challenges defined above, but for which currently programmed forces are ill-suited. For example, this approach would exclude technologies intended to improve the ability of U.S. fighter aircraft to maintain "no-fly zones" in the airspace above ethnic conflicts — not because the mission is unimportant, or unrelated to post cold war challenges, or because individual technologies are not promising, but because currently programmed forces already are relatively well-suited to such a task.⁶ By concentrating the analysis on emerging missions for which programmed forces are inadequate, the approach is thus intended to focus attention on areas where long-range planning can make the greatest difference.

Approach: Key Tasks

1. Identify critical long-term security challenges
2. Project programmed forces
3. Compare forces with challenges — identify critical military mission areas
4. Develop options to provide critical mission capabilities
5. Assess options
6. Recommend changes in programmed forces to implement best options

Slide 6: Key Tasks of Approach

This slide describes the specific analytical tasks required to implement the strategy given above. First, a set of critical long-term security challenges must be identified. The strategy described above implies a two-part process for doing this: creation of an initial (broad) list of

⁶ Additionally, because the existing planning process is relatively likely to already have taken account of ongoing modernization needs as a function of evolving air defense threats. Note that long-range planning takes place in the context of an existing (and ongoing) FYDP process; the approach developed here is not meant to supplant that process, but rather to augment it by focusing attention on a set of long range issues that may not be fully or adequately treated in existing planning.

possible future military operating environments, and winnowing that list by applying the selection criteria described above. No rigorous method exists for creating a definitive initial list, although an extensive catalogue of future possibilities can readily be compiled from the existing literature.⁷ For the illustrative analyses described below, an initial list was developed through a series of internal and external discussions with academic, government and intelligence community personnel. These discussions, however, were intended only to identify the existing body of opinion, not to provide a novel methodological contribution in themselves — the purpose of the approach developed here is to help cope with the wide variance typical of such predictions, not to specify a method for creating them per se.

Second, the forces available to respond to these challenges must be projected from current program guidance. Methodologies for such projection are available in the existing literature

⁷ Available forecasting methodologies have significant limitations as prescriptive or exclusive guides for planning. For recent critical reviews of the state of the art, see, e.g., John Lewis Gaddis, "International Relations Theory and the End of the Cold War," *International Security*, Winter 1992/93 (Vol.17, No.3), pp.5-58; Robert Jervis, "The Future of World Politics: Will it Resemble the Past?" *International Security*, Winter 1991/92 (Vol.16, No.3), pp.39-74. Methodological limitations notwithstanding, the literature contains a wide variety of alternative forecasts. For a representative sampling, see, e.g., David Abshire, "Strategic Challenge: Contingencies, Force Structures, Deterrence," *The Washington Quarterly* 15 (Spring 1992), pp. 33-42; Dora Alves, *Pacific Security Toward the Year 2000: The 1987 Pacific Symposium*. Washington D.C.: National Defense University Press, 1988; W. Seth Carus, *Ballistic Missiles in the Third World: Threat and Response*. New York: Praeger, 1990; Steven R. David, "Why the Third World Still Matters," *International Security* 17 (Winter 1992), pp. 127-159; Seymour Deitchman, "After the Cold War: U.S. Security for the Future," The Atlantic Council of the United States, Occasional Paper, (August 1990); John M. Deutch, "The New Nuclear Threat," *Foreign Affairs* 71 (Fall 1992); Nicholas Eberstadt, "Population Change and National Security," *Foreign Affairs* 70 (Summer 1991), pp. 115-131; John Esposito, *The Islamic Threat: Myth or Reality* (London: Oxford University Press, 1993); Thomas H. Etzold, "The Strategic Environment of the Twenty-first Century: Alternative Futures for Strategic Planners," *Strategic Review* 18 (Spring 1990), pp. 23-31; Sumit Ganguly, "Ethno-religious Conflict in South Asia," *Survival* 35 (Summer 1993), pp. 88-109; Patrick J. Garrity, and Sharon K. Weiner, "U.S. Defense Strategy After the Cold War," *The Washington Quarterly* 15 (Spring 1992), pp. 57-80; Andrew J. Goodpastor, "New Priorities for U.S. Security: Military Needs and Tasks in a Time of Change," Washington, D.C.: The Atlantic Council of the United States, Occasional Paper (June 1991); Francois Heisbourg, "Population Movements in Post-Cold War Europe," *Survival* 33 (January/February 1991), pp. 31-44; Samuel P. Huntington, "America's Changing Strategic Interests," *Survival* 33 (January/February 1991), pp. 3-17; Douglas M. Johnston, "Anticipating Instability in the Asia-Pacific Region," *The Washington Quarterly* 15 (Summer 1992), 103-112; Jessica Tuchman Mathews, "Redefining Security," *Foreign Affairs* 68 (Spring 1989), pp. 162-177; Barry R. Posen, "The Security Dilemma and Ethnic Conflict," *Survival* 35 (Spring 1993), pp.27-47; George Quester, "The Future of Nuclear Deterrence," *Survival* 34 (Spring 1992), pp. 74-88; Don M. Snider, and Gregory Grant, "The Future of Conventional Warfare and U.S. Military Strategy," *The Washington Quarterly* 15 (Winter 1992), pp. 203-228; Michael Teitelbaum, "The Population Threat," *Foreign Affairs* 71 (Winter 1992/93), pp. 63-78; John Tillson, et. al., *Planning for the 21st Century* (Alexandria: Institute for Defense Analyses, October 1992), IDA P-2640; James A. Winnefeld and David Shlapak, *The Challenge of Future Nonstandard Contingencies: Implications for Strategy, Planning, Crisis Management, and Forces, Volume I and II*. RAND Corporation, N-3098/1-DAG (October 1990); Robin Wright and Doyle McManus, *Flashpoints: Promise and Peril in a New World* (New York: Alfred A Knopf, Inc., 1991). While there can be no guarantee that any such set of forecasts are corporately comprehensive or exhaustive of future possibilities (nor is this likely), they do provide a rich set of plausible conjectures for use as a point of departure for planning — and this represents probably the best that can be done, given the current state of the art.

(although such projections currently are not provided as a formal element of the PPBS management process); this study has not attempted to extend or modify existing techniques for such projections.⁸

Third, these forces must be evaluated in the context of the critical long-term challenges and any shortcomings identified. These shortcomings represent the critical military mission areas around which the development of options for improvement are to be focused. Specific analytical techniques for identifying shortcomings must be selected on the basis of the particular challenges and forces being considered; the inherent variety of either, in a long-run context, will require a corresponding variety in analytical method.

Fourth, options must be developed to remedy the identified shortcomings and to provide the indicated critical mission capabilities. To develop any given option entails identifying a set of technological, doctrinal and/or organizational innovations that seem likely to provide the needed capability. Although an option need not involve changes in all three dimensions, wherever possible it is useful to describe options in terms of operational concepts integrating technologies with the doctrinal and organizational context required to use them effectively.

Fifth, the options must be assessed. Typically, to develop meaningful options will require an iterative process of development (task four), assessment (task five), and revision — the aim is to maximize the chance of finding an effective capability (rather than to assess any particular proposal per se), and to do this often will require multiple passes and multiple revisions.⁹ Note that this in turn requires that assessments often must be partial in nature. To maximize the number of iterations that can be accomplished within any given resource level, options found to be unsuitable to the given mission will be discarded or modified without comprehensive assessment. Many options thus will be discarded quite quickly after an initial analysis finds important weaknesses and others will receive more thorough consideration; but only those showing the greatest promise will be evaluated comprehensively. Those (relatively few) assessments that require comprehensiveness, however, must consider a wide range of properties — including the option's robustness against countermeasures, its consistency with treaty obligations, opportunity costs imposed on organizations and materiel, technical risk, development and acquisition costs, and the degree to which the option reduces the policy risks associated with the use of force, or

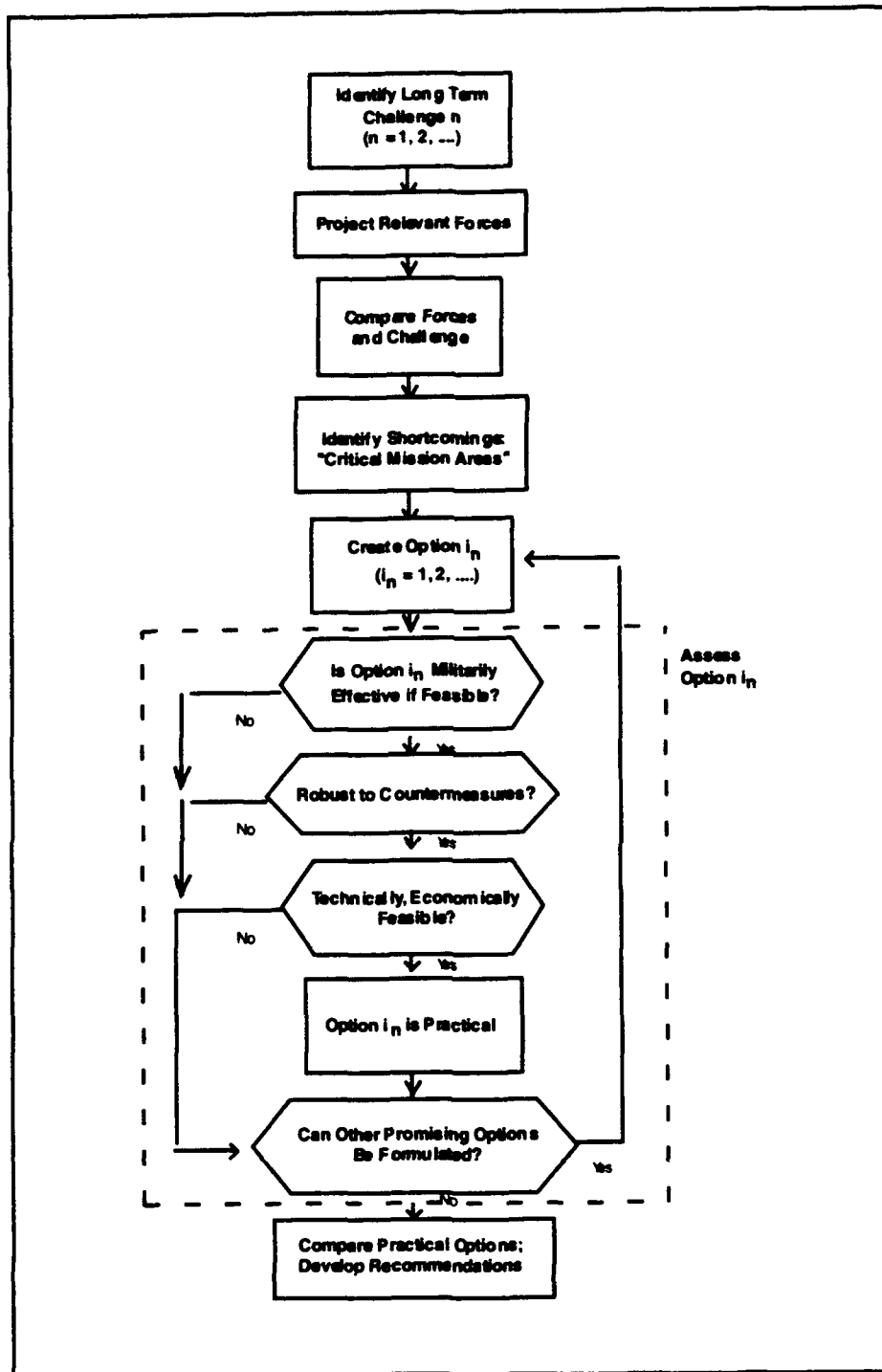
⁸ For illustrative projections, see, e.g., USD(P)/Policy Planning, Joint Staff/J-5, *Long Range Defense Planning*, op. cit., slides 8-9.

⁹ Of course, the presented analytical results may not explicitly reflect the iterative nature of process that produced them - only final results are ordinarily documented.

increases the likelihood of success.¹⁰ Finally, the remaining set of apparently effective options must then be compared to determine their relative cost-effectiveness by these criteria.

Given the results of these tasks, recommendations must be made to change programmed forces (if necessary) so as to implement the most cost-effective options that emerge.

¹⁰ In addition, the flexibility of a weapon, organization or operational concept to perform multiple missions is a valuable property, but for the purposes of the approach described here it will be treated as a second-order advantage of options that demonstrate an ability to resolve a critical shortcoming, rather than as a primary objective in itself.



Slide 7: Flow Chart

Slide 7 organizes the analytical tasks described above into a flow chart algorithmically describing the process of an illustrative analysis. Note that this chart assumes that resource limitations will mandate a partial consideration of future challenges and potential responses; the

process is formulated as one of a set of "case studies" of individual challenges and associated responses. Note also that the algorithmic representation here will rarely be followed in as mechanical or deterministic a way as the flow chart suggests; for any given case study, some steps may be treated implicitly or dispensed with quickly. By depicting the process as a whole, however, the flow chart describes the logical elements of the analysis — even if it may not necessarily provide a literal description of any given case study.

The process begins by identifying a critical long-term challenge; projecting programmed forces relevant to that challenge; comparing the capabilities of those forces to the nature of the challenge; identifying shortcomings in those capabilities, or "critical mission areas," against which to plan options for improvement; identifying an option (that is, a combination of technology, doctrine and organization); and assessing its relative cost-effectiveness by comparison with any other options considered previously. If resources permit, and if one or more additional (and promising) options can be formulated, then these are described and assessed in the same way. If not, then the best available option is recommended for programming consideration.¹¹

¹¹ Of course, it also is possible that for some missions, it will be impossible to identify effective options (see, e.g., the illustrative analysis of leadership coercion below). Where this is the case, either the challenge, the mission, or the direction of ongoing technology development must be revisited and/or revised.

Note also that the utility of the approach as a whole does not rest entirely upon completion of all the steps described here. Even if only part of the process is completed, the exercise can still be of value for planning by forcing a systematic review of at least a subset of the emerging security environment and the ability of programmed forces to respond to the military challenges it poses.

OUTLINE

- I. Analytical Approach
- II. Illustrations
 - ⇒ A. Identification of Critical Long-Term Security Challenges
 - B. Analyses of Capability Shortcomings and Options for Response:
 - 1. Incremental Aggression and Discriminate Military Capability
 - 2. Incremental Aggression and Coercion of Hostile Leadership
 - 3. WMD Proliferation and Counteroffensive Action against Proliferation Sites
- III. Conclusions and Implications

Slide 8

We will now go on to describe the illustrative analyses performed to evaluate the feasibility of the approach, beginning with the identification of critical long-term security challenges.

CRITICAL LONG-TERM CHALLENGES

I. "Off-Axis" Aggression to Avoid U.S. Strengths

Incremental Aggression

- Slow and continuous
- Fast and limited

Hit-and-Run Warfare

- Terrorism
- Insurgency/popular insurrection
- Resistance to stationed forces

Proliferation

- Development of WMD
- Use of WMD against:
 - U.S. intervention forces
 - Other U.S. overseas installations
 - Allied forces and populations
 - CONUS (via covert, as well as overt, delivery)

II. Problems of Failed States

Ethnic/racial/religious warfare

Mass migration

Breakdown of civil order

III. Affronts to Humanity

Genocide

Ethnic/tribal cleansing

Third-party WMD warfare/accident

Slide 9: Critical Long-Term Challenges

An initial list of critical long-term security challenges that emerged from the process described above is given in slide 9, and can be divided into three broad classes. While these are not necessarily mutually exclusive (and indeed, some often give rise to others), they are different enough in nature to warrant separate treatment.

The first of these is a set of aggressive strategies for avoiding U.S. strengths. In particular, in Operation Desert Storm the United States demonstrated extraordinary capability in large-scale conventional land and air warfare. To wage conventional mechanized warfare against the United States is thus to engage the world's only superpower in a form of warfare at which it clearly excels. In the aftermath of Desert Storm, many potential opponents have concluded that such a strategy is ill-conceived.¹² Instead, there is reason to expect such states to gravitate increasingly toward strategies that avoid head-on, large-scale mechanized operations against U.S. forces.¹³

Many such strategies exist. Hostile states could, for example, pursue aggression incrementally (about which there is more below). Alternatively, various forms of hit-and-run operations such as terrorism, insurgency, or guerrilla warfare against U.S. (or U.N.) forces stationed abroad could enable opponents to bring pressure to bear without exposing their forces to sustained heavy fighting. And, of course, acquisition and/or use of weapons of mass destruction (WMD) could provide hostile states with a form of leverage that does not require them to best the United States in conventional warfare.

A second class of emerging security challenge stems from the problems of failed states. The breakup of the Soviet Eurasian empire and the loss of Soviet support for its third world clients has led to the formation of a score of fledgling states. Few of these have any real experience in independent national governance, or a stable institutional foundation for the resolution of conflicting interests; most confront difficult internal social and political divisions; and almost all

¹² Patrick J. Garrity, *Why the Gulf War Still Matters: Foreign Perspectives on the War and the Future of International Security* (Los Alamos: Los Alamos National Laboratory Center for National Security Studies, July 1993) CNSS Report No.16, esp. pp.50-4, 68-9, 86-90.

¹³ *Ibid.*, pp.86-90. Note that this does not necessarily mean that these states will abandon efforts to build large mechanized armies. Such forces may well be pursued for use against comparably armed regional rivals, for prestige reasons, or for their value against domestic threats. The available evidence suggests, however, that at least for the foreseeable future, most states in a position to challenge U.S. interests have concluded that they cannot compete with the United States in its ability to wage large-scale mechanized warfare -- and that practical improvements in their own forces are unlikely to change this.

face grave economic problems.¹⁴ These difficulties pose major barriers to the development of effective government. Under such pressures, several of these proto-states have dissolved into civil warfare along ethnic, racial, or religious lines. And the resulting chaos can lead to the breakdown of civil order into anarchy and "warlordism," as well as give rise to mass migration of human populations as refugees flee economic collapse or open warfare.

Problems such as these can threaten important U.S. interests. Civil warfare, for example, has the potential to spill over across national boundaries. Even where the fighting itself is contained, uncontrolled mass refugee movements can bring the social consequences of the fighting across national borders. In either case, the locus of instability often lies dangerously close to areas of vital concern to the United States. Many of the emerging post-Soviet states border on Western Europe or the NATO nations of Turkey and Greece; the Islamic nations of the Middle East are tied to many of the new proto-states by religious and ethnic links; Cuba, the former client and economic ward of the Soviet Union, lies only a few miles south of Key West. Finally, several of the Soviet successor states have inherited parts of the Soviet nuclear arsenal, exposing weapons with nuclear warheads and intercontinental range to the possibility of open warfare.

A third class of emerging security challenge involves gross affronts to humanity. While these often fall outside the bounds of traditionally defined U.S. vital national interests, the extremity of the offense can create a powerful moral argument for intervention. A military capability to respond could thus provide an important opportunity to advance U.S. interests in human rights and the alleviation of human suffering. Affronts of such severity could include genocide, the systematic expulsion of peoples that has become known as "ethnic cleansing," the human consequences of a chemical, biological, or nuclear weapon exchange between states not directly involving the United States, or the results of a Chernobyl-style accident involving civilian or military nuclear facilities near large cities. Especially in the latter cases, military assets may offer the only effective option for immediate response — and the United States may represent the only military power potentially capable of projecting the necessary force into the affected region.

Of the challenges described above, some are already in evidence, such as terrorism, development of WMD, ethnic warfare and tribal cleansing. Others, such as fast and limited incremental aggression, the use of WMD against U.S. forces or allied populations, and third-party nuclear exchanges, have not yet appeared but could readily do so by 2011. In all cases, however, there is little reason to expect the possibilities to disappear any time soon. And where open

¹⁴ On the difficulties created by the combination of weak governmental/societal institutions and serious internal social and political divisions, see, e.g., Samuel P. Huntington, *Political Order in Changing Societies* (New Haven and London: Yale University Press, 1968), pp.192-263.

aggression, ethnic warfare or tribal cleansing have already broken out, we can expect to be living with the consequences for many years to come.

CASE STUDIES

1. Incremental Aggression and Discriminate Military Capability
2. Incremental Aggression and Coercion of Hostile Leadership
3. WMD Proliferation and Counteroffensive Action against Proliferation Sites

Slide 10: Case Studies

As noted above, we will not attempt to assess potential responses to all the challenges identified in slide 9 here. Rather, we will provide three case studies. Each case will begin with a more detailed description of one particular long-term challenge drawn from the list in slide 9, and will proceed in sequence through the tasks described in slides 6 and 7 for that specified challenge. Not all tasks will receive equal attention, however. As feasibility tests, the case studies will focus primarily on the more analytically novel aspects of the approach. In particular, we will concentrate primarily on comparing projected capabilities with critical challenges, identifying critical military mission areas, and developing options for improving U.S. capabilities in those areas. Extensive cost estimation and effectiveness assessment will not be attempted here (although we will provide at least an initial analysis of each option's susceptibility to countermeasures, and its potential to increase the likelihood of mission success if implemented), nor will we attempt detailed projections of programmed weapon modernization (for demonstration purposes, broad projections of capability, rather than detailed programming, will be sufficient).

The specific cases to be considered include two critical mission areas deriving from the challenge of incremental aggression — that is, discriminate military operations and coercion of hostile leadership — and one deriving from the challenge of WMD proliferation — that is, counteroffensive action against proliferation targets. Of course, many other cases could be considered (and may be pursued in subsequent efforts); the three addressed here are intended only to be broadly representative of the larger universe of potential cases, and to raise a variety of

analytical issues germane to the approach and its validity. They are intended neither to be definitive analyses of particular programs, nor to exhaust the range of potentially useful applications.

OUTLINE

- I. Analytical Approach
- II. Illustrations
 - A. Identification of Critical Long-Term Security Challenges
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 - ⇒ 1. **Incremental Aggression and Discriminate Military Capability**
 - 2. Incremental Aggression and Coercion of Hostile Leadership
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- III. Conclusions and Implications

Slide 11

The first of these case studies involves the challenge of incremental aggression and the critical mission area of discriminate military operations.

INCREMENTAL AGGRESSION

Aggression divided into slices, each below intervention threshold

Especially suited to post cold war regional aggression

- U.S. could intervene decisively if it chooses
- Strategy is designed to influence choice by keeping provocation ambiguous
- Multilateral decision making made especially difficult

Can threaten significant U.S. interests — accumulation of slices eventually produces large gains

Prevalence likely to increase

Variations:

1. Slow and Continuous (Milosevic)
2. Fast and Discrete (Saddam II: take only a piece of Kuwait, or give some back)

Will focus here on Variation 1

Slide 12: Incremental Aggression as a Critical Long-Term Security Challenge

Although we have already summarized the wider set of critical challenges that emerged from the first task of the analytical approach, it will be useful to begin the case study with a more detailed description of incremental aggression in particular, and a detailed discussion of why it qualifies as a critical long-term security challenge.

A strategy of "incremental aggression" calls for an invader to divide the intended conquest into pieces, each of which is small enough to stay below the provocation threshold for outside intervention, but many of which, taken together, may eventually produce large gains. Of course, incremental aggression per se is not new — Hitler's acquisitions of the Sudetenland, Austria, and Czechoslovakia followed such a design. Even during the cold war, such methods were sometimes

discussed as potential strategies for Soviet aggression in Central Europe, although they were never regarded as a likely or a primary threat.¹⁵

The end of the cold war, however, has created circumstances ideally suited for incremental aggression. In particular, the end of the cold war has made it possible for many regional powers to pursue territorial ambitions that were once suppressed by a risk-averse Soviet patron. But few of these states can ever hope to defeat a massive intervention by the United States — *if* the U.S. chooses to commit enough of its full military power. Under such conditions, the issue is not whether or not the U.S. is *able* to roll back a regional aggressor, but rather whether or not the U.S. will *choose* to do so given the relative costs and benefits of the intervention. Given this, the purpose of an incremental aggression strategy is to influence that choice by keeping the magnitude of the provocation ambiguous, thus altering the perceived costs and benefits of outside intervention.¹⁶ And while such a strategy can influence the choices of an individual state, it can have an especially powerful effect on the collective decision making of multinational coalitions. An ambiguous provocation often will be interpreted differently by different individuals or governments; thus the greater the number of independent decision makers involved, the greater the opportunity for discord and the lesser the likelihood of a unified response. Inasmuch as the United States continues to stress the importance of multilateral action for U.S. involvement, strategies that

¹⁵ During the cold war, this approach was sometimes referred to as a "salami-slicing" or "limited aims" strategy: see, e.g., John Mearsheimer, *Conventional Deterrence* (Ithaca: Cornell University Press, 1983), pp.29-30, 53-6. At no point, however, did consideration of such strategies supplant NATO's primary concern with a massive, high-tempo mechanized invasion.

¹⁶ Note that incremental aggression strategies often are accompanied by tactics designed to increase the perceived costs (and especially, the political costs) of outside intervention -- even where these tactics reduce the aggressor's military ability to take and hold the territory it seeks. Extensive intermingling of military and civilian personnel, for example, and extended operations in built-up areas both slow the pace of an invasion. But they present potential intervention forces with the prospects of substantial civilian fatalities and bloody urban warfare in the event of intervention, and thus increase the perceived costs of becoming involved (just as incremental conquest itself reduces the perceived benefits of involvement, or equivalently, the perceived costs of non-involvement, by concealing the magnitude of the aggression). In general, incremental aggression amounts to a strategy of trading off some immediate military efficiency against reduced odds of outside intervention -- and this often applies at both the strategic and the tactical levels.

Note also the contrast between incremental aggression and guerrilla (or "hit and run") warfare: whereas incremental aggressors often are able to advance more rapidly against their regional opponent but choose not to (in order to reduce the likelihood of extra-regional intervention), guerrilla forces typically adopt guerrilla methods because they are too weak to conduct operations in any other way. This in turn implies a variety of other important differences in the respective military operating environments: incremental aggressors, for example, often are relatively well equipped with heavy weapons, often enjoy substantial numerical superiority over their intended regional victim, often are associated with a national government and a national military organization, and are supported by a national economy. Guerrilla forces usually deploy lighter weapons, may operate at a substantial numerical disadvantage relative to their regional opponents, and often are fielded by insurrectionary or subnational groups. Of course, individual contingencies differ; moreover, many of these distinctions may break down in the later stages of a successful guerrilla campaign -- which often ends in substantial offensive operations along traditional, conventional lines. Nevertheless, as a whole, the differences are important enough to warrant separate treatment.

keep provocations ambiguous could provide particularly effective vehicles for aggression in the post cold war era.¹⁷

During the cold war, by contrast, the central problem was the sheer magnitude of the opposing military capability — it was generally assumed that the provocation (if it ever occurred) would be obvious, but that the weight of the attack might be too great to meet.¹⁸ Thus the problem for planning was less to cope with ambiguity than it was to cope with the unambiguous mass of the opposing forces.

Yet while incremental regional aggression is clearly less cataclysmic than the old cold war threat of a Soviet attack, it can still challenge important U.S. interests. By accumulating many individually modest gains, an aggressor can eventually produce large conquests without ever providing a discrete, unambiguous rallying point for intervention. And the strategy is unlikely to disappear any time soon — the nature of the post cold war environment will create substantial incentives for regional aggressors to pursue such methods for the foreseeable future. If anything, the prevalence of incremental aggression is likely to increase; it will surely be an important feature of the military environment within our nominal long-term planning horizon of 2011.

Incremental aggression thus meets each of the three criteria for consideration as a "critical long-term security challenge:" it poses problems substantially different than those addressed by cold war planning, it could threaten important U.S. interests, and it could plausibly be present in 2011.

There are at least two variants of this strategy that differ sufficiently to require separate treatment. In the first, or "slow, continuous" variant, ambiguity is obtained by creeping forward at a slow but sustained rate. In any given day (or week), gains are small, but fighting can be extended over many days or many weeks. A recent example of such tactics can be seen in Serbia's campaigns in Croatia and Bosnia under Slobodan Milosevic.

A second, or "fast, discrete" variant seizes ground much more rapidly, but by limiting the amount seized in any one grab it reduces the magnitude of the provocation and encourages varying interpretations by outside powers. Some have suggested, for example, that had Saddam Hussein limited his aggression in Kuwait to the disputed Ar-Rumaylah oil field and the islands of Warbah and Bubiyan, he could have reduced dramatically the odds of a U.S.-led international coalition

¹⁷ Note that, as the late 1930s demonstrate, a strategy of incremental aggression does not always succeed in averting eventual great power intervention -- nor is it ever likely to do so if aggression is extended indefinitely. Although it often can provide substantial territorial acquisitions, if aims are unlimited then outside intervention eventually becomes likely.

¹⁸ Note the partial exception of Alliance nuclear planning, where the problem of escalation involved an important element of ambiguity, and the danger of differing perceptions of provocation within (and across) coalitions.

intervening against him. Alternatively, it has also been argued that had Saddam begun a partial withdrawal from Kuwait in December 1990 or early January 1991, he could have greatly complicated the management of the Coalition and reduced the odds of an offensive campaign being launched against his forces. In either case, a strategy of rapidly securing a limited gain while encouraging outside powers to downplay the likelihood of further aggression arguably could have been much harder to oppose than the full-scale invasion that was actually launched. And to the extent that larger acquisitions were ultimately required, these arguably could have been obtained at a lower risk of intervention had they been pursued later, after tensions had cooled, using similar means.¹⁹

While each variant represents a broadly similar strategy — divide aggression into smaller pieces to limit the immediate provocation and reduce the odds of intervention — the two approaches pose very different military problems for the United States. Both are important. For our purposes, however, we will limit our consideration in this case study to the first of these, the "slow and continuous" approach.

PROGRAMMED CAPABILITIES TO RESPOND TO INCREMENTAL AGGRESSION

- Defeat Aggressor's Military Forces
- Coerce Aggressor's Political Leadership (promptly)

Slide 13: Current Capabilities to Respond to Incremental Aggression

Moving to the second task in the analytical approach outlined in slide 6, what military capabilities do programmed forces offer that would be relevant to a challenge of incremental aggression? In general terms, programmed forces could respond in at least two broad ways: they could attempt to defeat (or contain) the aggressor's military forces, and they could be used to

¹⁹ For representative arguments, see, e.g., Janice Gross Stein, "Deterrence and Compellence in the Gulf, 1990-91: A Failed or Impossible Task?" *International Security*, Fall 1992 (Vol.17, No.2), pp.147-79; also, Lawrence Freedman and Efraim Karsh, "How Kuwait Was Won: Strategy in the Gulf War," *International Security*, Fall 1991 (Vol.16, No.2), pp.5-41.

coerce the aggressor's political leadership. (Note that for our purposes we are interested only in coercive options that offer some prospect for prompt effects in response to aggression — while 10 or 20 year strategies for bringing democracy to an authoritarian state may ultimately succeed, they do not offer practical alternatives for reversing any particular act of aggression. Thus we focus here on military options for bringing leverage to bear promptly.)

Of these two classes of response, the first case study will focus on the first — defeating an incremental aggressor's military forces. The second response — coercing the aggressor's political leadership — will be the focus of the second case study, below.

ARE PROGRAMMED CAPABILITIES ADEQUATE TO DEFEAT INCREMENTAL AGGRESSOR'S MILITARY FORCES?

Principal responses would be massive intervention and limited air strikes

Massive Intervention:

- Difficult to motivate (esp. multilateral action) vs ambiguous provocation
- Excessive casualty exposure for stakes that seem modest to us

Air Strikes:

- Targeting, collateral damage problems
 - Incremental aggression permits low aggressor op tempo
 - Low tempo ops can be conducted under cover, intermingled with civilians; can be sustained with light, inherently mobile, easily concealed equipment
 - Capability to target small, mobile, concealed and intermingled targets is very limited

Slide 14: Comparison of Programmed Capabilities and Incremental Aggression Challenge

Moving to the third task in the analytical approach outlined in slide 6, are programmed capabilities adequate for the military operating environment created by incremental aggression? While a detailed analysis of specific projected forces in specific scenarios would be beyond the scope of this study, some broad conclusions can be reached that are relatively scenario-insensitive. First, the principal military responses available from either current or programmed forces are two-fold: massive intervention and limited air strikes.

Massive intervention would entail the use of a large, joint, air-ground force to defend the threatened territory or to roll back an aggressor's gains. While programmed forces are probably capable of accomplishing this against most potential regional aggressors (assuming sufficient force structure is retained), such large-scale operations are difficult to motivate against incremental aggression. Indeed, the whole point of incremental aggressive strategies is to reduce the likelihood that outside powers will be willing to employ such methods.

The principal less-massive military option available in currently programmed forces is that of limited air strikes. Programmed airpower, however, faces serious targeting and collateral damage problems against incremental aggressors. The reasons for this are inherent in the nature of incremental aggression. Slow and continuous aggression permits — in fact by definition requires — an invader to maintain a very low operating tempo. For instance, campaigns of this sort do not require massed tank formations driving forward over the highest trafficability approach routes to achieve a quick breakthrough. Instead, incremental aggressors can afford to conduct their low-tempo operations off roads, mostly under cover, and often closely intermingled with civilians in towns, villages, or the suburbs of large cities. Moreover, a low rate of advance can usually be maintained (especially against the kinds of light local opposition often encountered by such aggressors), if necessary, with weapons no heavier than towed artillery, light armor, mortars, unguided rockets, and automatic small arms or cannon. Such weapons are small, often highly mobile, easily concealed, easily dispersed, easily supplied, and readily operable in close proximity to civilian buildings and populations.²⁰

U.S. capabilities to acquire such small, mobile, concealed targets from the air, however, are extremely limited, and while some efforts to improve are being undertaken, currently programmed forces are unlikely to provide major increases in capability. In Desert Storm, for example, our capability to track elusive mobile targets proved extremely limited, even against such

²⁰ Note that the modest logistical and C3 demands of such low tempo operations also reduce the vulnerability of incremental aggressors to deep interdiction targeting. While the destruction of bridges, command posts, airfields, or ports, for example, may be of independent coercive leverage (i.e., they may be assets valued by the hostile regime even if they are not required to sustain the offensive), their value as targets in this context is best addressed as an issue for leadership coercion.

relatively large platforms as Scud TELs, and even in the relatively permissive terrain of the Iraqi desert. Smaller platforms operating, for example, under foliage cover or among the buildings and background traffic of a small town or village would be difficult and impractical to acquire today. And even were we able to find them in the necessary numbers, destroying targets intermingled with civilians poses serious collateral damage problems for current or developmental air-delivered munitions (which generally are designed either with large warheads for destroying hard targets or with scattering submunition payloads for striking soft area targets. Killing intermingled targets at minimal collateral damage has not been a design priority for air-delivered munitions heretofore).

CRITICAL MILITARY MISSION AREA

To Defeat Incremental Aggressor's Forces:

- Improved capacity to conduct discriminate military operations
 - Acquire small, mobile, concealed targets
 - Strike intermingled targets without killing civilians

Slide 15: Critical Military Mission Area for Defeating Incremental Aggressor's Forces

This analysis implies that improvements in the capacity to conduct discriminate military operations — and in particular, the capacity to acquire small, mobile, concealed targets, and to strike intermingled targets without killing civilians — constitutes a critical military mission area by the criteria given above. That is, it is a set of military tasks that are required to cope with the particular nature of the military operating environment posed by incremental aggression (especially, the concealed, intermingled nature of the targets it creates), but for which currently programmed forces are ill-suited.

OPTIONS FOR PROVIDING MORE DISCRIMINATE MILITARY CAPABILITY: TECHNOLOGICAL POSSIBILITIES

To acquire small, mobile, concealed targets

- Standoff IR, SAR/MTI radar
- Penetrating recce
- Unattended ground sensors
- Observe firing activity
- Ground patrols

To strike intermingled targets without killing civilians

- Non-lethal neutralization
- Precision lethal fires

Slide 16: Discriminate Military Operations

Moving to the fourth task in the analytical approach, slide 16 lists a set of technological possibilities used as points of departure for developing options to provide the critical mission capabilities identified in slide 15.²¹ In particular, for acquiring small, mobile, concealed targets we considered various forms of standoff infrared, and synthetic aperture or moving target indicator radar; penetrating airborne reconnaissance; unattended ground sensors; systems designed to exploit the firing signatures of hostile weapons; and technologies for improving the effectiveness of ground patrols. For striking intermingled targets without killing civilians we considered technologies for non-lethal neutralization of an aggressor's forces; and precision lethal fires.

²¹ Note that the development of effective options ultimately requires the integration of technology with appropriate doctrines and organizations; in this analysis, we began by considering technological opportunities, then used the results to formulate proposals for doctrine and organization. The result was the set of integrated "operational concepts" described in slide 23 below.

STRIKING INTERMINGLED TARGETS: NON-LETHAL NEUTRALIZATION

Non-lethal antimateriel agents: appear impractical here

Options include superreagents, biodeterioration

Problems:

- Toxicity, countermeasure/weather sensitivity (superreagents)
- Speed of action, BWC compliance (biodeterioration)

Incapacitants: some may be helpful, but not used alone

Options include foams/glues; sonic effects; plasma shock; drugs; entanglement systems

Drugs — muscle relaxants most promising, but would require:

- Chemical Weapons Convention (CWC) amendment
- Development of new agents with flatter DRC, transdermal transport, relative insensitivity to prophylaxis, faster action
- Follow-up military action

Entanglement Systems:

- Incapacitate for maximum of 10-15 minutes
- Require rapid follow-up military action

Slide 17: Striking Intermingled Targets: Non-Lethal Neutralization

Beginning with strike system alternatives, and in particular with non-lethal neutralization, two broad sets of possibilities are available: non-lethal antimateriel agents, and incapacitants. Can either of these provide an effective means of neutralizing an incremental aggressor's military targets without killing intermingled civilians?

Of the two, non-lethal antimateriel agents appear impractical in this application. Superreagents, for example, are highly reactive chemical compounds that could be used to embrittle elastic materials like rubber tires, hoses, and belts; to corrode optics or electronics; or to penetrate metals, fiberglass or composites. They are fast-acting, short-lived in the environment, and yield no known toxic breakdown products.²² But because they are based on hydrofluoric acid, they pose severe hazards to humans in the immediate target area who may come into contact with the agent before it breaks down. Hydrofluoric acid (and the related superreagents) produces severe, slow-healing burns and, if inhaled, can result in rapid congestive heart failure. Because they react quickly with water, such agents are ineffective in damp or rainy conditions, and are vulnerable to simple countermeasures (such as spraying exposed rubber or metal parts with water).²³

Alternatively, biodeterioration uses genetically engineered or naturally occurring microbes to attack fuels and lubricants, plastics, rubber, explosives, adhesives, solders, silicon and selected metals. Bioremediation agents are already in widespread civil use for counteracting oil spills and toxic waste products.²⁴ Biological action, however, requires significant lead time for disabling effects — from hours to as much as days or even months for some agents against some types and sizes of targets.²⁵ It is far from clear that such agents could remain in effective contact with mobile military targets (especially given deliberate hostile decontamination efforts) long enough to have meaningful effects. Perhaps more important, use of biological agents in war may also violate the Biological Weapons Convention.²⁶

Incapacitants, on the other hand, have the potential to be of value here — but only for some classes of incapacitant agent, and only when used in conjunction with other military capabilities. A wide variety of agents have been proposed for the purpose, ranging from foams and glues to sonic

²² John Alexander, "Non-Lethal Defense: A Comprehensive Defense Strategy to Provide Commanders More Options in Operations Short of War," Los Alamos National Laboratory, briefing slides.

²³ Personal communication, Dr. John Alexander, Los Alamos National Laboratory.

²⁴ Alexander, "Non-Lethal Defense," op. cit.

²⁵ Alexander, personal communication.

²⁶ For relevant treaty text, see appendix.

effects, plasma shocks, drugs and entanglement systems.²⁷ Of these, drugs and entanglement systems appear most promising.

Many drugs offer some incapacitating effect, but most are impractical for military purposes.²⁸ Muscle relaxants tailored to affect skeletal muscle only, however, could potentially immobilize target personnel without shutting down smooth muscles (e.g., the heart or diaphragm) necessary for life support. Before an effective muscle relaxant could be fielded, however, a number of requirements would have to be met. First, military use of incapacitant drugs is a violation of the Chemical Weapons Convention (CWC).²⁹ Treaty amendment thus would be necessary for the U.S. to field any such capability. Second, while skeletal muscle relaxants in principle could be effective, current agents are inadequate. An effective non-lethal military capability would require new drugs with flatter dose response curves (i.e., which do not kill at unintended high dosages, or when used against unusually susceptible individuals) and with transdermal transport (current agents must be injected). To be militarily effective, an agent must be capable of absorption through the skin; have relative insensitivity to prophylaxis; and be faster acting (to be effective, such agents would require response times of no more than a minute or two).³⁰ While none of these properties is theoretically unobtainable, to produce them in a usable agent could take considerable research effort. Finally, incapacitation in itself serves no ultimate military purpose; some form of follow-up military action is necessary to exploit the (temporary) effects of incapacitation.

Entanglement systems consist of ballistically deployed nets, possibly impregnated with glues or adhesives, that immobilize targeted personnel while the net is in place. Developed under DARPA sponsorship, tested systems have proven highly effective in preventing entangled subjects from running (or often even from standing) while encumbered. Nets range from 15 to 100 feet in diameter (and can be combined in larger numbers for wider coverage), are highly resistant to cutting or deformation by entangled subjects, and have been delivered by projectiles as small as 84mm artillery shells.³¹ But although entanglement nets are effective while in place, they can be

²⁷ For more detailed treatments of the pros and cons of these agents, see appendix.

²⁸ Hallucinogens or other psychoactive drugs, for example, may incapacitate exposed personnel but are clearly inappropriate for military use.

²⁹ For relevant treaty text, see appendix.

³⁰ Scott Kinkead, "Chemical Non-Lethal Defense," Los Alamos National Laboratory, briefing presented August 12, 1993; personal communication, Dr. Craig Taylor, Los Alamos National Laboratory.

³¹ The net is expelled from the shell and spread by small explosive charges. Terminal velocities are extremely low, posing little threat of lethal impact, and tested shells can be fuzed for dissemination at a variety of distances from the intended target. Delivery is not restricted to artillery projectiles, however; nor are projectile diameters limited to 84mm or above -- a wide range of delivery systems are feasible. For more detailed technical descriptions see, e.g., Arnis Mangolds, "Anti-Vehicle/Anti-Personnel Nets and Encapsulants," Foster-Miller

removed given sufficient time and effort.³² Test experience to date suggests a maximum effective delay time of 10 to 15 minutes before entangled subjects can escape (although successive reapplication can extend delay times accordingly).³³ To be effective, such systems thus require unusually rapid follow-up military action to reach the incapacitated subjects prior to escape.

Inc., FMI-721, August 1993; "Sting-Net Non-Lethal Incapacitation for Individuals, Crowds, Close Quarter Combat," Foster-Miller Inc., FMI-219-1TH; M. Finger, "Non-Lethal Defense: Concepts and Technologies," Lawrence Livermore National Laboratory, May 17, 1991; see also discussion in appendix.

³² The net material and construction render them highly resistant to cutting; the most effective countermeasure has been for the subject to locate the edge of the net and work himself free. For test results, see Mangolds, op. cit.

³³ Personal communication, Arnis Mangolds, Foster-Miller Inc., August 31, 1993.

STRIKING INTERMINGLED TARGETS: PRECISION LETHAL FIRES

Requires:

- Very small lethal radius
- Very high accuracy
- Direct human observation/direction
- Maximum decision making time
- Very rapid response to decision — both in firing and in holding fire/aborting fire mission
- Identifiable target

Implies:

- Slow - stationary platforms preferable to high speed
- Single, aimed shots preferable to automatic/area fire
- Continuous man-in-loop preferable to autonomous/fire-forget munitions

Examples:

- Direct fire, high-velocity guns
- Command-guided/Semi-active PGMs with command-abort

Precision lethal fire provides best all-purpose solution where target is identifiable

Slide 18: Striking Intermingled Targets: Precision Lethal Fires

Alternatively, precision lethal fires could be employed. For lethal fire to be effective against intermingled targets without killing civilians, however, a number of very demanding requirements must be met.

The munitions, for example, must have very small lethal radii. As an illustration, even if a current 155mm artillery shell hit a hostile mortar tube located in a village square³⁴ precisely in the barrel, the shell's lethal radius would be large enough to destroy the adjoining buildings — and kill their occupants. Ideally, non-bursting kinetic energy rounds would be best-suited to the task; failing this, the smaller the lethal radius, the better.

For a very small-lethal-radius munition to be effective, it obviously must be extremely accurate. But it is also necessary that even a very accurate round be fired under constant human direction against targets under constant human observation. The difference between civilians and military personnel, or between a school bus and a military vehicle, can be extremely subtle. Only human eyes can be relied upon to distinguish such differences with sufficient reliability.

Human observation alone, however, is insufficient without providing the observer the maximum possible decision making time in which to study the target area carefully and reach a carefully reasoned judgment before firing. To flash an image before an observer for a moment and demand a snap decision is to invite miscategorization and the inadvertent engagement of civilians.

Paradoxically, however, the requirement for maximum possible decision making time is accompanied by the need for a very rapid response to a decision once made — whether that decision is to fire, to hold fire, or to abort a planned fire mission. Both civilians and the military targets of interest to us here are highly mobile, and the movements of either can be unpredictable. An artillery round that requires 30 seconds of flight time between the firing decision and the impact risks the possibility of a civilian unexpectedly entering the target area before impact, or conversely, could enable military targets that had finally emerged after a long period of concealment to escape once more by the time the ordnance arrives. The ideal munition is one with instant responsiveness to a fire decision, and very short flight times.

Finally, precision lethal fires require an identifiable target. If the human observer cannot verify that the target is military, then to bring highly responsive lethal fire to bear is to risk immediate civilian fatalities. Incremental aggression strategies, however, may be conducted by irregularly equipped or clothed troops; alternatively, a crowd of mixed military and civilian

³⁴ A target type typical of those posed by incremental aggression campaigns such as that now ongoing in Sarajevo, for example.

personnel at dusk may simply make difficult to distinguish individuals from one another. Where targets cannot be positively identified as military, even very precise lethal fires offer little solution.

These requirements imply a number of important properties for a feasible solution. First, slow or stationary firing platforms are highly preferable to high speed systems. An A-16 at 400 knots, for example, is unlikely to be able to provide its pilot the decision making time required for this mission. A hovering helicopter or a crouching infantryman, by contrast, offers far greater opportunity to assess the target before firing.

Second, single, aimed shots are highly preferable to automatic or area fire systems. It is impractical to limit the lethal radius of a Rockeye or a 25mm chain gun to the degree required for this mission. One-round-one-trigger-pull systems offer better control and are far better suited.

Third, continuous man-in-the-loop munitions are highly preferable to autonomous PGMs or fire-and-forget weapons. Neither autonomous PGMs nor fire-and-forget systems can provide the constant direct human observation of the target throughout the engagement process that is required for this mission.

While these requirements and implied preferences exclude many existing weapons, they do not eliminate all possibilities. Illustrative examples of systems that meet the demands of the mission might include direct fire, high velocity guns such as sniper rifles. Alternatively, some types of PGMs also could provide the needed qualities: command-guided or semi-active missiles such as TOW, Hellfire, or NLOS, for example, could qualify if they were equipped with a command-abort capability to compensate for their relatively slow flight times and thus permit the human observer to dud the round (and provide a soft landing) in the event of unexpected masking of the target by civilian personnel (or in the event of guidance failure and the loss of positive missile control while in flight).

Overall, and given the capabilities of the available alternatives, precision lethal fires from such weapons provide the best single, all-around solution where the target is identifiable. Against incremental aggressors, however, this will not always be the case — and where targets cannot be positively identified, other solutions must be found (in particular, it may be necessary to combine precision lethal fire capability and temporary, non-lethal incapacitation — about which there is more below).

ACQUIRING SMALL, MOBILE, CONCEALED TARGETS

Requires both detection and identification

Concealment type matters:

- Buildings, towns
- Foliage
- Earth — slopes, ravines, valleys

Slide 19: Acquiring Small, Mobile, Concealed Targets

Moving from target destruction to target acquisition: to acquire small, mobile, concealed targets in the context of incremental aggression requires that a number of special problems be kept in mind.

First, effective target acquisition here requires not just detection of enemy activity, but also target identification of a very demanding nature. Not only must it be possible to discern the difference between a tank and a truck, but it also must be possible to identify the truck positively as civilian or military — and it also must be possible to identify personnel positively as soldiers or as bystanders. This is a degree of precision in target identification well in excess of that ordinarily considered by the target acquisition system design community.

Second, the type of concealment available to individual targets makes a significant difference in the performance of many sensor types. For convenience, we have divided the possible forms of cover into three broad categories: buildings and towns, foliage (the properties of which vary with season and coniferous content of the forest), and earth (for example, the use of slopes, ravines or valleys to conceal infiltration routes from remote observation).

ACQUIRING SMALL, MOBILE, CONCEALED TARGETS (cont'd.)

	Stand-off search radar	Counter- projectile radar	Unmanned monitoring	Ground patrols	Penetrating recce
Buildings/ towns	Limited detection capability; masking	Detects only when firing; Requires identification	Limited capability; false target rate	Effective detection and identification, but vulnerable, slow	Limited detection capability; Effective in identification
Foliage	Detection feasible; no identification	Detects only when firing	High false target rate; Short detection range; ltd. identification	"	Limited detection capability; Inconsistent identification
Earth	Limited detection capability; masking	Detects only when firing	High false target rate; Short detection range; ltd. identification	"	Limited detection capability; Effective in identification

Implications:

- Combination of systems provides complementary capabilities
- Key tasks include
 - Improve individual sensors
 - Integrate into larger systems
 - Examples:
 - Improving infantry survivability
 - Integrating fire-finding and imagery for identification

Slide 20: Acquiring Small, Mobile, Concealed Targets (continued)

The table shown here describes the performance of the sensor types listed above as a function of the form of the target's concealment.

Stand-off search radars such as the U.S. JSTARS (Joint Surveillance and TARgeting System) have limited capacity to detect targets in built up areas. Buildings mask the target from the radar, and to track targets moving into and out of masked areas against the complex background activity of a town or village is extremely difficult.

Alternatively, targets in wooded areas could in principle be detected by radars operating at frequencies that penetrate foliage.³⁵ To be effective, such radars would have to overcome difficult signal processing problems in distinguishing targets from tree trunks and other background clutter. Technical opportunities exist for overcoming this problem (see appendix in Volume II of this paper); these radars, however, would be capable of detection only — the resolution available at foliage-penetrating frequencies is insufficient to provide the kind of precise target identification required here. Finally, targets behind earthen cover, such as targets behind buildings, are largely masked from stand-off search radars at any frequency.

Counter-projectile radars, such as the current U.S. AN/TPQ-37 Firefinder system, are extremely effective in locating the firing point of high trajectory weapons such as mortars or artillery. By tracking the projectile in flight and using ballistic principles to compute its trajectory, existing Firefinders often can determine the shooter's position before the first round fired reaches the ground. Further development can be expected to provide further improvements in responsiveness and accuracy.³⁶

Such systems have the advantage of being insensitive to the concealment of the target (since the fired round rises above the cover). They have two important disadvantages for our purposes, however. First, they detect targets only when they are firing, and only after fired rounds are actually in the air. While they can limit enemy weapons to firing only a few rounds (by directing rapid counterfire against them), counter-projectile radars cannot preemptively locate those weapons before they have done at least some damage. Second, they provide no image of the target area that could provide positive identification to confirm that no civilians are in the vicinity. Under at least some circumstances this may be unnecessary — if the computed firing point is in a dense wood or

35 No such foliage penetrating (or FOPEN) radars are operational or in active development today, although considerable research was done on the subject in the 1960s and 1970s. For a more detailed assessment of FOPEN radar opportunities for target acquisition against incremental aggression, see the discussion in the appendix.

Alternatively, of course, deciduous forests in winter largely obviate the need for foliage penetration. By the same token, though, the lack of concealment afforded by such terrain would presumably encourage targets to seek other operating areas. Moreover, even a deciduous forest in winter poses challenging signal processing demands (though these are not unsolvable — for a more detailed treatment, see the appendix).

36 Other desirable improvements for use against incremental aggression would include systems designed to detect flatter trajectory projectiles, such as tank gun or automatic cannon rounds and, ideally, sniper fire (particularly in the case of these latter target types, infrared or acoustic firefinding systems could be advantageous; note that acoustic firefinders are already in widespread use for artillery counterbattery target acquisition).

ravine known to be unpopulated and rarely traveled, that information might in itself be judged sufficient to open return fire (and under such conditions the return fire need not be extraordinarily precise). But if the target is determined to be in a town or village, then additional identification beyond what the radar itself could provide would be required for our purposes.³⁷

Unmanned monitoring systems, such as the existing U.S. REMBASS (REMotely emplacED BAttlefield Sensor System) could be used for remote sensing of personnel or vehicular movement in a variety of terrain types; such systems also have a (limited) capability to identify targets.³⁸ Existing systems, however, have significant range and false target rate limitations against small targets. Perhaps most important, all current unmanned monitors can be defeated by relatively simple countermeasures, or destroyed by deliberate hostile fire. Combined with their range limits, this creates a requirement for very large numbers of sensors if large areas are to be covered. While performance could be improved to some degree with additional development effort, the inherently limited signatures of human targets (and the similarity of these to various sources of natural background clutter) will tend to limit sensor range even in the longer term.

Ground patrols are the oldest, and perhaps most widely used, means of locating concealed targets today. Human infantrymen are extremely effective detectors and identifiers of targets hidden in any of the concealment types under consideration here. They have two important disadvantages, however. First, they are extremely vulnerable. To see and hear well enough to locate hidden targets in forests, towns or rough terrain, soldiers must dismount from their vehicles and walk the ground directly. This denies them the protection of tanks or armored troop carriers, and leaves them vulnerable to any weapon type found on the modern battlefield. Second, ground patrols are slow. Since infantry must dismount to be effective sensors, they can patrol ground only at the speed of a walking soldier. If many soldiers are used, large areas can be swept in relatively short times, but the search rate of any individual infantryman is quite slow.

37 Of course, counter-projectile radars also cannot provide continuous observation of the target -- in fact, they *never* observe the target itself; they deduce its location by observing the projectile the target fires, and they can observe this projectile only after it has left the barrel of the target we seek to destroy, and typically after the projectile has traveled far enough to rise above the buildings, foliage, or earth that conceal the target itself. And since well-trained weapon crews displace after firing (a tactic known as "shoot and scoot"), the knowledge (much less direct observation) of the target provided by counter-projectile radars is anything but continuous in nature -- it should be expected that the shooter will leave the deduced location after at most a few minutes of firing the last observed round, and often before effective counterfire can be directed against it. If the target is determined to be in an unpopulated area, rapid counterfire using wide-area munitions can still sometimes destroy even quickly scooting shooters, but if not, then the lack of continuous observation associated with target acquisition systems that sense only fired rounds is a more serious drawback.

38 Armed personnel, for example, could potentially be distinguished by the use of magnetic anomaly detection equipment in some existing unmanned systems; effective system range in such a mode, however, would be very short. For a more detailed discussion, see appendix.

Penetrating airborne reconnaissance platforms such as UAVs (Unmanned Air Vehicles) or photo recce aircraft (e.g., the RF4C) can carry sensor systems within very short distances of potential targets, and can even overfly them directly at low altitude if necessary. This enables short-range sensors to be used effectively, but more important, it can negate the effects of masking from buildings or earth by bringing the sensor directly overhead or by maneuvering to the unconcealed side of the mask. In conjunction with the use of high resolution infrared or electro-optical sensors and modern real time data links, this provides penetrating recce with a powerful capability for identifying targets in urban or earthen cover (it also provides some capacity to identify targets in foliage, depending on the porousness of the canopy).

But while penetrating recce can be highly effective in identification, it has significant drawbacks as a detection system — especially its slow sweep rate. The platform's need to be directly overhead, coupled with the short slant ranges of many imaging sensors, produces a narrow swath width for most airborne systems in this role. Of course, high airspeeds or large numbers of platforms could compensate for a narrow swath width and provide a higher sweep rate in a wide area search role. But high-air-speed platforms limit observation of targets behind masks to brief glimpses only. And to provide the necessary numbers of platforms to create a high sweep rate given a very narrow swath width could become prohibitively expensive given even moderate unit costs for the kinds of light-weight, high-resolution, multispectral sensor packages and real-time, high-reliability data links needed, plus the large numbers of trained operators and ground crews this would require.

What, then, does this imply for developing effective options for target acquisition against incremental aggression? First, note that no single sensor type is capable of fully effective detection and identification against targets in all forms of concealment. Yet all sensor types have at least some capability for at least some functions through some kinds of cover. This suggests that it may be possible to combine multiple sensor types with complementary capabilities in ways that cover for the weaknesses of individual sensors taken alone. Counter-projectile radars, for example, can detect firing systems over wide areas, but cannot determine the presence or absence of civilians near firing points in towns or villages. Penetrating recce, by contrast, is a weak wide area detection system, but is very effective in identifying civilians in a specified area. Taken together, the two systems thus offer synergistic capabilities.

To create such synergistic effects, however, a number of key tasks must be performed. In most cases individual sensor systems must be improved before they can provide their intended role. Foliage penetrating radar is technically feasible, but no fieldable system exists today. Unmanned monitors could provide valuable spot coverage, but false target rates against small targets need to be reduced and detection ranges increased. Ground patrols offer one of the most

potentially robust target acquisition capabilities of any sensor considered here (patrols alone have at least some capability against all three forms of concealment), but the vulnerability of dismounted infantrymen must be increased if they are to become an attractive option.

In addition to improving individual sensors, however, architectures also must be designed by which to integrate diverse systems and exploit the potential synergism among them. In particular, wide area search systems must be teamed with higher-resolution imaging sensors in ways that meet the timing demands of locating fleeting targets in varying forms of cover.

To illustrate the nature of these tasks in somewhat greater detail, we will describe two examples in particular: improving infantry survivability (to illustrate sensor system improvement), and interconnecting counter-projectile radar and penetrating recce (an example of system integration).

INTEGRATING FIRE-FINDING AND IMAGERY

Use fire-finding radar as cueing device for short-range imaging sensor

Key Properties:

- Must react quickly — targets are mobile, fleeting
- Must be capable of investigative work where necessary — opposition personnel may be difficult to distinguish from surrounding civilians; may disappear into background after firing activity
- Must provide high-resolution multispectral imagery

Potential Solution: Combine penetrating UAVs in multiple orbits with infantry team follow-up capability

Slide 21: Integrating Fire-Finding and Imagery

Beginning with the second of these, the basic approach is to use counter-projectile radar as a cueing device to alert a penetrating recce system with short-range imaging sensors to the location of a potential target. The nature of the targets presented by incremental aggression strategies, however, place a number of unique demands on such a combination.

First, it must react to firing cues very quickly. The targets of interest are mobile and fleeting, and can be expected to displace shortly after firing. Mortar crews, for example, often will be capable of leaving a firing position within as little as two to three minutes after completing a fire mission.³⁹

Second, the system as a whole must be capable of providing investigative capabilities where necessary. This is because the target will not always be identifiable — even for very high resolution imaging sensors — by the time penetrating recce can reach the scene. Military personnel, for example, may lack distinctive uniforms and may seek to disappear into the surrounding population (or into neighboring buildings) after firing. Some capability to investigate the area, search buildings, and interrogate suspects thus may be an important element of a capacity to acquire targets in such an environment.

Finally, the penetrating recce platform must, of course, provide very high resolution imagery, and the sensor suite must operate in multiple spectral bands so as to improve night and all-weather performance, to complicate opposing camouflage efforts, and to reduce false target rates.

Although many specific combinations of technologies might meet these requirements, one potentially feasible example might be to combine an array of ground-based Firefinder-type radars with a network of armed airborne UAVs, and a back up investigative capability consisting of heliborne infantry teams on QRA (Quick Reaction Alert) status. The numbers of systems required will depend on the scenario selected, but as an illustrative estimate: to cover a roughly 30 by 10 kilometer region of potentially hostile territory would require on the order of one to two Firefinders and 8 to 15 UAV orbits to provide UAV response times of one minute or less to cues from ground based radars.⁴⁰ In addition, one or more QRA teams would be necessary to provide follow-up investigative capability should UAV imagery prove inadequate to distinguish identifiable targets.

³⁹ Personal communication, Col. W.M. Christenson, U.S. Army ret'd.

⁴⁰ For requirements analysis, see appendix.

	Today	Systems Integration Only	New Apps of Existing Technologies	Evolutionary Technology Improvement	Major Technology Improvement
Armor	Helmet, Kevlar flak jacket (torso)	Improved Helmet, flak jacket, eye protection	Full-body Assault Protection	FF-driven Powered Exoskeleton	MEG-driven Powered Exoskeleton, Active camo/LO
Sensors	NVG, binoculars	HUD, thermal sight, laser aiming light, hearing augm., GPS, med monitoring, image capture	=	=	=
Comms	None	Squad voice/data intercom	= Plus graphics	=	=
Programs	General Issue	SIPE/TEISS/21CLW		JSSAP/Batelle	LANL: Pitman
Risk/IOC	None/1993	Low/2000	Low/2005?	Med-High/ 2010-2025?	High/2025+?

Slide 22: Improving Dismounted Infantry Survivability

Moving to the improvement of individual sensor capabilities, this table describes a range of options for reducing the vulnerability of dismounted ground patrols. The options are rank-ordered by technological risk and likely development time, ranging from systems available today through options requiring only the integration of existing sub-systems, options requiring new applications of existing basic technologies, options requiring evolutionary improvements in basic technologies, to options requiring major technological advances. Each is described in terms of three basic dimensions of potential improvement: armor protection, sensor systems, and communications; representative program initiatives (where these exist) are listed for each class of technology.

Today, for example, infantry standard issue equipment includes a kevlar flak jacket covering the torso, and a helmet offering some protection for the head and neck. Current individual sensor systems are largely limited to binoculars and night vision equipment of varying

configuration; no individual-issue communications equipment is provided (radios are issued at squad and above).⁴¹

Infantry survivability could be improved substantially, however, by integrating a variety of existing technologies. The U.S. Army currently is investigating a number of these possibilities in the form of the recently completed SIPE (Soldier Integrated Protective Ensemble) advanced technology demonstration; the TEISS (The Enhanced Integrated Soldier System); and the 21CLW (21st Century Land Warrior) program. These programs involve varying combinations of improved helmets with integrated eye protection, head-up displays of key combat information, hearing augmentation, and individual squad net voice and data radio intercoms; improved flak jackets for torso protection with greater freedom of movement; thermal weapon sights with laser aiming lights; individual GPS (Global Positioning System) navigation equipment; continuous individual medical monitoring; image capture and transmission systems for disseminating reconnaissance imagery; and individual miniaturized computing equipment for managing the associated electronics and sensing equipment.⁴² Most of these technologies been borrowed from existing land vehicle or aircraft avionics programs and thus represent low risk initiatives; current Army estimates of initial operating capability fall around the year 2000.

Alternatively, by applying existing non-military technologies to infantry survivability it should be possible to reduce vulnerability further, albeit with some potential tradeoff against mobility. In particular, ongoing Army efforts place primary effort on the application of available sensor and communications systems to infantry use; relatively little effort has been directed at extending body armor from the current torso and limited head protection to full body coverage. Substantial efforts, however, have been directed at improving protection for civilian SWAT and bomb disposal team members — both of which can afford to trade some mobility loss for more complete armor coverage. While it is difficult to assess just how much protection could be afforded with appropriate development effort, to the extent that specialized infantry missions (e.g., assault) can be identified that limit the endurance required of the soldier, some opportunity exists to

41 This of course represents a rather modest level of capital investment. By way of (admittedly stark) contrast, a fighter pilot is provided with perhaps \$40 million or more of capital equipment -- not to mention expenditures for training in its use (and expenditures for its support). A current U.S. Army infantryman, on the other hand, is provided with less than \$1,000 in equipment -- a difference of more than four orders of magnitude in capital investment -- and receives far less expenditure for training.

42 In addition, SIPE, TEISS and 21CLW also involve various other initiatives to reduce soldier weight burdens and/or increase load bearing capacity, etc. The initiatives listed above, however, are arguably those with the most immediate influence on survivability. For a more complete description of current Army programs, see, e.g., Carol J. Fitzgerald, *Soldier Integrated Protective Ensemble (SIPE), Generation II Soldier Advanced Technology Demonstrations*, U.S. Army Natick RD&E Center; Albert J. Nahas, *Proponent Evaluation for the Soldier Integrated Protective Ensemble Advanced Technology Demonstration*, U.S. Army Infantry School, Ft. Benning GA, ATSH-CDT(70), 6 April 1993; Dr. Robert S. Rohde, "21st Century Land Warrior: Advanced Land Combat Top Level Demonstration No.3," SARD-TT, nd.

reduce vulnerability substantially in the relatively near term by extending armor coverage to the extremities.

To provide full-body armor protection without adversely affecting the endurance or agility of the soldier would require substantially more risky development efforts. In particular, some form of power assist likely would be required to enable the infantryman to support the added weight without debilitating exertion. Several programs have been proposed to provide such a capability. The JSSAP (Joint Service Small Arms Program), in conjunction with Batelle Memorial Laboratory, for example, has proposed a powered exoskeleton system to support the weight of a full-body armor suite sufficient to stop 7.62mm automatic small arms fire. Movement instructions would be conveyed by force feedback sensors on the inside surfaces of the suit.⁴³ Force feedback (FF) control systems are under ongoing, intensive exploration for civilian robotics applications.⁴⁴ FF methods are too slow, however, to provide normal agility to a running infantryman on a cluttered battlefield: sprinting under FF control has been compared with running under water.⁴⁵ To provide full natural agility would require a substantially higher-risk development effort to produce a magnetoencephalography (MEG) control system, as has been proposed by Los Alamos National Laboratory under the Pitman program.⁴⁶ The MEG approach would use muscle-associated electrical activity in the brain to anticipate movement commands and provide the necessary lead times to actuator systems. While MEG techniques have been under research for some time in the United States and Japan, the technical risk associated with such developments is very high.⁴⁷ By contrast, the risk level associated with the less-aggressive JSSAP/Batelle proposal would itself be at least medium-to-high; although IOCs are difficult to estimate, these

43 For a more detailed description of the JSSAP/Batelle proposal, see Tullington, B.J., et. al., "A Notional Individual Fighting System," Report for JSSAP 10, U.S. Army ARDEC, Joint Service Small Arms Program Office, Dover, NJ, 25 August 1987; also Paul F. Gorman, *Supertroop Via I-Port: Distributed Simulation Technology for Combat Development and Training Development* (Alexandria, VA: Institute for Defense Analyses, August 1990), IDA P-2374, pp.VI-1 to VI-3. A similar approach is under investigation by an Israeli team under Dr. Arie Yavnai of Rafael Autonomous Systems and Intelligent Machines Section: Personal communication, Dr. Jeffrey Moore, Los Alamos National Laboratory, August 13, 1993.

44 See, e.g., Gorman, op. cit., pp.V-1 to V-9.

45 Personal communication, Dr. Jeffrey Moore, August 13, 1993.

46 The Pitman proposal also would include heavier armor protection than that of the JSSAP/Batelle program (i.e., against weapons up to .50 caliber, vice 7.62mm for JSSAP/Batelle; note that the Soviet/Russian BMP-I armored personnel carrier is not armored well enough to stop .50 caliber projectiles), active camouflage systems, and limited exploitation of low observables technology. For a more detailed description, see Jeffrey A. Moore, *Pitman: A Powered Exoskeletal Suit for the Infantryman* (Los Alamos: Los Alamos National Laboratory, June 1986), LA-10761-MS, UC-38; idem., *Pitman: A System Description and Research and Development Plan* (Los Alamos: Los Alamos National Laboratory, January 1988); also Gorman, op. cit., pp.VII-1 to VII-4.

47 Edward R. Flynn and Grace Y. Hollen, *A New Probe of the Human Brain* (Los Alamos: Los Alamos National Laboratory, July 1993), LALP-93-060, No.7.

might range from 2010 to perhaps 2025 or beyond for the latter, and well beyond 2025 for an MEG-driven approach.⁴⁸

Overall, the table suggests that opportunities are available for improving dismounted infantry survivability — especially by incorporating well-understood sensor and communications technology from aircraft and ground vehicle systems. The level of technical risk and development time required for such adaptations are modest, and some degree of programmatic effort is already under way in the Army to realize their potential. More aggressive development efforts also are possible, and in particular, could provide more complete body armor coverage than that envisioned in current Army programs. The level of technical risk associated with such options, however, is considerably higher (or alternatively, the penalty to be paid in mobility loss would be higher if the technical risk is to be kept low).

48 For IOC estimates, see Fitzgerald, op. cit.; Gorman, op. cit., Tullington, op. cit., Moore, op. cit.; risk levels are an IDA estimate.

Illustrative Operational Concepts

1. Infantry Sweep

- Small teams of highly trained, highly capitalized ground soldiers search terrain on foot
- Survivability and lethality enhanced by improved body armor, sensor, comms
- Supported by massive firepower in the event of a main force encounter in unpopulated area; precision LOS/NLOS anti-materiel weaponry for use in built-up areas
- Ground soldier provides inherent covered terrain target acquisition and precision lethal fires; application of modern technology reduces casualty levels

2. Quick Reaction Discriminating Counterfire

- Target acquisition by combination of ground-based counterprojectile radars, orbiting UAVs with high resolution EO/IR sensor suite, stabilized, high ROF rifle for separately aimed shots
- Radars detect firing activity, cue UAVs to overfly firing location
- If firing system is armored vehicle, UAV calls for NLOS fire
- If firing system crew is exposed, distinguishable, UAV engages with rifle fire
- If firing system crew is indistinguishable, UAV non-lethally immobilizes/incapacitates suspect personnel, calls for follow-up by QRA heliborne infantry team

Slide 23: Illustrative Operational Concepts

The improvement opportunities described above can be brought together in a number of different ways to produce operational concepts for conducting discriminate warfare. Two examples illustrating the range of possibilities might include an infantry sweep approach and methods for quick reaction discriminating counterfire.⁴⁹

An infantry sweep approach could involve many small teams of highly trained, highly capitalized dismounted ground soldiers who search the terrain for concealed targets. The survivability and lethality of these soldiers would be enhanced by some combination of improved body armor, sensors and communications.

Should a team encounter a sizable enemy force in an unpopulated area, massive air and artillery support directed by the infantry themselves would provide the firepower needed to destroy the opposing force while minimizing the ground troops' exposure. In a populated area, fire support from command-guided or semi-active PGMs would provide precision lethal fires to deal with hard targets; opposing personnel would be engaged with precision small arms fire. By maximizing reliance on indirect sources of continuous, man-in-the-loop precision firepower to deal with large enemy forces (especially in unpopulated areas), infantry teams can be more thinly spread in order to increase reconnaissance swath width; by multiplying teams, a sweep rate of perhaps 150 square kilometers per day could be maintained per battalion of specially equipped soldiers.⁵⁰

Quick reaction discriminating counterfire would rely on a combination of ground-based counter-projectile radars, continuously orbiting UAVs, and heliborne infantry teams maintained on quick reaction alert status. For this role, UAVs would be equipped with high-resolution, real-time EO/IR sensor suites, and armed with a combination of stabilized, high-rate-of-fire rifles for firing separately aimed, precision-lethal rounds, and rockets for delivery of non-lethal delay/incapacitation payloads. QRA infantry teams would be given the same combination of improved body armor, sensors, communications and special training described above, as well as special equipment for investigative use.⁵¹

In this concept, counter-projectile radars would perform wide area search to detect firing activity. Upon detection, the computed firing point would be compared with the location of known

49 While these are not necessarily mutually exclusive, they could be employed independently, and in any case are meant primarily to be suggestive of the variety of ways in which specific improvements might be combined.

50 Assuming 10 meters search frontage per soldier, a sustained average speed of about two kilometers per hour, 12 hours effective search time per day, and an infantry strength of 500 soldiers per battalion.

51 Such as chemical sniffers for detecting combustion products associated with firearm or artillery discharge, or detectors for chemical taggant agents embedded in internationally obtained explosive ordnance. Such devices might be of considerable assistance in identifying individuals who had been involved in firing heavy weapons as much as several hours or more prior to the arrival of an investigative team. Some, such as taggant detectors, obviously require some degree of international cooperation among major armaments producers; others, such as sniffers, do not. For more detailed descriptions of such systems, see, e.g., Kincead, op. cit.

population centers in the area.⁵² If the calculated firing point is in an area known to unpopulated, immediate air- or artillery-delivered counterfire would be directed to destroy the target before it could displace. If the firing location suggests the possibility of a significant civilian presence, the UAV nearest the contact would be cued to overfly the firing location. As the UAV reached the target, positive identification would be obtained using imagery from the UAV sensor package. If the target identified is an armored vehicle (e.g., a self-propelled artillery piece), the UAV would call for command-guided or semi-active PGM fire from ground-based artillery or missile systems, which the (ground-based) human operator of the UAV would then positively guide to impact (or command-abort if necessary). If the target identified comprises exposed, distinguishable military personnel (e.g., a mortar crew), then the UAV immediately engages with rifle fire, again under continuous positive direction by the UAV's human controller. If the target is indistinguishable, however (e.g., a group of unknown individuals, some of whom may be combatants and some not), the UAV non-lethally immobilizes or incapacitates any suspect personnel and calls for follow-up by a QRA team of heliborne infantry. The infantry team, upon arrival, kills any suspect personnel who open fire, and conducts any further investigation necessary to identify combatants.⁵³ Identified combatants are taken into custody and transported to detention facilities as the team withdraws.

52 Note that accurate, current information on the distribution of the civilian population in the area is required for this check to be meaningful. If this is unavailable, or if the reliability of available data on some areas is uncertain, penetrating recce follow-up must be used to obtain positive information.

53 Note that an advantage of incapacitants here is that they prevent the incapacitated personnel from firing on the response team; delay/immobilizing systems such as entanglement nets may make firing more difficult, but do not necessarily prevent it.

POTENTIAL COUNTERMEASURES

Increase anti-personnel weapon caliber

- Body armor-penetrator race
- Larger weapons may increase odds of remote U.S. detection

Attack UAVs

- UAVs inherently difficult targets: small, agile, relatively fast
- Counter-UAV capability may require air defense improvements

Ambush Ground Forces

- Requires some concentration of opposing forces
- If large, and in unpopulated area, concentration of opposing combat power eases U.S. target acquisition problems — ambushers potentially vulnerable to U.S. firepower
- If small, survivability improvements reduce U.S. vulnerability
- Sizable ambush in populated area poses difficult problem

Smoke/Camouflage/Obscure targets

- Can reduce sensor's effective slant range, but
- Multi-spectral sensing complicates signature suppression, limits sensor vulnerability

Infiltrate reinforcements/replacements

- To prevent requires large ground forces for controlling terrain/securing perimeters
- Can force U.S. to extend operations; U.S. cannot sanitize an area and leave

Slide 24: Potential Countermeasures

Slide 23 presents two options with some potential to meet operational requirements if technically and economically feasible, and if robust against countermeasures. While we will not attempt to provide a comprehensive feasibility assessment, and while a detailed measure-countermeasure analysis is beyond the scope of this initial effort, we have taken a preliminary look at the vulnerability of the proposed improvements to some of the more important potential countermeasures (slide 24).

One such countermeasure to proposals involving enhanced infantry survivability is to increase the caliber of antipersonnel weaponry. Feasible increases in weapon caliber (e.g. from 7.62mm to 9mm rifles or .50 caliber/12.7mm crew-served automatic weapons) could indeed spur an extended race between improved body armor and improved penetrators. Body armor, however, is neither the sole nor necessarily the most important potential improvement in infantry survivability. To counter simultaneous improvements in body armor, multispectral sensors and jam-resistant communications would be a challenging undertaking, especially for the third world armies that often are the perpetrators of incremental aggression.⁵⁴ Moreover, simply to counter improved body armor alone may ultimately require nontrivial increases in the size of the weapon platforms required. Larger weapon platforms, however, make concealment more difficult and increase the odds of remote detection by the U.S. without requiring the use of dismounted infantry.

Alternatively, opponents could attack the UAVs that may be needed for target identification. UAVs, however, can be difficult targets for air defense systems: they typically are small, agile, fast enough to be difficult to track, and difficult to hit if tracked. While weapons certainly could be designed that would be more effective against UAVs than are current air defense systems, the improvements required can be substantial, and could actually *reduce* system effectiveness against some traditional air targets.⁵⁵

Opponents also could organize ambushes of U.S. infantry teams (and/or the helicopters that would carry them in the second of the two operational concepts described above). In Vietnam, for example, the North Vietnamese often used downed U.S. aircraft to lure rescue elements into prepared kill zones; similarly, a future opponent could expose ambiguous targets to draw U.S.

⁵⁴ On the difficulties faced by third world armies in undertaking complex applications of sophisticated technology, see Stephen Biddle and Robert Zirkle, "Technology, Civil-Military Relations, and Warfare in the Developing World," presented at the 1993 American Political Science Association Annual Meeting, Washington, D.C., September 3, 1993; see also Stephen Biddle, *Determinants of Victory in Operation Desert Storm: Analysis and Policy Implications* (Alexandria, VA: Institute for Defense Analyses, 1993) IDA P-2794; idem., "Recent Trends in Armor, Infantry and Artillery Technology: Developments and Implications," in W. Thomas Wander, ed., *Advanced Technology in the Developing World* (Washington, D.C.: American Association for the Advancement of Science, forthcoming).

⁵⁵ Personal communication, Dr. Peter D. Feaver, Duke University.

investigative reaction teams into planned ambushes. To be effective, however, an ambush requires some concentration of opposition forces, and the more effective the U.S. forces, the greater the relative degree of concentration required. *Ceteris paribus*, force concentration tends to increase an opponent's vulnerability to U.S. firepower, especially for ambushes in unpopulated areas where that firepower could be used more freely. A sizable ambush in a populated area, however, would limit our opportunity to employ mass firepower on short notice without killing civilians; such tactics could pose a difficult problem for operational concepts heavily dependent on QRA infantry teams.⁵⁶

Opponents could use smoke or camouflage to obscure targets and complicate identification efforts. Obscurants can indeed reduce the slant range of many sensor types. Multispectral sensing, however, can greatly complicate effective camouflage. To remain hidden to a UAV equipped with infrared and optical sensors requires simultaneous suppression of all relevant thermal and visual signatures; if UAVs are augmented with, for example, imaging millimeter wave or laser radar, then RF signature suppression also must be accomplished — errors in any of the three regimes could be sufficient to give away the target's location.⁵⁷

An additional countermeasure would be simply to replace losses or to reinforce the threatened forces. Areas swept by U.S. infantry teams could be repopulated with opposition forces by infiltrating new weapon teams into nominally cleared areas; mortars or howitzers destroyed by remote counterfire could be replaced with new ones. To prevent new forces from entering a swept area would require that we secure the perimeters of the area and/or control the terrain with defensive ground forces. Either mission could require substantial numbers of U.S. troops (although the use of indigenous allied forces or substantial improvements in unmanned monitoring systems could each reduce these requirements to some degree). If opposition forces are determined, however, a policy of continuous replacement/reinforcement could force us either to extend sweep/counterfire operations as long as the opponent is willing to introduce fresh forces, or to provide more or less sizable defensive ground forces of our own to prevent their introduction. In either case, we would be unable simply to sanitize an area quickly and leave, lest we risk losing what had been gained.

⁵⁶ Note also that any extensive use of helicopters will require the identification of relatively clear landing zones and overflight corridors to reduce the helicopters' exposure to ground fire. In the case of heliborne QRA infantry teams, for example, this will often prevent the infantry from disembarking directly onto the target; required delay times for non-lethal incapacitants thus must account both for the flight time of the helicopter and the movement time of the dismounted infantry from the disembarkation point to the target itself.

⁵⁷ And as noted above, the ability of likely incremental aggressors to cope with the level of operational complexity this would involve is unclear.

A variety of countermeasures are thus available to potential opponents, many of which have at least some potential to increase the difficulty or cost of waging discriminate warfare. None considered here, however, poses wholly unanswerable threats, and some involve significant cost or difficulty of implementation for the opponents themselves. Although the preliminary analysis given here is far from conclusive, initial indications suggest that further consideration may be warranted.

INCREMENTAL AGGRESSION and DISCRIMINATE MILITARY CAPABILITY: INDICATIONS

Finding/killing small, concealed, intermingled targets as critical military mission area

Combination of sensors, kill mechanisms offer most promising strategy for improvement

All-standoff surveillance, high speed air platforms, autonomous/fire-forget munitions poorly suited to incremental aggression role

Key development areas include:

- Dismounted soldier survivability improvements
- UAV adaptation for RT multispectral imagery collection, direct attack/target hand-off
- C³ for sensor integration
- Command disablement for PGMs
- Non-lethal incapacitation — especially entanglement
- Small target/foilage-penetrating surveillance radar; improved unmanned monitoring systems

***Slide 25: Incremental Aggression and Discriminate Military Capability —
Indications***

By way of summary, then, incremental aggression strategies put a premium on the ability to destroy small, concealed, intermingled targets. Such targets pose problems for programmed forces, both in target acquisition and in providing kill mechanisms that can neutralize intermingled targets without harming civilians. The capacity to find and kill such targets is thus a critical military mission area as defined by the approach developed here. Of the possibilities considered for improving such capabilities, no single sensor type or kill mechanism is likely to be effective against all important targets or forms of concealment. Rather, the most promising options involve integrated combinations of complementary sensors and weapon types designed to cover for the weaknesses of individual systems taken alone.

But while a combination of diverse systems may provide the best approach not all technology areas offer a meaningful contribution here. In particular, many of the more prominent classes of development efforts in the programmed force are poorly suited to the unique demands of responding to incremental aggression. All-standoff surveillance systems, high speed air platforms, and autonomous or fire-and-forget guided munitions, for example, all have important drawbacks against concealed, intermingled targets.

Development areas offering important capabilities for this mission, on the other hand, include improvements in dismounted soldier survivability; adaptation of ongoing UAV development efforts to integrate real-time multispectral imagery collection with a capacity for direct, precision lethal attack, delivery of non-lethal incapacitating or immobilizing payloads, or target handoff where necessary; C3 for sensor integration and coordination of diverse sensor and weapon systems; command disablement for PGMs; development of non-lethal incapacitant and immobilizing agents (especially entanglement systems); small target and foliage-penetrating surveillance radars; and improved unmanned monitoring systems.⁵⁸

⁵⁸ Also useful, though perhaps less generally so than the opportunities listed above, would be improved systems for facilitating on-site investigation (e.g., chemical sniffers for detecting combustion products associated with firearm or artillery discharge, or detectors for chemical taggant agents embedded in internationally obtained explosive ordnance); improved methods for rapid infantry team ingress and egress (especially in the absence of a cleared landing zone); the development and maintenance of accurate data bases on the distribution of civilian populations in potential conflict zones; and the development of automated data processing systems for rapidly correlating such data with reported enemy firing activity.

OUTLINE

- I. Analytical Approach
- II. Illustrations
 - A. Identification of Critical Long-Term Security Challenges
 - B. Analyses of Capability Shortcomings and Options for Response:
 - 1. Incremental Aggression and Discriminate Military Capability
 - ⇒ 2. **Incremental Aggression and Coercion of Hostile Leadership**
 - 3. WMD Proliferation and Counteroffensive Action against Proliferation Sites
- III. Conclusions and Implications

Slide 26

The second case study, as with the first, involves the challenge of incremental aggression. But whereas the first case study focused on U.S. capabilities to defeat the aggressor's military forces, the second considers U.S. capabilities to respond by coercing hostile leadership.

PROJECTED CAPABILITIES TO COERCE INCREMENTAL AGGRESSOR'S LEADERSHIP

1. Economic Sanctions
2. Arms Transfers/Embargoes
3. Leadership Targeting: kill key personnel

Slide 27: Projected Capabilities to Coerce an Incremental Aggressor's Political Leadership

Since the essential properties of the challenge of incremental aggression have been described in slide 12 above, we will move directly to the second task in the analytical approach outlined in slide 6 — that is, the identification of programmed capabilities relevant to the nature of the challenge. As noted in slide 13 above, there are at least two broad classes of such capabilities: defeating the incremental aggressor's forces, and coercing the aggressor's leadership. The first case study addressed the first of these; this case will concentrate on the second.

Means of coercing hostile leadership that are relevant to Defense Department responsibilities fall into at least three general categories: economic sanctions (which are often enforced by military assets, especially naval forces); arms transfers or embargoes; and direct targeting of hostile leadership personnel.

ARE PROGRAMMED CAPABILITIES ADEQUATE TO COERCE INCREMENTAL AGGRESSOR'S LEADERSHIP?

Economic Sanctions

- Require multilateral action: difficult to obtain consensus
- Difficult to make leak-proof, even with consensus
- Effects can be slow
- Vulnerable to reallocation, prior stockpiling of goods/production
- Difficult to affect elite self-interest
- Conflict with humanitarian interests

Slide 28: Comparison of Programmed Capabilities and Incremental Aggression Challenge

Moving to the third task in the analytical approach outlined in slide 6, are projected capabilities adequate for the military operating environment created by incremental aggression? Beginning with the first of the three classes of capabilities given in slide 27, economic sanctions have had a mixed record.⁵⁹ Under the right circumstances, they can be effective, but as general coercive tools they have important limitations that programmed improvements in military forces are unlikely to overcome.⁶⁰ First, to be effective, sanctions require multilateral action. If most states

59 The empirical literature on economic sanctions is extensive. Much of this literature, however, is flawed by significant methodological problems (especially regarding conflicting or ambiguous classification of data points). The more systematic analyses, however, tend to show limited effectiveness where the targeted state's stakes in the conflict are high: for a critical review of the literature, see Robert A. Pape, Jr., *Military Coercion* (Maxwell AFB, AL: U.S. Air Force School of Advanced Airpower Studies, forthcoming). See also: Otto Wolff von Amerongen, "Economic Sanctions as a Foreign Policy Tool?" *International Security*, Fall 1980 (Vol.5, No.2), pp.159-167; Mancur Olson, Jr., *The Economics of Wartime Shortage: A History of British Food Supplies in the Napoleonic Wars and in World Wars I and II* (Durham, NC: Duke University Press, 1963); for other perspectives, see Gary Clyde Hufbauer, Jeffrey J. Schott and Kimberly Ann Elliott, *Economic Sanctions Reconsidered: History and Current Policy* (Washington, D.C.: Institute for International Economics, 1990, 2d ed.); David A. Baldwin, *Economic Statecraft* (Princeton, NJ: Princeton University Press, 1985); Johan Galtung, "On the Effects of International Economic Sanctions," *World Politics*, April 1967, pp.378-416.

60 Preconditions favoring effective economic sanctions include an impoverished target state, limited overland communications, critical dependency on overseas trade, and, often, an underlying conflict with limited stakes for the target state and/or a politically weak leadership in the target state. For an analysis of a recent example of a case meeting these preconditions, see Thomas W. Lippman, "Dramatic Success of Sanctions Linked to Haiti's

restrict trade with the aggressor but a few do not, the few simply profit at the expense of the many, and the impact of the trade restriction can be dramatically reduced. The high degree of multilateral consensus required for effective sanctions, however, can be difficult to obtain given the inherently ambiguous nature of the provocation associated with incremental aggression.

Second, even with consensus among nations, subnational actors can often smuggle goods to the aggressor in quantities sufficient to dilute substantially the effects of the sanctions. To make sanctions leak-proof against such threats can be extremely difficult.

Third, sanctions can be slow. Before the effects of trade restrictions can really be felt, existing inventories must be exhausted, consumption must outstrip the ability of smugglers to supply goods surreptitiously, and substitutes for imported goods must be used up. Each takes time.

Fourth, the effects can be slowed further by reallocating domestic production to emphasize substitutes for imported goods, or to provide for the needs of decision making elites at the expense of the general public. Alternatively, aggressors who anticipate sanctions can stockpile key goods, build up domestic production capability, or introduce conservation measures well in advance of planned aggressive action.

Fifth, it is difficult to affect directly the self-interest of decision making elites through economic sanctions. The well-being of the ruling elite plays a disproportionate role in the effectiveness of coercive efforts (about which there is more below). This group typically is very small, however, relative to the size of the population as a whole. Given the target state's ability to reallocate its resources to protect the interests of such elites, the gross resources of the target state as a whole must thus be reduced dramatically before the elite itself can be made to feel any significant effect.⁶¹

Finally, the effect of economic sanctions is to impoverish the target state. Especially inasmuch as the decision making elite is typically the last segment of society to be affected, the heaviest effects of impoverishment brought about by trade restrictions are felt by innocent civilians,

Circumstances: Economic Pressure Has Yielded Few Clear Victories in Recent Uses," *The Washington Post*, August 29, 1993, p.A23.

61 Of course, the self interest of the elite would be affected quite directly if the effects of sanctions on the general public were to bring about a popular insurrection against the government. In fact, this is an important -- if generally implicit -- causal mechanism in many economic sanction strategies. Yet the effectiveness of either: (a) sanctions in causing popular uprisings, or (b) popular uprisings in toppling governments are both highly questionable. On (a), see, e.g., Pape, op. cit., and the discussion below under "Leadership Coercion." On (b), see the discussion below and associated references.

and particularly the very young and the very old (that is, the weakest members of the population). Such effects pose an inherent conflict with U.S. humanitarian interests.

**ARE PROGRAMMED CAPABILITIES ADEQUATE
TO COERCE INCREMENTAL AGGRESSOR'S LEADERSHIP? (continued)**

Arms Embargoes:

- Difficult to obtain consensus
- Difficult to make leak-proof
- Do not affect existing arsenals
- Can hurt own economic interests

Arms Transfers:

- May conflict with humanitarian interests
- Cannot control subsequent uses

Leverage from arms embargoes/transfers depends on strength of aggressor's victim — effectiveness often requires transfer *and* embargo

Effects can be slow

***Slide 29: Comparison of Programmed Capabilities and Incremental Aggression
Challenge (cont'd)***

As for the second of the three classes of capabilities given in slide 27, arms transfers and arms embargoes suffer many of the same limitations as do economic sanctions (of which arms embargoes are a subset). In particular, arms embargoes are difficult to make leak-proof; they require a degree of international consensus that can be difficult to obtain against an incremental aggressor; they affect existing arsenals only indirectly; and they can hurt the economic interests of

the states imposing the embargo where such states are themselves arms exporters — as is the United States.⁶²

Arms transfers, on the other hand, often prolong or intensify conflict in the region receiving them, and thus may conflict with humanitarian interests. Recipients may also sell or redistribute transferred arms to third parties that the originating nation would rather not arm (as has been the case recently with the Afghan Mujaheddin). Alternatively, the initial recipient may be defeated by the aggressor in spite of the transfer, in which case the transferred arms may ultimately strengthen the aggressor (as with U.S. arms transferred to South Vietnam in the 1960s and early 1970s) — or the initial recipient may itself change political orientation and come to threaten the originating nation (as with Iran in the late 1970s).

For either transfers or embargoes, the coercive leverage obtained depends on the strength of the aggressor's victim. Where the victim is very weak to begin with, real leverage may well require combining *both* the transfer of arms to the victim, and the embargo of arms to the aggressor. And finally, like economic sanctions, the effects of transfers and embargoes often can be slow. Not only do embargoes, like other trade restrictions, take time to affect the target state's real capabilities, but also transfers are often ineffective without significant training in the use of the transferred weapons, and at least some field experience in their use.

62 Arms embargoes can indirectly affect existing arsenals by cutting off the supply of spare parts and supporting equipment to the arsenal's owners. Over time, the effectiveness of existing weapons can thus be reduced as servicing requirements gradually exhaust existing inventories of parts and the weapons themselves become inoperable. The arms embargo against Iran in the late 1970s and 1980s, for example, reduced the (sizable) Iranian Air Force to near uselessness in only a few years by denying them resupply of American-made spares: see, e.g., Anthony Cordesman and Abraham R. Wagner, *The Lessons of Modern War, Volume II: The Iran-Iraq War* (Boulder: Westview Press, 1990).

ARE PROGRAMMED CAPABILITIES ADEQUATE TO COERCE INCREMENTAL AGGRESSOR'S LEADERSHIP? (concluded)

Leadership Targeting: kill key personnel

- Uncertain legality/ethics
- Limited capability — targeting individuals too difficult
- Uncertain efficacy — will successor regime be an improvement?

Slide 30: Comparison of Programmed Capabilities and Incremental Aggression Challenge (concluded)

Finally, leadership targeting faces three difficulties — at least one of which is crucial. First, the United States is prohibited by executive order from assassinating foreign leaders. By the same token, however, the military chain of command is a legitimate target, and the political leadership of many (especially authoritarian) states is an important part of the military chain of command; perhaps the most that can be said authoritatively is that the legality and the ethics of leadership targeting is uncertain.

Second, and most important, our capability to target individuals for attack is very limited. As we have seen with Noriega in Panama and Aideed in Somalia, locating non-cooperative individuals can be extremely difficult. Whatever the legality or ethics of leadership targeting, the technical difficulties of target acquisition constitute a binding constraint on current capability.

Finally, were we to develop an effective means of targeting individuals, and were issues of legality to be resolved, the efficacy of leadership targeting in bringing about the desired changes in state behavior would still be unclear. The real political power structure in many potential target states is highly complex, and substantially opaque to outside analysis. The chain of succession is thus difficult to predict (many Soviet specialists, for example, were surprised by Andropov's replacement of Brezhnev — and we had invested far greater efforts in understanding Soviet leadership politics than we have in any of the states we currently confront). And even if we could predict the identity of the nominal successor, it would be difficult to know whether the nominal successor represents the real nexus of decision making authority in the state. Especially if the United States had killed a predecessor, leadership elites would have a strong incentive to conceal

real authority behind a figurehead structure, or through some form of collective rule. Inasmuch as it is difficult to anticipate the nature of the real succession of decision making power, it is inherently difficult to ensure that the successor regime would change state behavior in the desired way.⁶³

Overall, then, our current capacity to coerce an incremental aggressor's political leadership is limited. Under the right circumstances — and especially where the stakes are modest for the aggressor, or the victim of aggression is a near match for the aggressor militarily — economic sanctions or arms transfers and embargoes can be effective. Alternatively, either or both can be useful adjuncts to other policy initiatives.⁶⁴ As principle means of reversing the effects of incremental aggression, however, neither economic sanctions, arms transfers and embargoes, nor leadership targeting today offers an adequate solution.

CRITICAL MILITARY MISSION AREA

To Coerce Leadership: leverage focused on leadership elite — not public at large

- Ethics
- Efficacy:
 - Authoritarian dictatorships are likeliest incremental aggressors
 - Personal interests of junta drive state behavior
 - To change state behavior, must alter personal decision calculus of small leadership group; punishing population affects this only indirectly

Slide 31: Critical Military Mission Area for Coercing Incremental Aggressor's Leadership

63 For a more detailed analysis of the succession problem in leadership targeting, see Robert Pape, "Airpower Use and Effectiveness," presentation to the MIT Conference on the Policy Implications of Non-Lethal Warfare Technologies, June 2-3 1993, Lexington, MA.

64 As in the proposed "lift and strike" policy for Bosnia; note, though, that the inherent limitations of current coercive options have posed serious problems here as well. Multilateral consensus is required, for example, but a combination of diverse international interpretations of the magnitude of Serbian provocation and humanitarian considerations associated with arms transfers have made this consensus difficult to obtain.

This analysis implies that the capacity to coerce an incremental aggressor's leadership constitutes a critical military mission area by the criteria given above. That is, it is a military task needed to respond to the particular nature of the threat environment posed by incremental aggression (especially, the need for a range of less-massive response options given the difficulties of motivating massive intervention against an ambiguous provocation), but for which projected forces provide limited capability.

More specifically, the analysis suggests that the task of providing coercive leverage should be focused narrowly on the target state's leadership elite, and not on its public at large. In part, this is for reasons of ethics and consistency with U.S. humanitarian interests — it would clearly be preferable to avoid punishing innocent civilians for the actions of their (mostly unelected) leaders.

But this conclusion is also for reasons of efficacy. The likeliest incremental aggressors are authoritarian dictatorships. In states of this type, however, it is typically the personal interests of a small leadership group — not abstract conceptions of a larger national interest beyond that of the leaders themselves — that drives state behavior.⁶⁵ To change state behavior in such regimes, it is thus necessary to alter the personal decision calculus of a small group of individuals. Punishing the population at large affects this personal interest calculus only indirectly at best. And at worst, it can have the paradoxical effect of rewarding the regime for its aggression: populations subject to punishment campaigns by outside powers often come to view the regime as a protector, transferring dissatisfaction to the foreign sources of the punishment and away from the local government itself.⁶⁶ Whether for reasons of ethics or effectiveness, then, the analysis here suggests that effective coercive leverage requires a narrow focus on the personal interests of the regime itself.

65 See, e.g., Steven David, *The Impact of Mass Protest on Regime Behavior and Survival* (Alexandria, VA: Institute for Defense Analyses, 1993), IDA D-1427, pp.13-14.

66 As has been the case most recently with U.N. sanctions against Iraq. The phenomenon in general, however, is quite common historically. For a detailed study, see Pape, *Military Coercion*, op. cit.

OPTIONS FOR PROVIDING FOCUSED COERCIVE LEVERAGE

Potential sources of leverage considered:

- Life/health — Remote tracking of non-cooperative individuals an enduring problem
- Wealth — DoD mission?
- Political power:

Threaten/instigate:

- Popular insurrection
- Palace coup

Instruments:

- Control of broadcast media
- Elimination of state security system
- Technical/financial support of conspirators

Slide 32: Leadership Coercion

Moving to the fourth task in the analytical approach, slide 32 lists a set of potential sources of coercive leverage which were used as points of departure for developing options to provide the critical mission capabilities identified in slide 31. In particular, the study team considered three possibilities: the lives or health of the leaders themselves; their personal wealth; and the sources of their political power. Several of these, however, were discarded after initial investigation suggested significant flaws.

To threaten the lives or health of the leaders themselves, for example, raises important legal, ethical, and efficacy issues, as noted above. But however these are resolved, our capability to pose the threat credibly is likely to remain limited for the foreseeable future. This is because

continuous remote tracking of non-cooperative individuals, while essential for a credible capability, is a problem we are unlikely to solve in the time frame of this study.⁶⁷

Threats against the personal financial assets of leaders raise difficult legal and international commercial issues — in addition to questions of feasibility, given the capacity of individuals to conceal assets and protect financial records, the incentives of financial institutions, and the capacity of autocratic leaders to continue to extract wealth from the national economies they control subsequent to any U.S. intervention. But even if these questions could be successfully resolved, it is unlikely that any capacity to threaten financial assets would require Defense Department resources, and as such, the issue is largely outside our purview.

By contrast, to threaten the power base of authoritarian leaders involves instruments that both (a) fall within the Defense Department's area of responsibility, and (b) could become available to U.S. decision makers by 2011. As such, they lie within the scope of the study and warrant detailed analytic attention. In particular, we considered three classes of such instruments — technologies for control of broadcast media, elimination of state security systems, and the provision of technical or financial support to internal conspirators — for threatening or instigating two importantly different kinds of outcome: popular insurrection, and palace coup.

⁶⁷ Non-continuous tracking (e.g., observation at checkpoints, appearances at public functions, etc.), while more tractable, is too inconsistent to convey a credible threat. In fact, most authoritarian leaders are *already* subject, on a permanent, ongoing basis, to assassination threats based on non-continuous tracking by domestic opposition groups. Such threats are part of the political landscape in many such regimes; it is far from clear that they convey important coercive leverage in themselves.

**COERCIVE LEVERAGE vs POLITICAL POWER BASE:
LIMITED POTENTIAL, THOUGH UNCERTAINTIES REMAIN**

Coercive leverage smallest where need is greatest: high stakes confrontations with repressive authoritarian regimes

Authoritarian leaders often protected by elaborate human-organizational networks largely beyond the reach of U.S. firepower/information warfare capabilities

- "Cocoon strategy"
- Informer networks
- Loyalty/payoff networks
- Environment of fear — long-standing, well-known pattern of surveillance, political violence

Palace coup conspirators may be willing, but success rates declining, difficult for U.S. to assist

- Effective support requires access to conspirators
- Conspiracies usually small, highly secretive, wary
- Access easiest where extensive prior contact has established trust
- Contact/trust strongest with allies, weakest with hostile/renegade states

Popular uprisings rarely succeed vs violence capacity of repressive authoritarian regimes

Slide 33: Coercive Leverage vs Aggressor's Political Power Base — Limited Potential, though Uncertainties Remain

Unfortunately, our analysis suggests that potential U.S. leverage tends to be least where the need is greatest: in high stakes confrontations with repressive authoritarian regimes. As a result, although important uncertainties remain, our best assessment on the basis of available

evidence is that the prospects for improved leverage against incremental aggressors' political base are limited.

This is because modern authoritarian regimes are often protected by elaborate "soft" human and organizational means largely beyond the reach of U.S. firepower and information warfare capabilities. These methods include the adoption of "cocoon strategies," informer networks, loyalty/payoff networks, and the cultivation of an environment of fear among the general public.

"Cocoon strategies," for example, comprise a set of specific techniques for recruiting, training, and maintaining the loyalty of a small elite palace guard for protection of the autocrat and his closest advisors. These techniques were developed more or less in parallel by the Cuban, East German and Israeli intelligence services in the 1960s, who then transmitted them through much of the third world by training client regimes. Such palace guards have proven remarkably resilient to penetration or subversion, and today provide a major barrier to indigenous assassination or coup attempts.⁶⁸

Informer networks can become extraordinarily elaborate, and often reach into all sectors of society in the modern authoritarian state. In Iraq, for example, at least seven separate security agencies performed domestic surveillance duties by the late 1980s.⁶⁹ As one European diplomat put it, "there is a feeling that at least three million Iraqis are watching the eleven million others."⁷⁰ Or as another analyst concludes: "Who is an informer? In Ba'thist Iraq the answer is anybody."⁷¹ Combinations of systems of special privilege and the deliberate implication of broad segments of the military and civil government in the crimes of the regime build loyalty and encourage informal surveillance on a broad front.⁷²

Perhaps most important, however, is the deliberate cultivation of an atmosphere of fear throughout the society. Most Iraqis, for example, have lived for a generation in a culture in which it was widely assumed that informers were everywhere, that everyone was subject to surveillance from unknown quarters at any time, and in which examples of people disappearing in the middle of

68 See, e.g., Steven R. David, *Third World Coups d'Etat and International Security* (Baltimore, MD: Johns Hopkins University Press, 1987); idem., "Soviet Involvement in Third World Coups," *International Security*, Summer 1986 (Vol.11, No.1), pp.3-36.

69 Judith Miller and Laurie Mylroie, *Saddam Hussein and the Crisis in the Gulf* (New York: Random House, 1990), pp.48-50; Samir al-Khalil, *Republic of Fear: The Inside Story of Saddam's Iraq* (New York: Pantheon Books, 1989), pp.12-16, 36, 61-3; see also Phebe Marr, *The Modern History of Iraq* (Boulder: Westview Press, 1985); Efraim Karsh and Inari Rautsi, *Saddam Hussein: A Political Biography* (New York: The Free Press, 1991), pp.40-1, 178-9, 190; Marion Farouk-Sluglett and Peter Sluglett, *Iraq Since 1958: From Revolution to Dictatorship* (London: I.B. Tauris & Co., Ltd., 1987), pp.206-7.

70 *The New York Times*, 3 April 1984.

71 Samir al-Khalil, op. cit., p.61.

72 David, *Third World Coups d'Etat*, op. cit.

the night and never returning are known to many from personal experience, and to most others by reputation. The habits of thought and behavior deeply established by such methods are perhaps the most powerful control mechanism available to any autocrat. They also are extremely difficult to overcome through U.S. interference in foreign broadcasting, or through the destruction of buildings associated with foreign intelligence services.

In the face of such methods, the odds weigh strongly against success in either popular uprisings or palace coups. Even where they are attempted, popular uprisings rarely if ever succeed against the sheer capacity for violence of repressive authoritarian regimes.⁷³

Small groups of conspirators continue to be willing to attempt palace coups, but the success rates of such attempts have fallen substantially since the 1960s.⁷⁴ Perhaps more important, it is systematically very difficult for the United States to provide meaningful assistance in such attempts because effective support requires access to the conspirators. By definition, however, coup conspirators are engaged in illegal — and extremely dangerous — activity. Such conspiracies are thus typically small, highly secretive, and its people are extremely wary of outsiders. Under such conditions, access virtually demands extensive prior *personal* contact to establish a basis of trust. Prior contact and trust of this sort, however, is typically strongest with allies, and weakest with military officers of hostile or renegade states — precisely the group we most need to reach. By way of illustrating the severity of the problem, it is worth noting that at no point in the more than four decades of the cold war did either the United States or the Soviet Union ever succeed in overturning, by coup, a government in the other superpower's sphere of influence. The barriers to success in such an endeavor are strong and difficult to overcome by any of the instruments under study here.⁷⁵

73 David, *The Impact of Mass Protest on Regime Behavior and Survival*, op. cit. Where popular uprisings have succeeded, as in Eastern Europe, Iran, or the Philippines, for example, the target regime either has been a democracy or a liberalizing authoritarian regime (and in the case of the latter, especially where a regime's superpower patron, typically the United States, pressured the regime not to use force against demonstrators). For a more detailed discussion, see appendix.

74 David, *Third World Coups d'Etat*, op. cit., pp.141, 160; see also Biddle and Zirkle, op. cit.

75 David, *The Impact of Mass Protest on Regime Behavior and Survival*, op. cit.

INCREMENTAL AGGRESSION and LEADERSHIP COERCION: INDICATIONS

Current coercive leverage limited vs likeliest incremental aggressors

Some, but limited, opportunities to improve leverage

- Cultivate covert military contacts in potential opponent states
- Reduce response times for reaction to serendipitous target acquisition
- Promote liberalization of authoritarian regimes
(e.g., by breaking autocrats' information monopoly)

Drivers of coup success/failure imperfectly understood but amenable to study:
better understanding may provide additional leverage

Slide 34: Leadership Coercion — Indications

In short, then, our potential coercive leverage is limited against the kinds of repressive authoritarian regimes that are the likeliest incremental aggressors. And because this is due to structural characteristics of the control systems adopted by such regimes, and in particular their heavy exploitation of human, rather than technical, resources, our options for improvement (though non-zero) are few.

If, for example, we could develop relationships of trust with potential coup plotters in hostile states, we would then have a better chance of assisting such efforts when they occur. To do this would require that we cultivate covert military contacts in relevant states well in advance.

Alternatively, although continuous tracking of non-cooperative individuals is an enduring problem, non-continuous tracking is possible. Exploiting irregularly available targeting information, however, would require that we radically reduce potential response times — either through planned anticipation of such information or through an improved technical capacity for rapid response to serendipitous target acquisition.

And of course, if it is primarily repressive authoritarian regimes that pose the threat of incremental aggression, then by promoting the long-term liberalization of authoritarian governments we could eventually reduce somewhat the magnitude of the problem. Means by which to pursue this goal are in fact available, such as technologies for breaking a regime's domestic information monopoly. None, however, can be effective quickly; although such methods fall largely outside the scope of this study, they are nevertheless worthy of investigation.

Finally, it should be pointed out that the theory of coup success and failure upon which these conclusions rest, while not inconsequential, is nevertheless imperfectly understood. It is, however, amenable to study given appropriate analytical attention. While the current state of knowledge on the subject suggests few opportunities for improved leverage, it is possible that an improved understanding may uncover more productive possibilities. Given the importance of the subject for responding to a national security challenge of growing significance, the development of such an improved understanding is perhaps the most promising option available for improving coercive leverage in the long run.

OUTLINE

- I. Analytical Approach
- II. Illustrations
 - A. Identification of Critical Long-Term Security Challenges
 - B. Analyses of Capability Shortcomings and Options for Response:
 - 1. Incremental Aggression and Discriminate Military Capability
 - 2. Incremental Aggression and Coercion of Hostile Leadership
 - ⇒ 3. **WMD Proliferation and Counteroffensive Action against Proliferation Sites**
- III. Conclusions and Implications

Slide 35

The final case study involves the challenge of weapons of mass destruction (WMD) proliferation and the critical mission area of counteroffensive action against proliferation targets.

ACQUISITION OF WMD

End of cold war increases importance for defense planning — no longer eclipsed by Soviet threat

Threatens U.S. forces, U.S. allies, regional stability

Provides renegade states with means of countering post cold war U.S. conventional superiority

By 2011, highly likely that renegades will acquire WMD unless stopped

Slide 36: Acquisition of WMD as a Critical Long-Term Security Challenge

Beginning with the first step in the analytical approach, why is acquisition of WMD a critical long-term challenge as defined here? Although we have addressed this question briefly in the general survey given in slide 9 above, it may be useful to review the issue of WMD acquisition in particular before moving on to the remainder of the case study. Recall that the three criteria adopted here to define such challenges are that they (1) pose problems significantly different from those addressed by cold war planning; (2) involve important U.S. interests; and (3) could plausibly be present in 2011.

As for the first, while WMD proliferation is hardly a new problem, it is one whose context and salience have changed dramatically with the end of the cold war. During the cold war, the Soviet threat tended to overshadow proliferation as an issue for defense planning. But with the end of the cold war, WMD proliferation has emerged as a central issue for national security policy generally, and for planning in particular.

As for the second criterion, WMD proliferation potentially threatens a wide range of U.S. national security interests, including the security of important allies; the stability of regions, like the Mideast, with vital economic consequences for the United States; the safety of U.S. forces overseas; and even the lives and property of U.S. citizens on American soil (especially in the form of terrorist or subnational acquisition of WMD).

With respect to the threat to U.S. forces in particular, acquisition of WMD, like incremental aggression, offers a means by which hostile states could pursue aggressive ambitions in the face of superior U.S. conventional military power. For many potential aggressors, the futility of taking on the United States where it is strongest — i.e., conventional mechanized warfare — was demonstrated vividly by the Iraqi defeat in Operation Desert Storm. Few potential opponents seem to have responded to that event by trying to compete with the United States in conventional mechanized capability.⁷⁶ Rather, most seem to have concluded that ways must be found to *avoid* U.S. strengths — and for those who can afford them, weapons of mass destruction offer one of the most potentially powerful. In fact, one of the most widespread lessons of Desert Storm in the non-Western world has been, as a retired Indian Army Chief of Staff put it, "Don't fight the Americans without nuclear weapons."⁷⁷

As for the third criterion, there are, of course, many uncertainties surrounding the proliferation issue. We cannot be certain exactly how many states have acquired a usable WMD capability today, or how rapidly any given state is progressing toward such a capability. But one thing that *can* be known with certainty is that in the long-term, many such states will acquire WMD unless something is done about it in the meantime. Certainly by 2011, these weapons *will* reach the hands of potential aggressors unless this is prevented by deliberate policy intervention on the part of the outside world — and especially by the United States.

WMD proliferation, like incremental aggression, is thus a critical long-term security challenge by the criteria given in slide 5: it was not a primary focus of cold war defense planning; it threatens important U.S. interests; and it is likely to be present within the nominal long-term time horizon of 2011.

⁷⁶ Garrity, *op. cit.*, p.xvii. Of course, this is not to say that they will not continue to modernize their mechanized forces (albeit gradually and selectively), or even that they will not choose to accelerate that modernization at some point in the future (especially if the United States allows its conventional mechanized capabilities to atrophy). In the meantime, however, the general perception of U.S. superiority in mechanized warfare creates incentives for hostile states (i.e., to avoid mechanized warfare with the U.S.) that are of considerable importance to U.S. long-range planners.

⁷⁷ Or, alternatively, that "if a state has nuclear weapons, it may not need to fight the Americans." *Ibid.*, p.xiv. Of course, states have many motivations for pursuing WMD that do not necessarily involve the use of such weapons against the United States, including the perceived prestige value of WMD, or deterrence of neighboring states with similar capabilities. Nevertheless, the most important issue for U.S. defense planning is the possibility that such weapons could be used against us, or in support of other aggressive actions contrary to our security interests.

PROJECTED CAPABILITIES TO RESPOND TO ATTEMPTED ACQUISITION OF WMD

Denial/interdiction

Defend forces from effects

Eliminate hostile capability: counteroffensive action

Will focus here on counteroffensive action

Slide 37: Projected Capabilities to Respond to Attempted Acquisition of WMD

Moving to the second task in the analytical approach described above — projection of programmed capabilities for responding to critical challenges — slide 37 lists some broad alternative capabilities for dealing with WMD proliferation. We have long attempted, for example, to prevent hostile states from obtaining WMD in the first place by denying them access to essential equipment, materials and expertise through export controls, international monitoring and inspections, trade sanctions, and active tracking and interdiction of shipments. Alternatively, we can improve the ability of our forces to operate in a WMD environment by, for example, providing protective equipment, decontamination and monitoring systems; hardening existing materiel; or modifying doctrine, procedures or force dispositions to reduce vulnerability to attack. Or we could attempt to eliminate a hostile state's WMD (or capacity to develop or use WMD) by direct attack. Of course, these are not mutually exclusive — we have, and will continue to, pursue all three. But although all are important, we will focus here on the third — direct counteroffensive action against an opponent's WMD capabilities.

COUNTEROFFENSIVE ACTION

Timing

- **Peacetime**
- **Wartime**

Targets

- **Research/production/storage facilities**
- **Launch/delivery systems**
- **Support/C³ infrastructure**
- **Subnational/terrorist groups as well as national assets**

Purposes

- **Prevention**
- **Preemption**
- **Proof**
- **Delay**

Important differences between types of WMD

Will focus here on peacetime operations against research/production/storage facilities

Slide 38: Counteroffensive Action

Counteroffensive action against WMD capabilities could take many forms. Action could be taken in peacetime or as one element of a larger military campaign in time of war. Potential targets include WMD research, production, or storage facilities; weapon launch or delivery platforms; or essential logistical or C3 support infrastructure. These targets may be national assets of a hostile state, or they could be holdings of subnational groups such as terrorist organizations, renegade military factions, or even disaffected ethnic groups. Potential purposes of such action include prevention (destroying WMD capabilities before they become an immediate threat), preemption

(destroying WMD that pose a threat of imminent use), proof (conducting military operations to provide evidence of proliferation activity), delay (slowing, rather than halting, WMD acquisition), or, most likely, some combination of these.

Moreover, there are important differences between types of WMD. Biological weapons, for example, can be produced in quantity very quickly, given appropriate seed stocks and equipment, and thus need not be extensively stockpiled to represent a threat; nuclear weapons are much harder to produce on short notice. Chemical or nuclear weapons require extensive, fixed production facilities; biological agents can be produced in large factories or small, mobile laboratories.

A complete investigation of such a large set of issues would be beyond the scope of this initial effort; for illustrative purposes, we limit our consideration to a subset involving peacetime operations against research/production/storage facilities.⁷⁸ Where appropriate, we will note at least some of the more important differences between the respective types of WMD, and we will draw some eventual implications for the relative merits of the differing purposes for such strikes, but we will not attempt to be comprehensive or to devote equal analytical effort across all possible purposes or all possible WMD agent types. Again, our primary purpose is to illustrate the analytical approach described above, rather than to provide a definitive analysis of WMD counteroffensive options.

⁷⁸ In effect, this subset corresponds to the "Osiraq model," or the response adopted by the Israelis in 1981 when they attacked the Iraqi nuclear reactor then nearing completion at Osiraq. Note, however, that this does not imply that this subset is either the most, or the least, effective of the available alternatives for dealing with WMD proliferation; it was selected for illustrative purposes rather than to provide definitive policy or programmatic guidance in itself.

**PROJECTED CAPABILITIES
FOR STRIKING WMD RESEARCH/PRODUCTION/STORAGE FACILITIES**

Air/Missile Strikes

Special Operations Forces (SOF)

Large Scale Airborne/Airmobile/Marine Raid

Slide 39: Projected Capabilities for Striking WMD Research/Production/Storage Facilities

Programmed capabilities for striking this target set fall into three broad categories: air and missile strikes; special operations forces (SOF); and large-scale airborne, airmobile, or Marine amphibious raids.

WMD RESEARCH/PRODUCTION/STORAGE TARGETS: UNIQUE DIFFICULTIES

Facilities often large, dispersed, heavily defended, sometimes hardened — esp. underground

Ambiguity of activity

- Difficult to ensure that all essential facilities have been located
- Difficult to locate key activities within any given facility
- Difficult to prove wrongdoing

Toxic hazard

- Poor local safety standards
- Combat risks NBC release: major potential collateral damage

Slide 40: WMD Proliferation Targets — Unique Difficulties

Moving to the third task in the analytical approach described above, comparison of projected capabilities and long-term challenges, WMD research/production/storage facilities pose a number of special difficulties for all three classes of projected capabilities. National WMD research, production and storage facilities, for example, are often large, can be widely dispersed, and/or heavily defended.⁷⁹ As an example from our own experience, Pine Bluff Arsenal (where the United States conducted its offensive biological warfare research prior to 1970) contains 33 separate buildings spread over 450 acres, with a total of some 1.7 million square feet of floor space. Rarely does a single installation contain the entirety of a national proliferation effort. The Iraqi biological weapons complex as a whole comprised at least four separate facilities; while their chemical and nuclear weapons efforts were spread over considerably larger numbers of sites — most of which constitute sizable installations in themselves. Since such efforts usually constitute a top national priority, they typically receive unusual defensive attention. Especially since the Israeli raid on Iraq's Osiraq reactor in 1981, potential proliferators have been alert to the prospect of direct

⁷⁹ Although subnational groups may pose substantially smaller, more concentrated (and less numerous) targets; and depending on the group's access to weaponry, the defenses available for protecting any assets they may possess could be substantially less imposing.

attack, and many have taken considerable pains to protect their resources.⁸⁰ And where such facilities are located underground, they pose especially difficult targets — either to find or to destroy.

Proliferation activities also are typically ambiguous in nature. In many cases the activity itself is in violation of international treaty obligations,⁸¹ and even where it is not illegal, most proliferators take extreme precautions to maintain secrecy. As a result, it is typically very difficult to obtain reliable intelligence on the nature of the activity in any given state. As we discovered following Desert Storm, it is possible for determined proliferators to conceal a great deal of WMD development activity. In spite of an extraordinarily intensive U.S. intelligence effort, significant fractions of the Iraqi proliferation complex went wholly undetected until after the war — fully half of Iraq's biological warfare facilities, for example, went unlocated until their existence was revealed by postwar documentary examination.

Even where a facility has been identified as WMD-associated, it is extremely difficult to determine the location of key activities within the structure. Satellite photography, of course, can show the roofs of buildings, but it cannot reveal their contents. Human intelligence (HUMINT) is usually necessary to provide information on interior activities; HUMINT, however, can rarely be obtained on a consistent, comprehensive basis. Where the buildings are large and (as is often the case) used for multiple purposes, this can leave tremendous uncertainty as to the actual locus of proliferation activity.

Similarly, it can be very difficult to prove that a given state is actually developing WMD. Yet without unambiguous evidence, it can be difficult to justify the violation of national sovereignty involved in peacetime counteroffensive action. More generally, many forms of counter-proliferation activity (e.g., trade sanctions or export restrictions) require that a multilateral coalition be induced to take painful actions against reputed proliferators. To accomplish this without strong evidence of wrongdoing by the target state can be problematic.

WMD sites also pose serious toxic hazards — both to the environment and potentially to the attackers themselves. WMD facilities in third world states do not necessarily meet the safety standards required of similar installations in the West. Many such labs are thus dangerous environments in themselves (especially for special operations teams, for example, who may not be

⁸⁰ For a more detailed description of defenses associated with current proliferation sites, see appendix.

⁸¹ Although much of the effort needed to support an illegal WMD program may itself be legal, either because it is indistinguishable from peaceful civilian activities (e.g., power generation or biomedical research), or because it is indistinguishable from legal defensive military activities (e.g., development of protective equipment). In many cases, the fraction of an overall proliferation program that is demonstrably illegal may be quite small (though no more legal for its restricted scale).

familiar with the layout or design of the facility and its equipment). And combat action in and around such sites multiplies hazard levels enormously for any friendly personnel required to enter the structure, in addition to creating an inherent risk of large scale toxic agent release into the atmosphere. Especially where such facilities are located in or near major urban areas, this in turn implies a major risk of civilian fatalities in such operations.

**ARE PROJECTED CAPABILITIES ADEQUATE:
AIR/MISSILE STRIKES**

Target acquisition — difficult to locate key components for attack

Collateral damage — downwind threat from NBC release

Kill mechanism — can destroy structures but not critical NBC material

Cannot provide proof of wrongdoing

Slide 41: Are Projected Capabilities Adequate: Air and Missile Strikes

As for specific capabilities, air and standoff missile strikes would in many ways be the preferred solution, given an effective capability.⁸² Currently programmed air and missile systems, however, have serious limitations against such targets.

For example, WMD research, production and storage facilities pose difficult target acquisition problems. In particular, it is difficult to be sure that all the necessary structures have been located for attack, given the inherent ambiguities of WMD proliferation activity. In addition, the critical equipment or materials that may constitute the actual objective of the attack are often small and difficult to locate within any given structure, making the achievement of high damage probabilities with modest collateral damage constraints more difficult.

⁸² Air strikes, for example, expose only limited numbers of U.S. personnel to hostile fire -- and missile strikes (for example, by long-range cruise missiles), can expose none at all. Air strikes pose no risk of becoming bogged down on the ground, and exploit U.S. advantages in defense suppression, precision munition delivery, and high technology warfare generally.

Air attack also poses an inherently high risk of agent release into the atmosphere. While it is not inconceivable that improved munitions could limit this to some degree, programmed capabilities involve a substantial danger of large-scale civilian fatalities for WMD targets located near populated areas.

Kill mechanisms also are problematic. In particular, programmed air-delivered munitions offer inadequate lethality against biological and chemical agent stocks, while nuclear materials are effectively indestructible.⁸³ While air attack could, for example, destroy centrifuges, computers, isotope separators or other support or production infrastructure, this does not provide the ability to destroy an existing WMD stockpile (or an existing stock of NBC raw materials). Without an ability to destroy the agents themselves, the most that can be achieved is to cap the inventory of any proliferator that had actually obtained materials, and/or delay access to those materials by damaging their storage systems, creating a reprocessing problem, or scattering mines or other obstructions.⁸⁴

Finally, air attacks cannot readily provide evidence to prove the claim that the target was indeed involved in proliferation activity. While attacks that release large quantities of toxic agents into the atmosphere could enable remote monitors to detect the airborne material, this is not *prima facie* evidence of proliferation (airborne release of nuclear material, for example, could be caused by air attack on a civilian power reactor as well as a proliferation site). Moreover, large-scale agent release poses generally unacceptable collateral damage risks; to rely on this to provide evidence of wrongdoing is to create an inherent conflict with U.S. humanitarian objectives.

83 For a more detailed discussion of current agent defeat capabilities, see appendix.

84 Note also that even a capacity to kill existing agent stocks would not necessarily be sufficient to deny an opponent an effective biological warfare capability, given the ease with which additional agent can be produced given seed stock and appropriate equipment. But while an ability to kill BW agents is thus not sufficient, it is necessary. If we are ultimately to disarm a proliferator, we would need to destroy both production capability *and* any existing stockpiles. While it is unclear whether either is fully achievable for BW, both are nevertheless necessary preconditions for such an outcome.

ARE PROJECTED CAPABILITIES ADEQUATE: SOF

Current direct action capability oriented to small team operations; limited firepower, operational mobility

Existing capabilities best suited to subnational group targets, providing intell/targeting vs launch/delivery platforms

National research/production/storage targets pose serious problems:

- Facilities are large, information on contents inherently limited — to find materials/evidence, SOF teams must search large areas
- Facilities are potentially hazardous — poor safety standards, combat effects on structures, possibility of deliberate booby traps
- Facilities are well defended — especially reaction forces outside perimeter
- NBC materials may be small, carefully hidden, difficult to identify, extremely hazardous to move/handle
- Implies that SOF would require:
 - Long time on target/very large team size
 - Protection from reaction forces
 - High technical skills

Slide 42: Are Projected Capabilities Adequate: Special Operations against WMD Research/Production/Storage Sites

Alternatively, special operations forces could conduct direct action missions against WMD targets. A variety of SOF options are available for such missions, but current and programmed capabilities are oriented primarily toward small team operations.⁸⁵ Such teams ordinarily emphasize stealth and surprise rather than firepower or operational mobility. As such, they are

⁸⁵ Current U.S. Special Operations Forces are organized to operate at levels ranging from two man teams (e.g. for clandestine sabotage missions) up to reinforced companies (e.g. for raid or ambush missions): Headquarters, Department of the Army, *FM 31-20, Doctrine for Special Forces Operations* (Washington, D.C: USGPO, 20 April 1990), p.11-2.

well suited, for example, for conducting strategic reconnaissance against WMD targets or for direct action operations against subnational groups (which tend to present smaller, less dispersed and less heavily defended targets).⁸⁶

National research, production, and storage targets, however, pose serious problems for programmed SOF capabilities. Because the facilities are large and information on their contents is inherently limited, SOF teams must be prepared to search large areas in order to locate WMD materials or provide unambiguous evidence of proliferation activity. Moreover, the materials they would be searching for will often be present in only small quantities and will generally be carefully hidden, difficult to identify, and extremely hazardous to move or to handle. More generally, the potentially hazardous nature of the facilities themselves (both to the SOF team and to surrounding civilians) requires the team to perform careful monitoring, safety and, if necessary, decontamination duties while on the target. And because the facilities are often well-defended, especially by reaction forces outside the site perimeter, the teams must be capable of fighting their way into the facility, and if necessary, blocking the arrival of reaction forces from outside.

These target characteristics imply a number of key requirements for an effective SOF direct action capability. First, the SOF team would have to spend an extended time inside the facility and/or place a large number of people inside the facility in order to complete the necessary search, survey and safety requirements. Second, significant defensive effort would be required to hold reaction forces off long enough to complete the activities inside the facility. Finally, the nature of the tasks and the materials involved implies a requirement for very high levels of specialized technical skills in the individuals comprising the team.

⁸⁶ Alternatively, providing intelligence and targeting support is a traditional SOF mission that could assist in target acquisition for air or missile attack of WMD launch or delivery systems. Note, however, that large operating areas and mobile targets pose serious problems for low-mobility SOF teams, as was the case, for example, in counter-Scud operations in the Gulf War. Effectiveness in such a role also requires an otherwise effective air option, which is not the case today.

ARE PROJECTED CAPABILITIES ADEQUATE: SOF (continued)

Relevant examples: UN/NTI inspections

- Involved national WMD sites
- Used all available intel to facilitate search
- Mission was to locate/verify/destroy proliferation activity

UN experience in Iraq

- Salman Pak BW site: 28 people, 5 days
- Samarra CW site: 25 people, 5 days
- Al Tuwaitha nuclear site: 34 people, 5 days
- UN did not provide security forces
- Iraqis were responsible for destruction, other support activities

NTI, Redstone Arsenal

- 10 people, 3 days
- Partial inspection only, no support personnel

Specialist skills required

- Nuclear physicists/engineers/weapon designers/detection/decontamination experts
- Chemists, chem. engineers, chem. detection/decontamination experts, conventional munition experts
- Microbiologists, bacteriologists, aerobiology specialists, fermentation specialists, toxicologists, virologists, decontamination experts
- Structural engineers, explosive ordnance disposal teams, translators, photographers

Implication: task is ill-suited to small teams with limited firepower, mobility, specialist technical skills

Slide 43: Are Projected Capabilities Adequate: SOF (concluded)

Can such an extensive set of requirements be met by a small SOF direct action team? It is difficult to know, of course, without planning and rehearsing an actual mission against an actual site to develop detailed requirements, but some general insight can be acquired by considering several close analogies.

In particular, the UN inspections of Iraqi WMD sites following Desert Storm and the U.S. National Trial Inspections (NTI) in support of the Chemical Weapons Convention were similar undertakings to that of a counter-WMD SOF direct action mission in important respects. All, for example, involved national WMD research, production and storage facilities of precisely the type an SOF team could be required to attack in the future. The inspection teams (in particular the UN effort) used all available intelligence information on the targeted sites to facilitate the search. And in each case the purpose of the inspections was to locate, document and (for the UN) destroy any proliferation activities in facilities where such activities were assumed to have been undertaken in secret prior to the inspection. While there also are some important differences between these efforts and an SOF mission (e.g., less demanding time limits, the availability of host nation support for the inspection teams, and the absence of hostile fire), nevertheless the resemblance is close enough to allow some important observations to be made.⁸⁷

The chief observation to emerge from this experience is that large numbers of highly trained specialists are required to conduct such searches safely — and especially if they must be completed quickly. The UN inspection of the Iraqi Salman Pak BW facility, for example, took 28 people five days to complete; their inspection of the Iraqi Samarra CW facility took 25 people five days; and to inspect the Al Tuwaitha nuclear site required 34 people and five days. Of course, none of these totals includes security forces (since the Iraqis were not firing at the inspectors during the search), and the actual destruction of WMD materials as well as a variety of support functions were performed by the Iraqis (and thus are not represented in the manpower totals above). Similarly, in the Redstone Arsenal National Trial Inspection for the CWC, no support or security functions were provided by the inspection team, and the inspection itself was a partial one carried out by statistical sampling methods. The job still took ten people fully three days to complete.

Moreover, the specialist skills required of the inspection team members were very extensive in nature. The teams included (depending on the nature of the facility): nuclear physicists; nuclear

⁸⁷ Note also that many of the differences have the effect of making the UN/NTI inspections easier to complete successfully than an analogous SOF mission would be. Thus it is probably reasonable to regard the UN/NTI experience as a lower bound on the level of effort required to conduct such an inspection successfully. With site guards firing on the inspection team, an outside reaction force bearing down on the facility, and the need to bring all necessary support elements along with the team, an SOF mission would in many ways face a substantially more difficult job -- and thus could well require greater resources to complete it successfully than did the UN or NTI task forces.

engineers; nuclear weapon designers, detection and decontamination experts; chemists; chemical engineers; chemical detection and decontamination experts; conventional munition experts; microbiologists; bacteriologists; aerobiology specialists; fermentation specialists; toxicologists; virologists; structural engineers; explosive ordnance disposal teams; translators and photographers. Few of these represent skills readily available in current special forces organizations.

Overall, then, the available experience of analogous searches suggests that such a task could pose serious difficulties for a small SOF team — even without considering the problems of defense against reaction forces, penetration of site defenses, or associated support and logistical requirements. Current SOF WMD direct action capabilities are thus best regarded as responses to subnational proliferation, rather than as sufficient responses to the larger problem of national WMD programs.

**ARE PROJECTED CAPABILITIES ADEQUATE:
LARGE SCALE AIRBORNE/AIRMOBILE/MARINE RAID**

Marines limited by distance from sea

Airmobile limited by distance from bases

Airborne could reach targets, deploy large forces — but cannot extract in time

Slide 44: Are Projected Capabilities Adequate: Airborne, Airmobile or Marine Amphibious Raids

Finally, WMD counteroffensive action could be conducted by large-scale raids using airborne, airmobile, or Marine amphibious forces. Such forces each would be capable of deploying large forces with substantial combat capability against WMD facilities and associated defenses. None, however, possesses the range of technical skills required to carry out the necessary search tasks. More important, each has substantial mobility constraints associated either with reaching, or returning, from facilities located at such great distances from U.S. bases.

Marine units, for example, are limited by helicopter ranges and logistical requirements to operations near seacoasts; WMD sites located far inland would be well beyond their effective operating range. Army airmobile forces are limited by the operating constraints of their helicopters to an effective range of no more than about 100 miles from a significant repair and resupply base. WMD sites located more than 100 miles from a secure base would require a multi-stage operation. Finally, Army airborne units can be airdropped onto any target at any range. Airborne units, however, cannot readily be extracted by air from drop zones located away from substantial runways, nor do they have sufficient mobility once on the ground to transport themselves from a distant WMD site to a suitable airport. Airborne units can thus reach the target, but cannot safely be withdrawn after the mission. None thus offers a suitable capability.

CRITICAL MILITARY MISSION AREA

Capacity to:

- Develop targeting information on large, ambiguous facilities
- Destroy production capability and existing stockpiles
- Contain collateral damage
- Reach inland/distant targets safely
- Provide evidence of wrongdoing

Slide 45: Critical Military Mission Area

This analysis implies that the military capabilities listed in slide 45 describe a critical military mission area — that is, they constitute a set of military capabilities needed to cope with the demands of counteroffensive action against WMD research/production/storage facilities, but for which currently programmed forces are ill-suited.

In particular, the most important shortcomings of programmed capabilities for this role involve targeting information, weapon lethality, collateral damage, range and geographical limitations (e.g., the Marine Corps or the 101st Airborne), and the ability to provide evidence of wrongdoing.

POTENTIAL OPTIONS

Improved air strike capability

- **Effective kill mechanisms, collateral damage limitation may be possible for at least some WMD materials — further research required**
- **Air strikes ill-suited for evidence development**

Improved ground capability — requires capacity to:

- **Neutralize WMD agents**
- **Search large facilities**
- **Hold off significant reaction forces**
- **Withdraw safely**

Slide 46: Potential Options

Moving to the fourth step in the analytical approach described above, slide 46 lists potential avenues for providing the critical military mission capabilities listed above: improved air or missile strikes, and an improved capacity to conduct ground forces raids or direct action missions.

As for air strikes, there is some reason to believe that, with the necessary research effort, more effective kill mechanisms and collateral damage limitation techniques could be developed.⁸⁸ Such research could provide a major improvement in our ability to destroy subnational WMD targets, or (in conjunction with ongoing improvements in target acquisition and responsiveness) to strike WMD launch or delivery systems.

Air strikes, however, have structural limitations against national WMD research, production or storage targets. They cannot develop their own information on materials location or

⁸⁸ For a more detailed review, see appendix.

interior activities (and it cannot be assumed that national intelligence assets will be able to fill this gap).⁸⁹ And they cannot in themselves provide unambiguous evidence of wrongdoing.

To improve ground capability, by contrast, involves fewer inherent constraints on information or evidence gathering. To provide an effective option against national research, production or storage targets, however, will require a number of key developments. As with air strikes, an improved ground capability would require an effective means of neutralizing WMD weapons materials without causing collateral damage. In addition, ground forces would require an ability to search large facilities, to hold off significant hostile reaction forces while doing so, and to withdraw safely upon completion of the mission.

Given this, we will focus for the remainder of the case study on a more detailed examination of some of the key issues associated with providing a more effective ground capability against large WMD facilities. In doing so, we will first sketch out a set of requirements that would have to be met were a relatively near term capability to be provided — that is, without assuming the completion of any major long-term technology development efforts. We will then conclude by considering possible directions for research into technologies that could reduce the (major) difficulties associated with those near term requirements.

We will begin by considering requirements for search, security and blocking forces in the comparatively near term, that is, in the absence of substantial advances in search or fire support technologies.

⁸⁹ While intelligence limitations underlie many of the shortcomings in current U.S. capabilities, many of these limitations are inherent in the nature of the target. It is extremely unlikely that even aggressive efforts to improve U.S. intelligence on WMD proliferators will ever provide the kind of detailed information required to find small, carefully hidden quantities of WMD materials in toto -- or to specify the interior floor plans and functional roles of the literally hundreds of buildings that can be associated with a national proliferation effort. Only HUMINT is likely to provide such information for any given site, and it is highly unlikely that HUMINT sources will ever provide the volume or consistency of information required to underpin a significant, broadly applicable capability. Of course, this is not to say that intelligence improvements would not be helpful or should not be pursued. Rather, it is to argue that they are unlikely ever to be sufficient in themselves for this purpose, and that substantial improvements in capability will thus require other initiatives -- possibly including, for example, the use of SOF or other penetrating ground forces to develop local information in the course of a given mission.

FORCE REQUIREMENTS FOR SEARCH, SECURITY/BLOCKING FORCES

Search

- Facilities vary widely — implies widely varying requirements
- Need for high-speed execution
- Technical complexity of task implies specialist personnel
- UN/NTI experience: 30–170 man-days per facility; no support, agent destruction provided
- Nominal 100-man specialist team for illustrative purposes

Security/Blocking Forces

- Airpower/indirect fire preferable to direct fire ground forces
- Terrain, proximity of reaction forces to target can limit air/ indirect fire effectiveness
- Janus analyses suggest light battalion with heavy fire support on ca. 15 kilometer frontage can resist ca. brigade-strength reaction force with light U.S. casualties

Slide 47: Force Requirements for Search, Security/Blocking Forces

Requirements for search forces will necessarily vary significantly with the varying size and nature of WMD facilities in potential target states. Some characteristics of general relevance, however, include the need for high-speed execution of the search, and the technical nature of the task. The longer the duration of the mission, for example, the more complex the logistical requirements and the more difficult the task of defending the searchers from hostile reaction forces. As for the search team itself, the UN/NTI experience ranged from a total of about 30 to as many as 170 man-days of search activity per site, most of which was performed by highly skilled technical specialists, and none of which includes necessary support or agent destruction activities. Of course, a detailed analysis of (and ideally, mission rehearsal against) an actual target would be required to establish the necessary search team size — and the requirements for any two targets are likely to be different. For illustrative purposes, however, a crude ballpark figure might easily run

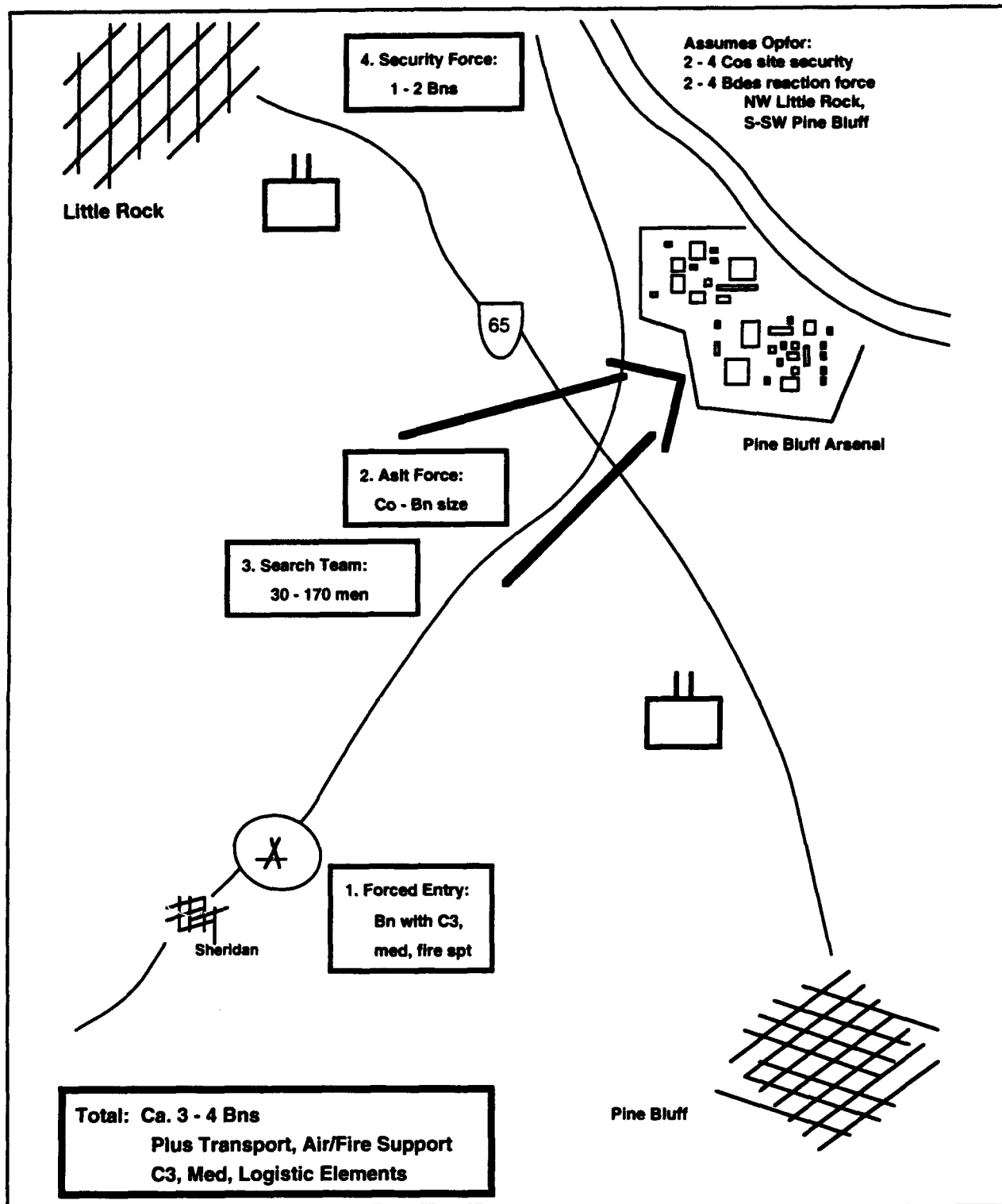
as high as 100 or more specialists, and additional personnel could be required for support, local security, or agent destruction.

Requirements for security and blocking forces likewise depend heavily on scenario conditions, but again some general considerations apply. Of the two functions, blocking forces are likely to demand larger resources than local security within the facility. For the former, air-, missile-, or artillery-delivered firepower are clearly preferable to direct fire weapons on the ground, since air or indirect fire platforms involve smaller casualty exposures and are easier to extract following mission completion. Air or indirect fire effectiveness, however, can be limited by terrain, or by close proximity of reaction forces to the target facility. A reaction force located only a few miles from the WMD site and able to move along wide, high-speed, high trafficability approach routes, for example, would be very difficult to bring to a halt in time using air-delivered fires alone. To keep such a force away from the target site long enough to complete the search could thus require a combination of air, artillery, and direct fire ground forces to hold key terrain astride primary approach routes to the target.⁹⁰

To provide some insight on the requirements for ground elements of a blocking force, a series of simulation runs were conducted using the IDA Janus facility.⁹¹ The results of these analyses suggest that a modernized U.S. light battalion deployed on a roughly 15 kilometer frontage and heavily reinforced with anti-tank guided missiles and NLOS indirect fire support might be expected to halt as much as a brigade-size armored reaction force while suffering only light U.S. casualties. Of course, to the extent that airpower could weaken the reaction force prior to engagement by U.S. ground forces, this requirement could be reduced accordingly — the Janus analyses assumed that the force to be engaged represented a fresh formation that had undergone only modest air attack prior to its arrival at the blocking position. Note, however, the synergistic effects produced by a combination of ground and air forces in this role: by delaying the reaction force and compelling it to deploy in response to ambush, the ground defenders extend the opponent's exposure to U.S. air attack. The result can be a much wider window for effective air support than would be the case if the reaction force were able to race directly to the target facility without leaving the road en route.

⁹⁰ Note also that the more extensive the dependence on air-delivered fire support, the more complete the degree of air defense suppression that may be necessary before the insertion of the necessary ground forces, and thus the more extensive the preliminary defense suppression effort and the greater the tradeoff against the need for surprise.

⁹¹ For a more detailed discussion of the Janus analyses, see appendix.



Slide 48: An Illustrative Mission — Direct Action Against Pine Bluff Arsenal

As an illustration of how these elements might be combined, and of the potential size and difficulty of the resulting mission, a rough sketch of requirements for a notional, comparatively near term direct action mission against the U.S. Army's Pine Bluff Arsenal was performed. Pine Bluff Arsenal was chosen as a broadly representative biological warfare (BW) research facility of known nature and extent.

Opposition forces comprising two to four companies of local site security within the facility and two to four brigades of mechanized reaction forces northwest of Little Rock and south to southwest of Pine Bluff were assumed available. It was further assumed that the reaction forces would be garrisoned in fairly close proximity to the Arsenal, would have access to high-speed approach routes, and could travel in part through populated areas posing collateral damage risks for air attack.

The direct action team's mission was posited to be to secure the facility, locate any evidence of offensive BW research or realized capability, document the evidence, remove samples of live agent, destroy any remaining agent and essential lab equipment, and withdraw from the facility. It was assumed that of the 33 buildings in the complex, perhaps 20 to 25 could be excluded from search on the basis of photo reconnaissance and limited HUMINT information. No other intelligence as to internal floor plans or building function was assumed to be available. The nearest suitable base for the direct action force was assumed to lie outside the continental United States.

The notional concept of operations called for a forced entry force to seize a nearby runway of sufficient length to support C-17 operations. Using this runway, an assault force, a mission team, and two blocking forces would be flown in. The assault force and mission team would be transported to the Arsenal where the assault force would penetrate local defenses and secure the facility, whereupon the mission team would then search the complex. The two blocking forces would meanwhile be transported to ambush sites northwest and south of the Arsenal, where they would prepare to intercept hostile reaction forces if necessary. Upon completion of the mission, the assault force, mission team and blocking forces would be withdrawn to the runway and extracted by air.

The nearest runway of sufficient length is located some 15 miles from the Arsenal at a small airport northeast of Sheridan, Arkansas. To seize the runway and provide local security was assumed to require a force of roughly battalion size with associated C3, medical, logistical and fire support elements. To gain control of the Arsenal given the assumed local security was estimated to require an assault force of company to battalion size. As per the illustrative estimate above, a mission team of at least 100 BW specialists, structural engineers, photographers and security escorts was assumed necessary to search a complex of eight to thirteen suspect buildings (i.e., those of the 33 total buildings not assumed to be excluded on the basis of prior intelligence).

Given a two-to-four-brigade hostile reaction force subject to some, but limited, air attack en route, it was estimated that blocking forces totaling one to two battalions would be required.

Taken together, the forces required for such a notional mission thus might total some three to four battalions in size, plus transport, air and fire support, C3 medical and logistics elements.

This is clearly an enormous force to expose to combat deep in hostile territory at the end of a long air bridge to the nearest friendly base — leaving aside the potential difficulties of penetrating the site defenses, disengaging blocking forces, extracting the force upon completion of the operation, or actually conducting the search itself in a complex that has been subject to recent combat action. The inherent requirements of the mission, however, combined with current technology for search of large installations and defense against reaction forces, demand a large ground force if the mission is to be completed successfully in the comparatively near term. To provide even this capability in the near term would require considerable reorganization, doctrinal development, and the development of more effective means of agent neutralization (see below); to reduce force requirements significantly for targets of this size would require significant, longer term technological advances.

POTENTIAL IMPROVEMENTS

Reduce reliance on direct fire systems for blocking forces

- Long-range, all-weather, responsive air/offshore/indirect fire support
- Unmanned combat systems
- Information warfare to override, disrupt, deceive military and civilian systems
- Rapid air defense suppression
- Battlefield surveillance from hostile airspace

Improved search/destruction techniques

- Non-destructive test equipment

Improved insertion/extraction/operational mobility

- Long-range tilt-rotor aircraft
- Air transportable/drop-able light armored vehicle
- Individual air vehicles

WMD material neutralization/removal

Organizational, doctrinal adaptation

Slide 49: Potential Improvements

To provide a more effective capability, a number of improvements would have to be made. To reduce the size of the required forces, for example, would require less manpower-intensive means of blocking hostile reaction forces and searching a large facility. Examples of possible initiatives might include improvements in the reliability and accuracy of long-range fire support from missiles and aircraft. Many such improvements are under development today in the context

of preparations for a large scale conventional war. Capabilities that would be especially useful in the WMD counteroffensive mission would include long-range, all-weather, highly responsive fire support for blocking forces. Although some current programs, such as advanced cruise missiles, would not meet the responsiveness requirements of this mission, others, such as aircraft with long range and the ability to provide all-weather interdiction and close air support fires could meet the need. Another variation on a current capability would be to use the Army Tactical Missile System (ATACMS) launched from aircraft or ships and submarines. For example, a B-52 carrying ATACMS missiles could provide very responsive fire support from hundreds of miles away from the target. Ships or submarines could provide similar responsiveness at a shorter range. The ATACMS or similar missile or the aircraft providing fire support could be armed with improved air-to-ground submunitions.

The Army also is developing non-line-of-sight systems, such as the Fiber Optic Guided Missile, that are relatively light and could extend the reach of a blocking force out to 15-20 kilometers. The disadvantage of ground-based systems, of course, is that they would have to be inserted into enemy country. Unmanned systems such as wide area mines also can be used to reduce the size of the blocking force. Unmanned vehicles might be employed in the assault phase to reduce friendly casualties.

Success in this kind of operation may depend on improved deception, electronic warfare, and surveillance capabilities. In particular, emerging techniques for control of both military and commercial broadcast media can allow for improved deception of enemy air, air defense, or reaction forces and for jamming of all forms of broadcast media.⁹²

In addition, battlefield surveillance systems, manned or unmanned, that are not susceptible to the problems of weather and schedule that affect satellites are essential for providing critical intelligence information such as the location of a reaction force. But to operate successfully deep within hostile territory will require substantially more survivable platforms than, for example, current AWACS or JSTARS aircraft — both of which were designed for long standoff surveillance from positions well within friendly airspace.

Initiatives to reduce the size of search teams and/or the time required to search large facilities also would be needed. Although further research is needed to broaden the range of technical possibilities for this task and to determine the feasibility of proposed means, some needs can be identified immediately. Non-destructive test equipment, for example, if feasible, would enable search teams to determine whether a given container might hold a particular class of agent

⁹² For a survey of relevant technologies, see appendix discussion under "focused coercion."

without requiring the laborious (and hazardous) process of opening and sampling from the containers themselves. Especially as common containers for chemical and biological agents include artillery shells or other explosive munitions, such a capability could dramatically speed the inspection process. Approaches currently under study for arms control verification purposes include acoustic or neutron activation technologies for chemical agent identification, although other possibilities may exist.⁹³

The need to defend staging runways for insertion — and especially extraction — is likewise a major potential force requirement. At least three planned or possible improvements could help reduce this requirement. The first is a long-range tilt-rotor aircraft, such as the V-22, which could provide a much greater range to the forces and, more importantly, could allow them to operate without intermediate basing in hostile territory. But because tilt-rotor (and other) aircraft (as well as airborne soldiers) are susceptible to enemy antiaircraft fires and are most likely to face these fires at the objective, the force will still require a means of operational mobility that will allow it to exit the aircraft at some distance from the objective.

An air-transportable and drop-able light armored vehicle such as is currently under development by the Army as a scout vehicle (or as is currently in use by German airborne forces) could provide the kind of operational mobility needed. Alternatively, the force could employ a militarized version of the commercial paraplane⁹⁴ that would allow attackers to exit an aircraft in flight, fly 25-50 miles to the objective, and conduct the assault directly from the air. Upon completion of the mission, the force could be withdrawn directly from the objective or could employ its paraplans to fly to a rendezvous with the strategic airlift aircraft.

Whatever the size of the force, however, a capacity to neutralize or remove discovered agent is essential. We currently have no means of accomplishing this efficiently — especially where there may be large quantities of agent present.⁹⁵

Finally, current U.S. special forces ordinarily operate in very small teams; it is likely that even after considerable reductions in manpower requirements, the size of the needed force would still be substantially larger than this, and would require the integration of large non-SOF support elements. To carry out such larger operations effectively would thus require the development of

⁹³ Alternatively, remote access (for example, via satellite communications networks) to supercomputing capabilities would be of value across a broad range of inspection requirements, from data processing support for portable mass spectrometers to structural analysis of combat-damaged buildings.

⁹⁴ The Paraplane is an ultra light aircraft that obtains its lift from a ramair parachute and its propulsion from a pusher-propeller located directly behind the single occupant. The commercial version is made by the ParaPlane Corp in New Jersey.

⁹⁵ For a review of technical opportunities, see appendix.

appropriate procedures and, probably, organizations. A first step might be to create an organization responsible for developing WMD counteroffensive options. Just as the Joint Special Operations Command (JSOC) was created to develop and maintain a capability for hostage rescue, a Joint Task Force headquarters might be established with the responsibility for developing the doctrine, tactics, and force structure needed for WMD counteroffensive action. Existing forces also could be assigned to this Joint Task Force to assure necessary assets are properly organized and to further develop doctrine and procedures.

POTENTIAL COUNTERMEASURES

Strengthen site security, reaction forces

- Could increase U.S. force requirements, likely casualties
- Large local defenses may conflict with secrecy demands

Hide/disperse facilities — e.g., underground

- Could reduce likelihood that U.S. can locate/penetrate enough of opponent's WMD industry to guarantee elimination
- Goals could shift toward documentation of wrongdoing, relative to destruction of capability

Booby trap facilities

- Could increase risk to U.S. personnel, increase time required to search facilities
- Danger of collateral damage

Slide 50: Potential Countermeasures

Many questions thus need to be answered and many improvements in projected forces need to be made before an effective capability can be developed, but were such a capability to be developed, what potential countermeasures could hostile states employ in response, and how robust would U.S. capabilities be in the face of such measures? As with the first case study, a complete measure-countermeasure assessment for WMD counteroffensive action would be beyond the scope of the current study. To provide some initial insight, however, three first-order countermeasure options were considered here: strengthened site security and reaction forces, greater efforts to hide or disperse WMD facilities, and booby trapping of WMD sites.

By strengthening site security and reaction forces, hostile states could certainly increase U.S. requirements for assault and blocking forces. And these larger U.S. forces could well suffer higher casualties against more substantial opposition. While large increases in defenses around nominally civilian facilities may at times conflict with secrecy requirements, on balance, stronger local defenses are likely to increase the costs, and risks, to the United States of carrying out such missions.⁹⁶

Alternatively, hostile states could make greater efforts to hide or disperse WMD facilities, and in particular, they could transfer more of their activities to underground installations beyond the reach of U.S. satellite photography. Such measures could eventually reduce the likelihood that the United States could locate enough of the opponent's WMD industry to ensure its elimination in the event of counteroffensive action. They also could increase substantially the difficulty of penetrating site defenses for those facilities that the U.S. could find. If done systematically on a large scale, it could eventually make it very difficult for the United States to be confident that we had identified the entirety (or even the majority) of an opponent's WMD capability. As a result, such countermeasures could eventually force a shift in the relative weight we attach to the different goals of counteroffensive action — i.e., away from prevention and especially preemption, and toward providing unambiguous (though selective) evidence of wrongdoing.

Finally, hostile states could booby trap their facilities against unfriendly search efforts. To some degree, any search team entering a hostile WMD facility must already assume that it has been booby trapped — even if the opposition has not deliberately placed such traps, combat action associated with the assault itself, coupled with poor local security standards, already establishes an environment in which activities must be conducted very carefully. Of course, permanently booby

⁹⁶ Although more elaborate defensive preparations around officially "civilian" facilities may tend to give away their true purposes to Western photo intelligence, relocating legitimate defense installations into the vicinity can mask the effect. Moreover, in some states, such as Iraq, camouflage and local defensive preparations were characteristic of such a large variety of facilities (military and civilian) that the intelligence value of such preparations can be limited.

trapped facilities pose some ongoing danger to the employees of the facility itself, and risk the accidental destruction or contamination of expensive equipment that can often only be acquired by considerable (and often clandestine) effort. And of course, booby trapping a structure containing highly toxic materials creates an inherent danger of collateral damage (which may matter more to some regimes than to others, but does at least represent an important consideration for the facility's owner). Nevertheless, it is likely that such efforts could on balance increase the casualty risks to U.S. personnel, the time (and/or manpower) required to conduct a safe search, and the risks of collateral damage associated with such a mission.

Overall, then, while none of these countermeasures is without at least some cost to the proliferating state, many could increase the difficulty and the risks associated with U.S. counteroffensive action. And in the limit, such developments could require a shift in the ultimate objectives of the counteroffensive mission by reducing our ability to locate key elements of a dispersed WMD development effort. While the analysis above is highly preliminary in nature, the initial results thus suggest that countermeasures may constitute an important concern for the development of an effective long-term capability.

WMD PROLIFERATION and COUNTEROFFENSIVE ACTION vs WMD SITES: INDICATIONS

National WMD research/production/storage targets pose difficult problems for currently programmed forces — esp., many WMD facilities are:

- Large
- Ambiguous
- Well-defended

Near-term options involve substantial collateral damage risk, lethality shortcomings (air strikes); could require very large forces (ground attack)

To develop more effective capability could require:

- Fire support, defense suppression improvements to reduce blocking force requirements to support ground force raid
- Improved ground force search techniques
- Improved insertion/extraction/operational mobility to support ground force raid
- Improved agent neutralization/collateral damage containment technology
- Organizational, doctrinal adaptation

Hostile countermeasures could increase risks, costs

Ability to identify extent of hostile WMD complex an enduring problem — esp. with increased hostile concealment efforts; may eventually drive mission goals toward proof, away from effective prevention/preemption

Slide 51: Counteroffensive Action vs. WMD Sites — Indications

For WMD counteroffensive action as a whole, then, currently programmed forces have some capability against some types of WMD targets, but important limitations exist. Current forces are relatively well-suited, for example, to attack small, relatively lightly defended targets like subnational WMD assets, or to conduct air strikes against fixed national WMD assets in time of war (when collateral damage and evidentiary concerns are likely to be less constraining than for peacetime operations, and when high damage probabilities may not be a prerequisite for attack). Current capabilities to destroy national level WMD research, production and storage facilities outside the context of an ongoing war, however, are very limited. In particular, such facilities are often large and widely dispersed; the function of individual buildings or the location of specific activities within a building are often ambiguous; and the facilities are often well defended, especially by mobile reaction forces located outside the complex itself. Air strikes against such targets lack kill mechanisms effective against critical NBC materials (and thus cannot actually eliminate an existing weapon capability itself), pose serious risks of collateral damage, and cannot provide unambiguous evidence of wrongdoing by the target state; current, small-scale SOF direct action capabilities are ill-suited to such large, little-known and well-defended targets; and large-scale ground force raids lack the range or the extraction means required to deal with targets located so far from U.S. bases.

To provide a more effective capability requires surmounting a number of major hurdles. In the near term, available options (i.e., air strikes and ground force raids) are likely to involve substantial risks of collateral damage and/or insufficient lethality (in the case of air strikes), or could require very large forces (for ground attack). In the longer term, developments potentially capable of making a significant difference include improved fire support and defense suppression technologies to reduce blocking force requirements in the context of a ground force raid; improved methods for conducting ground force searches of large WMD facilities; improved means of inserting, extracting, and maneuvering ground force raiders; more effective methods for neutralizing (or removing) WMD materials while containing collateral damage risks; and organizational and doctrinal adaptations to provide for larger scale SOF operations.

The initial analyses conducted here have not attempted to evaluate the technical or economic feasibility of such improvements. Assuming that they could be provided, however, such measures offer some potential for meaningful improvements in U.S. capabilities. Some difficulties, however, are likely to remain. Plausible countermeasures, for example, could increase the risks and costs of any such operation. And perhaps most important, it is likely to remain difficult to guarantee that we have located enough of a proliferator's WMD industry to ensure that its weapon capability can be destroyed by counteroffensive action. Eventually, this may force us to shift from counteroffensive goals emphasizing effective prevention or preemption of hostile WMD capability

toward a goal of providing unambiguous evidence of wrongdoing (while delaying, but not wholly destroying, hostile development efforts in the process).

OUTLINE

- I. Analytical Approach
- II. Illustrations
 - A. Identification of Critical Long-term Security Challenges
 - B. Analyses of Capability Shortcomings and Options for Response:
 - 1. Incremental Aggression and Discriminate Military Capability
 - 2. Incremental Aggression and Coercion of Hostile Leadership
 - 3. WMD Proliferation and Counteroffensive Action against Proliferation Sites
- ⇒ III. Conclusions and Implications

Slide 52

We now go on to provide some conclusions and implications of these initial analyses.

CONCLUSIONS AND IMPLICATIONS

Approach is feasible and provides potentially useful insights

Cases illustrative of three classes of potential outcome

- **Incremental Aggression and Discriminate Military Capability:**
 - Projected capabilities have significant shortcomings
 - Improvement may be possible by adapting/combining relatively mature technologies
- **Incremental Aggression and Leadership Coercion:**
 - Projected capabilities have significant shortcomings
 - Improvement unlikely without reconsidering underlying phenomena — may need to revisit goals/means, seek other solutions
- **WMD Proliferation and Counteroffensive Action:**
 - Projected capabilities have significant shortcomings
 - Improvement possible but may require extensive effort, provide only partial solution

Slide 53: Conclusions and Implications

The main conclusion of the study is that the approach developed here can enhance long-range planning in the face of an uncertain environment. Of course, the demonstration provided was necessarily partial in nature — only three case studies were performed, and none of these was exhaustive (none, for example, included formal, detailed program projections or cost estimates for options). The approach would thus benefit from further testing and a more extensive treatment of some of the cases addressed here. Nevertheless, enough of the principal elements of the approach were exercised to constitute a reasonable first test, and no fatal flaws were encountered in the process. The study can thus be said to have provided the "proof of principle" called for in the objectives for the task.

In addition to testing the feasibility of the steps making up the approach, the three case studies also illustrate three broad classes of outcome the approach can produce. In each, significant shortcomings were identified in projected capabilities. But in the first (incremental aggression and discriminate military capability), the approach identified a set of relatively mature technologies and relatively modest doctrinal modifications that might be adaptable to the identified military mission. While these improvements will never eliminate the inherent casualty risks of operating in an incremental aggression environment, they nevertheless offer some potential for meaningful risk reduction that would not be available from projected capabilities alone.

In the second case study (incremental aggression and leadership coercion), the analysis failed to identify any options that, given the current state of knowledge, could meaningfully improve projected capabilities to perform the identified mission. Given the nature of the target regimes and the means available to them for resisting coercive pressure, foreseeable options appear to work best against regime types least likely to threaten U.S. interests, and are least effective against the repressive authoritarian states that pose the greatest threat. This suggests that if capabilities are to be improved, we must either reconsider the nature of the mission itself (for example, by emphasizing discriminate military capability, rather than leadership coercion, for dealing with incremental aggressors), or reconsider the underlying phenomena. As for the latter, the analysis suggests that the threat of regime change offers the most important potential source of coercive leverage; and while the current state of knowledge provides few viable options for creating such a threat against repressive authoritarian regimes, that state of knowledge is very limited. It is, however, amenable to improvement given systematic analysis. Basic research on the dynamics of regime change in authoritarian states might suggest new capabilities in this area — but absent productive results from such research, available options show limited potential.

In the third case study (WMD proliferation and counteroffensive action), the analysis suggests that for the subset of counteroffensive actions considered (i.e., peacetime operations against national WMD research/production/storage facilities), the mission as formulated is extremely demanding. To accomplish it would probably require extensive development of new capabilities, and even then the result may provide only part of the stated objectives. Pending consideration of alternative forms of counteroffensive action (e.g., operations against delivery systems or supporting infrastructure), or alternative responses to WMD proliferation (e.g., defenses against WMD attack), it is difficult to determine the relative costs (both monetary and political) and benefits of the indicated improvements. But without such improvements, it seems unlikely that projected forces will provide the capability to perform the mission as formulated within the planning horizon for the study.

CONCLUSIONS AND IMPLICATIONS (continued)

Tentative implications of case studies for policy — development areas warranting further consideration:

- Survivability enhancements for dismounted personnel
- Close up armed airborne recce, C3 for integration with cueing radars
- Non-lethal incapacitation, command disablement for PGMs, FOPEN radar, unmanned sensors
- Fire support, defense suppression improvements for SOF direct action
- Improved WMD materials search techniques
- Insertion/extraction methods for larger forces
- Improved WMD agent neutralization/collateral damage containment technology

Slide 54: Conclusions and Implications (continued)

In addition to their primary role in testing the feasibility of the approach developed here, the three case studies also suggest some possibilities for development areas warranting further consideration. For defeating military targets associated with incremental aggression, for example, these include survivability enhancements for dismounted personnel; armed penetrating airborne reconnaissance and C3 for integrating this with radar systems for cueing; non-lethal incapacitation technologies; command disablement for PGMs; foliage penetrating radar; and improved unmanned sensors. For striking proliferation targets, these include fire support and rapid defense suppression improvements to support SOF direct action missions; improved procedures and technologies to search large facilities for WMD materials; improved insertion and extraction methods for large forces; and more effective methods for WMD agent neutralization without large-scale agent release. Of course, in no instance has this initial analysis provided a definitive case for the feasibility or effectiveness of a specific system — but it has suggested some potentially promising directions for development along lines often different from those pursued most

extensively during the cold war. More extensive analysis is required to make more definitive any programmatic recommendations from this preliminary work.

CONCLUSIONS AND IMPLICATIONS (continued)

Lessons learned for approach:

- Utility of mission focus
- Utility of multiple iteration, variable length assessment
- Variable resource requirements of individual case studies
- Parallel vs. sequential process organization — utility of mostly sequential design
- Skill requirements, team organization — need for interdisciplinary team; the tighter the deadline, the greater the need

Issues for further research:

- Fitting this approach into PPBS context
- Implications of comprehensive (vice case study) scope

Slide 55: Conclusions and Implications (concluded)

Finally, the testing process has generated some "lessons learned" and some issues for further research regarding the development of effective approaches for long-range planning. In particular, the first "lesson learned" regards the utility of a mission focus for long-range planning. The approach developed here identifies missions and seeks capabilities to perform them, rather than, for example, identifying long-range technological developments or weapon concepts and evaluating them. This strategy has at least four advantages in this context. First, it helps focus attention on the policy problem to be solved by the analysis. Second, it facilitates cross-system and cross-Service analysis: the WMD counteroffensive case, for example, considered Air Force ground attack, Army airborne, Marine Corps amphibious, and joint special operations force

capabilities for a single mission. Third, it facilitates the integration of technological and doctrinal change into operational concepts for the use of new systems. And fourth, a mission focus makes it easier to integrate the unusually wide range of disciplinary perspectives required to evaluate the unusually diverse range of analytical issues raised by long-range planning.

A second "lesson learned" regards the utility of a multiple-iteration approach with variable length analyses in any given iteration. Long-range planning requires conceptual development to identify technological and tactical opportunities, to integrate those into options, and to anticipate countermeasures to those options. To do this, it is important to be able to create, modify or discard alternatives quickly and re-start assessments in mid-stream as difficult problems and new opportunities are discovered. Without a predetermined set of options to be compared, this ability to modify and revisit is crucial to avoid artificially restricting the set of alternatives (i.e., by prematurely freezing the specification of an option in order to permit a more complete assessment) or investing unnecessary analytical effort in flawed alternatives. As a result, the attention given to individual options or technologies must be allowed to vary widely, and it must be anticipated that many cycles of proposal, assessment, and revision will be necessary to produce the best possible option set.

A third lesson follows directly from the second — that is, that the resource requirements of individual challenge-option case studies are likely to vary widely. Since the length and types of analyses to be performed will vary widely from option to option and case to case, so the levels of effort, analytical skills, and overall resources required will vary accordingly.

A fourth lesson concerns the relative balance of parallel and sequential processes in the approach, and the utility of an essentially sequential design. The flow chart in slide seven depicts an *entirely* sequential design — at no point are any two tasks performed simultaneously. Of course, performing several tasks in parallel would save time; it has been suggested, for example, that the identification of challenges and the projection of programmed forces, or the assessment of several options, could be performed simultaneously to reduce the duration of any given planning exercise. The advantages of a sequential approach, however, are two-fold. First, it provides maximum opportunity to use the winnowing strategies outlined in slides four and five to reduce the scale of the effort required in subsequent tasks. If challenge identification and program projection are performed in parallel, for example, the entire defense program must be projected two FYDP cycles forward — even if the case studies involve only a fraction of the 2011 programmed force. If program projection follows challenge identification, projections can be limited to those forces relevant to the challenges selected for further analysis. Some time may be lost, but the scale of the required analytical effort is reduced substantially. Second, a sequential approach maximizes the opportunity for serendipitous insights to be exploited in related analyses. If, for example, a series

of related options are all susceptible to an unanticipated common flaw, conducting option analyses sequentially allows the flaw to be discovered, once, in the first analysis, permitting the remainder of the related set to be discarded without absorbing further effort. Were the analyses to be conducted in parallel, on the other hand, each would absorb comparable effort prior to the discovery of the common flaw, reducing the resources available for investigating alternative possibilities accordingly.

A final lesson concerns team skills and organization for conducting such analyses. While we have focused on outlining an approach rather than staffing it, one useful lesson to emerge is the need for an interdisciplinary analytical team — and the close relationship between the range of skills required and the time available for carrying out the analysis. In particular, the shorter the time available, the greater the need to incorporate a wider range of specialists in the analytical team. For the case studies considered here, perhaps the most important specialist skills include technology assessment (and in particular, the availability of a dedicated representative from the technical community who is both aware of the relevant policy issues and knows where to go to find technical information or expert specialists),⁹⁷ simulation (both the construction of simple analytical models and the adaptation of more sophisticated, off-the-shelf simulations to particular needs), cost analysis, and military operations and logistics. Of course, where time permits, these skills can be sought from outside the assigned analytical team — but such a process can be very time consuming. Under such circumstances, there is no substitute for immediately available, thoroughly briefed, dedicated specialists within the analytical team — even where those specialty skills are only intermittently required.

The testing process also suggested at least two significant issues for further research with respect to the approach itself. First, the analytical framework described here was developed and tested by a non-governmental organization. The issue of fitting this approach into the governmental PPBS context merits explicit consideration. For example, the iterative concept development process of proposal, assessment, and revision described above could prove difficult to implement effectively and objectively in a PPBS environment in which the proposals at stake carry important budgetary consequences for the participants. The particular issue of structuring such a process, as well as the broader questions of adapting this framework to a different

⁹⁷ Note that the defense R&D community is not particularly well organized to support analyses such as these. Research effort in particular technology areas (e.g. non-lethal weapons, or biological warfare defense) is often scattered among a large and loosely connected array of labs and contractors, and communication among researchers is often intermittent or non-existent. As a result it can be difficult and time consuming to locate information sources for particular technologies, and it is not uncommon to discover previously unlocated research efforts late in a given analysis. Availability of a dedicated technical community interface can ease these difficulties somewhat, but probably cannot eliminate them altogether.

organizational context, or of integrating governmental and non-governmental analytical input, thus warrant further consideration.

Second, the analytical framework described here assumes a selective, case study approach to long-range planning. This has the advantage of focusing available analytic resources, but it has the disadvantage of making it difficult to assess opportunity costs or relative priorities across a wider set of challenges and potential responses. A more comprehensive planning process could overcome these disadvantages, but the analytical implications of providing a comprehensive assessment warrant careful consideration.