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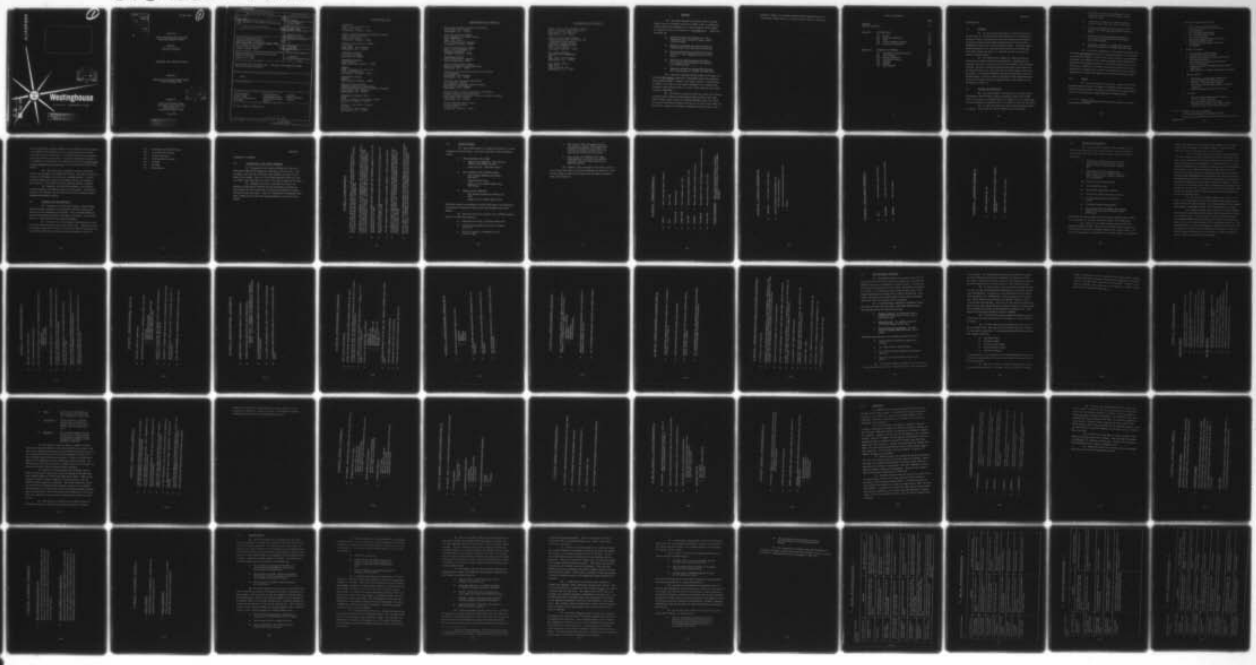

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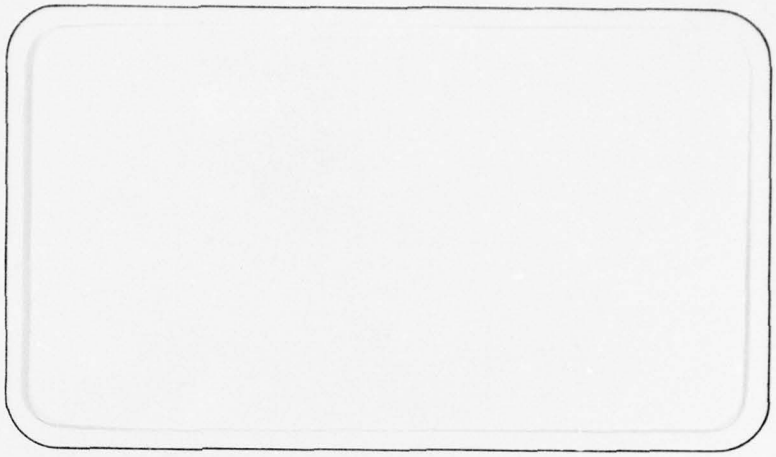

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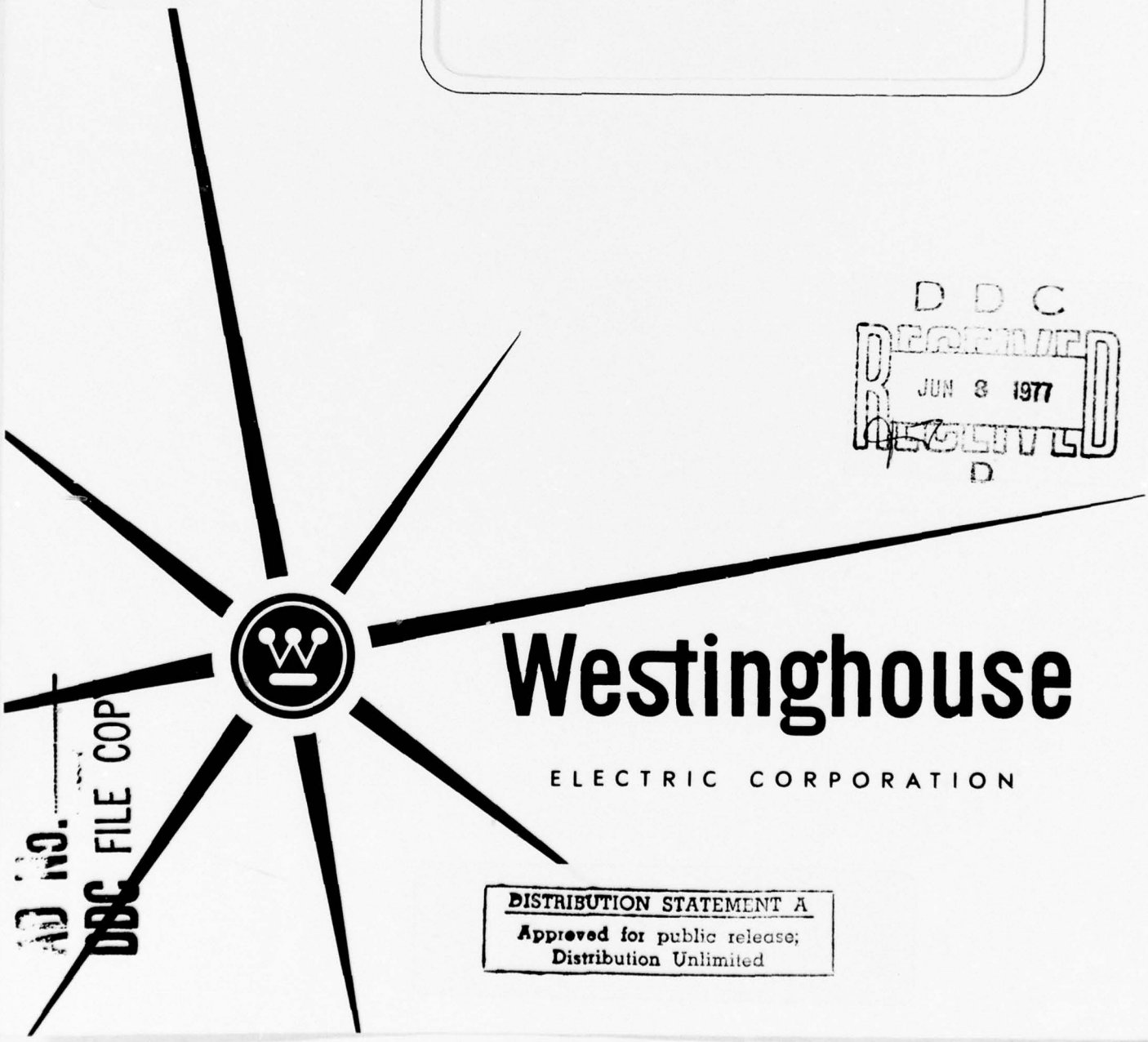

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Final Report

R&D IMPLICATIONS FOR POST-1990 CRISIS MANAGEMENT FORCES

VOLUME I

EXECUTIVE SUMMARY

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ABSTRACT

(U) This project identified areas of R&D related to General Purpose weapons and supporting systems where DARPA could, by investing now, materially enhance the capability of U.S. Crisis Management Forces (CMFs) to accomplish a broad mix of missions in the circa 1990 period. Specifically, this project has:

- Postulated and described candidate U.S. Crisis Management Forces, equipment, doctrine, organization and tactics;
- Projected and described the worldwide conflict environment within which those forces would operate;
- Developed detailed design scenarios for the evaluation of U.S. CMFs viz-a-viz projected adversary threats;
- Ascertained and described perceived shortfalls in U.S. equipment when evaluated in the framework of the design scenarios; and
- Postulated, described and evaluated R&D initiatives which could overcome the shortfalls identified above.

(U) It should be emphasized that the purpose of this project was to identify R&D initiatives responsive to requirements stemming from perceived system-oriented shortfalls. Nowhere in this project was there - nor should there be inferred - any explicit nor any implicit comparison of the candidate Crisis Management Forces themselves (that is, in terms of their respective value, effectiveness or capabilities).

(U) This research was performed under the auspices of the Tactical Technology Office, Defense Advanced Research Projects Agency under Naval Surface Weapons Center Contract No. N00178-75-C-0357, Project No. G9466. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either

expressed or implied, of the Defense Advanced Research Projects Agency, the Naval Surface Weapons Center, or any other agency of the U.S. Government.

TABLE OF CONTENTS

INTRODUCTION

1.0 GENERAL

(U) This document represents Volume I, Executive Summary, of the final report on the research project "R&D Implications for Post-1990 Crisis Management Forces" conducted by the Studies and Technology Center (STC) for the Defense Advanced Research Projects Agency/Tactical Technology Office (DARPA/TTO) under Contract Number N00178-75-C-0357. It contains a highly distilled presentation of the most salient points derived from the several task areas which comprised this project. A companion document to this report is Volume II, Technical Report.

(U) The materials which comprise the substantive portion of this document are highly abstracted summary statements, representing the key conclusions drawn by the study team for each of the substantive areas of research performed. Therefore, methodology-related discussions have been omitted from this document except in those few cases where the method itself was felt to be a key product. The detailed methodology discussions are contained in Volume II - Technical Report. Since this volume is to represent a highly abstracted statement of only the most salient findings, the supporting data, interim results, etc. are all contained in Volume II.

2.0 PURPOSE AND OBJECTIVES

(U) The overall purpose of this project was to ascertain areas of R&D related to General Purpose weapons and supporting systems where DARPA could, by investing now, materially enhance the capability of U.S. Crisis Management Forces (CMFs) to accomplish a broad mix of missions in the circa 1990 period.

(U) To realize this broad goal, several technical objectives had to be achieved. Among these more specific objectives were the following:

- To postulate* and describe candidate U.S. Crisis Management Forces, equipment, doctrine, organization and tactics

- To project and describe the worldwide conflict environment within which those forces would operate

- To develop detailed design scenarios for the evaluation of U.S. CMFs viz-a-viz projected adversary threats

- To ascertain and describe perceived shortfalls in U.S. equipment when evaluated in the framework of the design scenarios

- To postulate, describe and evaluate R&D initiatives which could overcome the shortfalls identified above

(U) It should be emphasized that the purpose of this project was to identify R&D initiatives responsive to requirements stemming from perceived system-oriented shortfalls. Nowhere in this project was there - nor should there be inferred - any explicit nor any implicit comparison of the candidate Crisis Management Forces themselves (that is, in terms of their respective value, effectiveness or capabilities). Shortfalls and subsequent assessments were drawn based upon the assumption that a specific task organized force structure with its expected array of weapons and support systems had been assigned the mission.

3.0 SCOPE

(U) The overall purpose of this project, coupled with the many technical objectives necessary to support its realization, clearly indicates the breadth of analysis involved. The project was divided into six major analytical areas, and each of these was viewed separately for scoping purposes:

---

*All forecasts/projections included in this project were for the long-range (circa 1990-95).

- CMF Force Concepts and Equipment

  - Quick reaction, active duty forces*
  - Broad mix of missions from combat assault to peacekeeping
  - No mobilization time permitted
  - One reinforced division or less
  - No service distinctions
  - Capable of independent action for 60 days
  - No doctrine/tactics changes
  - Equipment currently held or under active consideration

- Conflict Environment

  - 107 potential worldwide conflicts
  - Five levels of conflict intensity
  - Scenario assessments done on less than General War intensity conflicts
  - Assessments assume continued active role of U.S. in world affairs
  - Conflicts must have a credible potential for CMF applications
  - Three CMF roles: *Combat, Peacekeeping,* Deterrence

- Threat Forecasts

  - Evolutionary, general purpose weapons only
  - Inventory forecasts for major actors only
  - WEI/WUV** values used where possible
  - Twelve major General Purpose classes of weapons considered
  - Military Potential forecasts for major actors

- Scenarios

  - More than 1600 potential cases*** reduced to five for analysis in depth
  - Map exercises for each of five cases
  - Natural terrain, weather, etc. factors included
  - Political, social, economic factors included

---

*Airborne, Airmobile, Amphibious

**Weapons Effectiveness Index/Weighted Unit Value

***Product of 107 Potential Conflicts, 5 Levels of Intensity, and 3 U.S. Military Roles.

- Shortfall Analysis

  - Six measures of effectiveness for U.S. CMFs
  - Five mission events
  - Major problems identified using expertise
  - Emphasis on technology-related shortfalls
  - No doctrinal, tactical or TO&E* shortfalls to be treated other than to note their presence

- R&D Initiatives

  - Only technically feasible concepts
  - Nine evaluation criteria
  - Expert judgment used to evaluate concepts

4.0 TECHNICAL APPROACH OVERVIEW

(U) As indicated in the foregoing discussions on Objectives and Scope, the breadth of coverage of this project is quite broad. Figure 1-1 depicts the general analytical flow of, and the interrelationships among, the several tasks which comprised this effort. There were three independent starting points: 1) forecasting the 1990's conflict environment and the U.S. roles in those conflicts, 2) the form and capabilities of alternative U.S. Crisis Management Forces as projected to the 1990's, and 3) forecasting the broad threat environment to the same time frame. The following paragraphs briefly summarize the approach.

(U) With these three elements in hand, extensive effort was undertaken to structure five very specific representative, likely, and technologically challenging scenarios (from a total population of more than 1600 possible cases) into which U.S. forces could be introduced to compare CMFs with specific adversaries and their attendant threat systems, in specific geophysical circumstances.

(U) Each CMF was independently interjected into each scenario to accomplish identical missions in an identical threat and natural environment. Measures of effectiveness (MOEs) were developed and applied evenly to all forces.

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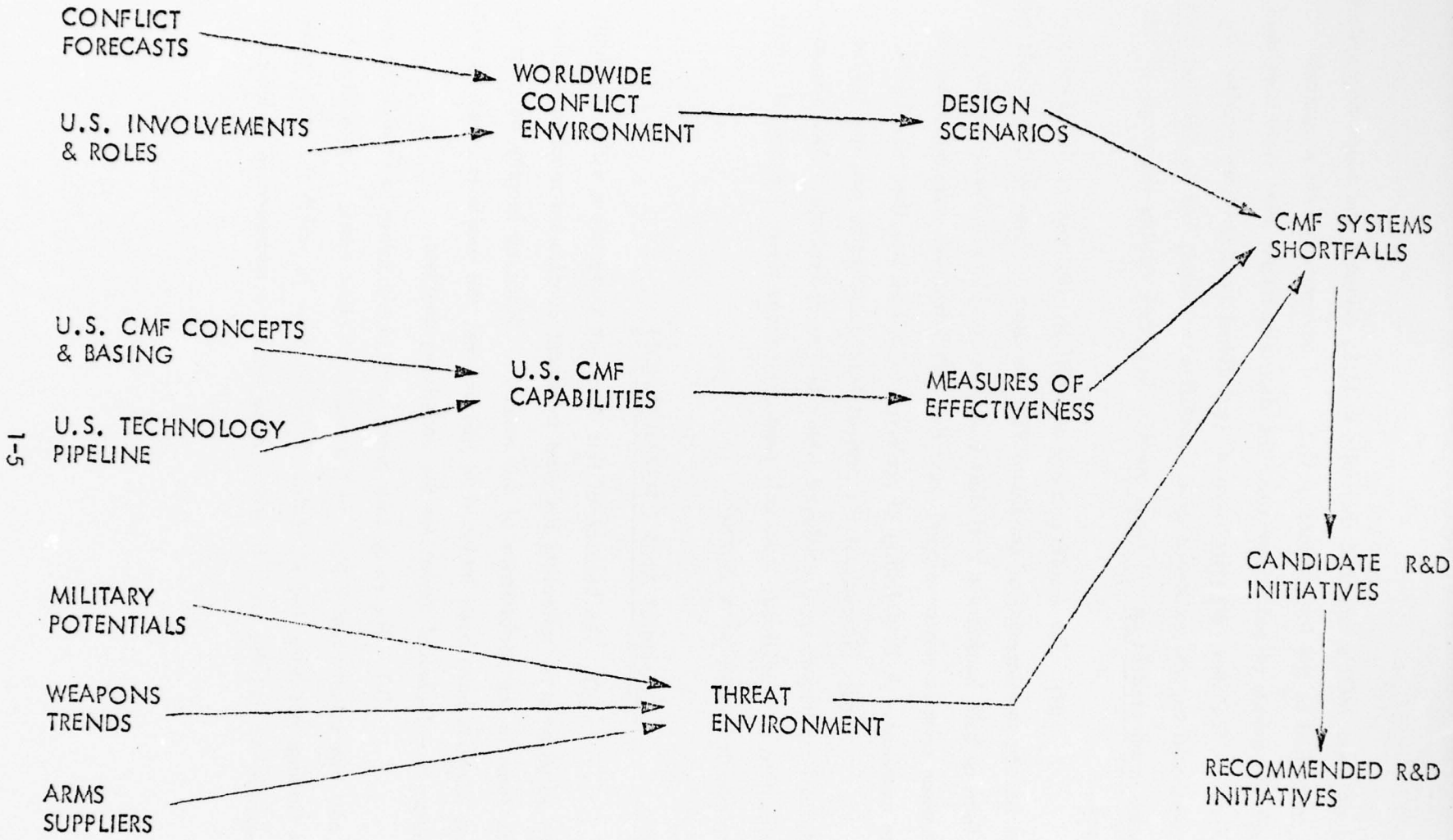
*Table of Organization and Equipment.



(U) FIGURE 1-1. OVERALL APPROACH (U)

Based on these MOE's, specific shortfalls in U.S. weapons and supporting systems were identified as the interactions of U.S. and adversary systems progressed through the events of each scenario. The shortfalls sought were systems-related. Cases where doctrinal, organizational or operational considerations resulted in, or contributed to, the existence of a shortfall were noted, but no detailed analyses were conducted in any of these areas - they were outside the scope of this project.

(U) The resulting array of shortfalls was used as the starting point for the development of candidate R&D concepts. These R&D concepts took the form of both hardware and studies (i.e., research) initiatives. A set of evaluation criteria was developed, and the R&D initiatives were subjected to these measures. A final listing of preferred initiatives was then developed.

(U) Throughout the project both quantitative and qualitative analytical techniques were employed where and as appropriate. The discussions pertinent to the individual tasks will detail the areas where judgmental efforts complemented quantitative methods.

5.0 CONTENT AND ORGANIZATION

(U) The balance of this document comprises a series of highly distilled statements, reflecting the most trenchant conclusions reached by the study team in the performance of this research. Since no lengthy defenses for these contents have been included in this volume, the reader is urged to review Volume II - Technical Report for the underlying analyses.

(U) The study task areas were highly interrelated and the results of one task usually had impact on the results of other tasks. Generally, however, the findings are presented in Section 2 in the order in which the study tasks were accomplished and the order in which these tasks are addressed in Volume II.

1.0 - Introduction and Global Summaries

2.0 - U.S. CMF Force Concepts

3.0 - Conflict Environment

4.0 - Technology/Threat Forecasts

5.0 - Scenarios

6.0 - Shortfalls

7.0 - R&D Initiatives

SECTION 2

SUMMARY OF FINDINGS

1.0 INTRODUCTION AND GLOBAL OVERVIEW

(U) As suggested by the Scope and Objectives of this study, a broad range of observations resulted from examination of the basic data. Some are unique, many have been individually noted elsewhere, and none are considered to be marginal. Taken as a whole, these observations define the needs for a CMF, current CMF status, and what must be done to prepare for the future.

(U) Throughout the analysis, every effort was made to sift through the myriad details, conflicting opinions, and tentative conclusions to focus attention upon the pivotal issues, to examine their interactions in detail, and determine their joint impact. Table 2-1, distilled from the paragraphs which follow, outlines the seven most basic findings developed in the course of this analysis.

(U) TABLE 2-1: GLOBAL SUMMARIES (U)

- IN THE MID- AND LONG-RANGE TIME FRAME, U.S. CMF'S ARE ALMOST CERTAIN TO BE MILITARILY INVOLVED IN ALL REGIONS OF THE WORLD, PERFORMING ALL RELEVANT MISSIONS, AT ALL LEVELS OF CONFLICT LESS THAN GENERAL WAR

- PEACEKEEPING AND DETERRENCE ARE THE PREDOMINANT CMF ROLES, PLACING A HIGH PREMIUM UPON THE ABILITY TO PROVIDE A TIMELY RESPONSE WITH A SENSITIVE AND FLEXIBLE FORCE ENTRY AND OPERATIONAL CAPABILITY. EXTREMELY HEAVY RELIANCE WILL BE PLACED UPON INTELLIGENCE CAPABILITIES, IN ROLES FOR WHICH THEY ARE NOT PRESENTLY DESIGNED

- NO SINGLE SERVICE (OR FORCE CONCEPT STUDIED) HAS THE NECESSARY CAPABILITY TO FILL CMF REQUIREMENTS IN THE 1990'S

- SEA SURFACE DEPLOYMENT TIMES ARE EQUIVALENT TO THOSE OF AIR FOR THE CLOSURE OF AN EFFECTIVE CMF FIGHTING FORCE

- THE MOST LIMITING COMBAT SHORTFALL IS TACTICAL MOBILITY -- BOTH AIR AND GROUND

- THE GREATEST PAYOFF FROM R&D INVENTIONS IS IN THE AREA OF ADVANCED SENSORS AND PLATFORMS TO EXPLOIT THE RANGE OF INDIRECT FIRE GUIDED ORDNANCE, TO EXTEND THE RANGE OF DIRECT FIRE WEAPONRY, AND TO INCREASE THE COVERAGE OF SURVEILLANCE/ RECONNAISSANCE SYSTEMS

- BROADLY BASED GENERAL PURPOSE FORCES DEVELOPMENT PROGRAMS, AS CURRENTLY CONFIGURED, WILL NOT RESULT IN ADEQUATE SOLUTIONS TO CMF REQUIREMENTS DUE TO AN EMPHASIS ON MAXIMUM THREAT, LITTLE NEED FOR SENSITIVITY, AND SEPARATE SERVICE DISTINCTIONS

2.0 FORCE CONCEPTS

(U) Three division-sized U.S. military force structures - currently candidates for the CMF mission - were used as the basis for CMF capabilities analysis:

- Marine Amphibious Force (MAF)
  - Marine Division (MARDIV): Nine Maneuver Battalions plus Artillery and Armor
  - Marine Air Wing: 140 Combat Aircraft
- Army Airmobile Division (Airborne Assault)
  - Nine Airmobile Battalions plus Artillery (No Armor)
  - Organic Aviation Group
  - Support From Two Tactical Fighter Wings (144 Aircraft)
- Airborne Division (ABN DIV)
  - Nine Airborne Battalions plus Artillery and Armor
  - Support From Two Tactical Fighter Wings

While each concept was maintained as a distinct force option, task organizations for the specific requirements of each scenario were performed as per current doctrine.

(U) Each force concept was exercised in the capabilities analysis subject to the following assumptions:

- Maintained continuously in elevated readiness state
- Organic supply capability for 60 days of independent action
- Each force supported, as appropriate, by two carrier air wings

- 1975 doctrine, TO&E, and concepts of operations assumed to remain to 1990; weapons, their performance characteristics and operational inventories were forecast to benefit from the ongoing R&D and evolutionary improvements

- Basing posture, lift capabilities, and support forces postulated on the basis of best available information, drawn from Service planning and objectives documents

(U) Although a direct comparison of their relative merits was not at issue in this project, some obvious differences were observed in the alternative CMFs, and these form the basis for the conclusions contained in Tables 2-2 through 2-5.

(U) TABLE 2-2: FIREPOWER DIFFERENCES (U)

- TANKS - Only in MAF (Light Tanks in Airborne)
- APCs - Only in MAF
- TACTICAL AIR - Approximate Parity
- ARMED HELOS - Most in Airmobile, Least in MAF
- ARTILLERY - Heaviest (Including Self-Propelled) in MAF
- MORTARS - Most in MAF, Heaviest in Airmobile and Airborne
- AIR DEFENSE - Hawk Battalion in MAF, 20 MM Battalion in Airborne and Airmobile
- SMALL ARMS - Same Type and Density, Most in MAF

GENERAL CONCLUSION: TOTAL FORCE STRUCTURE GENERALLY ADEQUATE TO SUPPORT CMF MISSIONS IN TERMS OF COMBAT CAPABILITY

(U) TABLE 2-3: STRATEGIC LIFT REQUIREMENTS (U)

- TONNAGE - MAF Heaviest, Airborne Lightest

- RELATIVE CLOSURE TIMES DEPENDENT ON:
  - Force Posture (Location/Readiness)
  - Amount of Available Dedicated Air/Sea Lift Units
  - Warning

(U) TABLE 2-4: TACTICAL MOBILITY DIFFERENCES (U)

- MAF - Good Amphibious, Ground and Aerial
- AIRMOBILE - Good Aerial, Poor Ground, No Amphibious
- AIRBORNE - Poor in All Regimes

(U) TABLE 2-5: SUSTAINABILITY DIFFERENCES (U)

- SUPPORT ACCOMPANIES MAF
- AIRBORNE/AIRMOBILE REQUIRE SUPPORT INCREMENT ADDITIONS
- RESUPPLY MOST DIFFICULT VIA AIRLIFT

3.0 CONFLICT ENVIRONMENT

(U) A forecast of the worldwide conflict environment in the 1990 time frame formed the basis for threat forecasts, scenario development, and shortfall analysis tasks. This conflict forecast is composed of the following elements:

- Probabilities of specific crises occurring over specific issues, in specific locales, at specific levels of intensity, between specific belligerents
- Probabilities of the U.S. becoming militarily involved in those conflicts, in one of three specific roles (i.e., Combat, Peacekeeping, or Deterrence)

(U) The scope of this forecast included:

- Seven geopolitical regions
- 107 potential conflict issues worldwide
- Five levels of conflict intensity for each issue
- Two types (Domestic and International) of conflict
- 24 regionally qualified experts polled
- Three possible CMF roles (Combat, Peacekeeping, Deterrence) for each level of intensity of each conflict issue

The resultant data base comprised some 1600 discrete, potential conflict situations (i.e., the product of 107 issues, 5 levels of intensity, and 3 CMF roles).

(U) Extensive use was made of expert judgment, solicited in controlled balloting exercises. This is the third iteration of the long-range conflict/involvement forecasting methodology employed in the present analysis. Due to the heavy dependence of study findings on the conflict forecast, a comprehensive

critique was performed on the results of the prior forecasts to test the basic validity of the methodology. The critique consisted of comparing forecast crises with actual events to determine a "batting average".

(U) A worldwide conflict environment forecast was performed in 1972 and included a near-term (1973-1978) forecast for 311 potential conflicts. Since approximately half of the forecasting period has elapsed, it was possible to compare the forecast projection with actual experience. To avoid definitional ambiguities, the comparison was based upon events with likelihoods greater than .5, and conflict levels higher than minor incidents or unrest. Sixty-six cases fit this criterion. In roughly one half of the forecast interval: of those 66 high probability/higher level potential cases, 42 have occurred at the forecast level; 21 others have occurred at a level lower than forecast, but with escalatory potential; and in one case nothing has yet happened. Further, the survey of recent history indicates that no conflicts of any consequence have actually occurred that were not included in the list of 66 high probability cases; that is, all real-world conflicts of the past three years were accounted for in the 66 cases referenced above.

(U) As most of the probability estimates were in the .5 - .7 range, only 25 to 35 percent of the events would have been expected statistically in half of the forecast interval. These findings indicate that the methodology produces a conservative forecast with no detectable errors of omission.

(U) Another conclusion can be drawn from a similar comparison between the long-range forecasts of this project with the corresponding forecasts from the earlier effort. It was found that two entirely independent groups of area-qualified geopolitical experts, performing the forecasts some three years apart, in the face of major perturbations in the international system (e.g., 1973 Arab/Israeli War, U.S. pullout and subsequent collapse of South Vietnam, Arab oil embargo, etc), project the circa 1990 period in essentially the same way. Both the numbers and intensities of, and the parties to, high probability/high intensity conflicts remained essentially unchanged.

(U) The few changes that did manifest themselves in the present forecast displayed a little more pessimistic view of the long-range. Numbers of more likely, higher intensity conflicts increased slightly, along with a notable increase in the worldwide likelihood of General War.

(U) The summaries which follow are focused on the middle three levels of conflict for both Domestic and International cases (i.e., Levels 2, 3 and 4). These levels cover International conflict intensities ranging from border clashes (Level 2) through high level regional wars (Level 4); Domestic conflicts range from terrorist sabotage, assassinations, bombings, etc. (Level 2) through civil war (Level 4). Level 1 conflicts were deleted from the summaries because they are ubiquitous; Level 5 conflicts (General War) are deleted as being out of scope for CMF operations. The summaries of findings pertinent to the conflict environment task are divided into a Global Overview (Table 2-6), Regional Summaries (Tables 2-7 through 2-13), and a Table (2-14) indicating the world-wide likelihood of General War.*

*Although General War is outside the scope of this project, it was included in the forecasting effort to round out the conflict spectrum. The resulting probabilities were surprisingly high.

(U) TABLE 2-6: GLOBAL OVERVIEW OF CONFLICT/INVOLVEMENT FORECASTS (U)

- THE HIGHER LIKELIHOOD CONFLICTS CLEARLY INDICATE THAT EVEN IN THE FACE OF MAJOR POWER ACTIVITIES AND INTERNATIONAL TENSIONS THE VAST MAJORITY OF CONFLICTS ARE FORECAST TO BE DOMESTIC (INSURGENCIES, TERRORISM, ETC.)
- ENOUGH CASES SHOW UP WHERE THE LONG-RANGE IS MORE CONFLICT PRONE THAN THE MID-RANGE TO DISPEL THE NOTION THAT CURRENT EVENTS UNDULY DRIVE JUDGMENTAL FORECASTS OF THIS TYPE
- OF 107 CHANCES FOR CONFLICT AT EACH INTENSITY LEVEL, 73 HAD A PROBABILITY OF OCCURRENCE $\geq .5$ AT LEVEL 2; 36 AT LEVEL 3; AND ONLY 6 AT LEVEL 4 (ALL IN THE MIDDLE EAST)
- NUMERICALLY, THE MIDDLE EAST, LATIN AMERICA AND SUB-SAHARAN AFRICA* ARE CLEARLY THE MOST CONFLICT-PRONE REGIONS; EUROPE, THE FAR EAST AND SOUTH ASIA HAVE THE FEWEST HIGH PROBABILITY CONFLICTS
- U.S. MILITARY INVOLVEMENT LIKELIHOODS INCREASE WITH CONFLICT INTENSITY LEVELS AND CONFLICT OCCURRENCE PROBABILITIES
- U.S. MILITARY INVOLVEMENTS ARE PREDOMINANTLY IN THE MIDDLE EAST AND LATIN AMERICA
- U.S. COMBAT ROLES ARE LEAST LIKELY OF THE THREE IN A WORLDWIDE SURVEY, BUT MOST LIKELY IN LATIN AMERICA
- DETERRENCE TENDS TO BE THE DOMINANT U.S. ROLE, EXCEPT IN LATIN AMERICA WHERE COMBAT DOMINATES

*Sub-Saharan Africa quickly falls out of this category at Level 3 or greater and becomes quite quiet.

(U) TABLE 2-7: CONFLICT ENVIRONMENT: EUROPE (U)

- RELATIVELY STABLE IN LONG-RANGE
- TOTAL NUMBER OF POTENTIAL CONFLICTS = 7
- ONLY THREE CONFLICTS (ALL AT LEVEL 2) HAVE PROBABILITY OF OCCURRENCE $\geq$ .5
  - GREECE-TURKEY
  - NORTHERN IRELAND
  - US/SOVIET INCIDENTS
- NORTHERN IRELAND UNREST SHOWS > .5 PROBABILITY OF CIVIL WAR IN MID-RANGE
- RELATIVELY HIGH PROBABILITY (.20) OF GREEK/TURKEY PRECIPITATING GENERAL WAR IN MID-RANGE, FALLING OFF IN LONG-RANGE
- U.S./SOVIET CLASH MORE LIKELY IN LONG-RANGE THAN MID-RANGE
  (See Also General War Table)
- PORTUGAL UNREST PEAKS IN MID-RANGE, DECLINES IN LONG-RANGE; CIVIL WAR MORE LIKELY THAN EXTERNALLY SUPPORTED INSURGENCY
- ALTHOUGH LIKELIHOODS OF MAJOR CONFLICT REMAIN RELATIVELY LOW, U.S. INVOLVEMENTS REMAIN QUITE HIGH

(U) TABLE 2-8: CONFLICT ENVIRONMENT: FAR EAST (U)

- RELATIVELY STABLE IN LONG-RANGE
- SEVEN POTENTIAL CONFLICTS; $\geq .5$ LIKELIHOOD AT LEVEL 2 FOR FOUR:
  - CHINA-USSR
  - JAPAN DOMESTIC PROBLEMS
  - TWO KOREAS (MORE LIKELY IN MID-RANGE)
  - SOUTH KOREA DOMESTIC UNREST
- RELATIVELY, CHINA/SOVIET ISSUE PRESENTS ONE OF HIGHEST PROBABILITIES OF GENERAL WAR (.24) IN THE LONG-RANGE
- INSURGENCY IN SOUTH KOREA MORE LIKELY IN LONG-RANGE THAN MID-RANGE
- CONFLICT PROBABILITY FOR LEVELS 3 AND 4 IN JAPAN HIGHER (LESS THAN .5) IN LONG-RANGE
- ONLY HIGH LIKELIHOOD U.S. INVOLVEMENT (COMBAT) IS IN KOREAN CASE

(U) TABLE 2-9: CONFLICT ENVIRONMENT: LATIN AMERICA (U)

- EXTREME INSTABILITY THROUGHOUT REGION IN LONG-RANGE
- NINETEEN POTENTIAL CONFLICTS (ONLY ONE INTERNATIONAL)
  - EIGHTEEN HAVE $>.5$ PROBABILITY OF OCCURRENCE OF TERRORISM
  - TWELVE HAVE $>.5$ PROBABILITY OF OCCURRENCE OF INSURGENCIES
- ALL MAJOR SOUTH AMERICAN COUNTRIES FORECAST TO BE INVOLVED IN INSURGENCIES BY LONG-RANGE
- U.S. COMBAT INVOLVEMENTS QUITE LIKELY IN SEVEN OF TWELVE INSURGENCIES
- U.S./PANAMA ARMED INCIDENTS MORE LIKELY (.7) IN MID-RANGE THAN LONG-RANGE

(U) TABLE 2-10: CONFLICT ENVIRONMENT: MIDDLE EAST (U)

- MOST CONFLICT PRONE REGION
- REGION OF HIGHEST LIKELIHOOD OF DIRECT US/SOVIET CLASHES AT ALL LEVELS
- GENERAL WAR MORE LIKELY IN LONG-RANGE THAN MID-RANGE; MORE LIKELY AS RESULT OF ARAB/ISRAELI WAR THAN VIA DIRECT COMPETITION
- OF 26 POTENTIAL CONFLICTS, OCCURRENCE PROBABILITIES $\geq .5$ AT LEVEL 2 IN 18; AT LEVEL 3 IN 13; AND AT LEVEL 4 IN 6
- MAJOR HIGH LIKELIHOOD LEVEL 4 CONFLICTS
  - US/USSR (.70)
  - ISRAEL/EGYPT (.69)
  - OMAN/SOUTH YEMEN (.60)
  - ISRAEL/SYRIA (.59)
  - CIVIL WAR IN OMAN (.58)
  - IRAN/IRAQ (.53
- INSURGENCIES FORECAST (>.5) FOR IRAQ, IRAN, LEBANON, MOROCCO, SOUTH YEMEN, SUDAN
- AREA OF HIGHEST NUMBER OF US INVOLVEMENTS
- COMMITMENT TO ISRAEL FIRM TO LONG-RANGE
- GENERAL WAR MORE LIKELY IN LONG-RANGE (SEE TABLE 2-14)

(U) TABLE 2-11: CONFLICT ENVIRONMENT: SOUTHEAST ASIA (U)

- LONG-RANGE INSURGENCIES FORECAST ($\geq$ .5) FOR:
  - PHILIPPINES
  - BURMA
  - INDONESIA
  - MALAYSIA

- U.S. INVOLVEMENT LIKELIHOODS SUGGEST COMMITMENT ONLY TO PHILIPPINES

- ALL CONFLICTS SHOW HIGHER LIKELIHOODS IN LONG-RANGE THAN MID-RANGE

- NO INTERNATIONAL CONFLICTS WITH $>$.5 LIKELIHOOD OF OCCURRENCE FOR LONG-RANGE

(U) TABLE 2-12: CONFLICT ENVIRONMENT: SOUTH ASIA (U)

- ONLY FIVE POTENTIAL CONFLICTS, BUT FOUR OF THEM HAVE > .5 PROBABILITY OF OCCURRENCE AT LEVEL 3 (ALL 5 AT LEVEL 2)
  - INSURGENCY IN PAKISTAN
  - INDIA/CHINA
  - PAKISTAN/INDIA
  - PAKISTAN/AFGHANISTAN

- INDIA/CHINA CONFLICT SHOWS SURPRISINGLY HIGH LIKELIHOOD OF GENERATING GENERAL WAR (.23)

- U.S. INVOLVEMENT LIKELIHOODS ARE QUITE LOW ACROSS THE BOARD

(U) TABLE 2-13: CONFLICT ENVIRONMENT: SUB-SAHARAN AFRICA (U)

- MOST POTENTIAL CONFLICTS HERE (32); NINETEEN HAVE > .5 PROBABILITY AT LEVEL 2; AND 3 AT LEVEL 4

- LONG-RANGE MORE CONFLICT-PRONE THAN MID-RANGE

- REGION APPEARS HEADED FOR LONG PERIOD OF DOMESTIC UPHEAVAL SIMILAR TO LATIN AMERICA

- U.S. INVOLVEMENTS UNLIKELY AND LIMITED TO ONLY MAJOR COUNTRIES; U.S. MILITARY DISINTEREST CONTINUES TO LONG-RANGE

(U) TABLE 2-14: WORLDWIDE SUMMARY OF GENERAL WAR LIKELIHOODS, LONG-RANGE*(U)

- 37 POTENTIAL CASES WORLDWIDE
- WORLDWIDE: 9 CONFLICTS WITH PROBABILITY $\geq$ .10 OF TRIGGERING A GENERAL WAR; TWO INVOLVE DIRECT US/SOVIET ISSUES; THE REMAINING SEVEN ARISE FROM THE AFFAIRS OF OTHER COUNTRIES, WITH THE CONCOMITANT INVOLVEMENT OF THE MAJOR POWERS
- GENERALLY HIGHER LIKELIHOODS THAN IN PREVIOUS FORECASTS
- EUROPE: HIGHER LIKELIHOOD (.14) IN LONG-RANGE FOR DIRECT US/SOVIET INITIATION
- FAR EAST: TWO CASES WITH PROBABILITY $\geq$ .10 -- CHINA/USSR (.24) AND JAPAN/USSR (.10); CHINA/SOVIET CASE IS TIED FOR HIGHEST PROBABILITY WORLDWIDE
- LATIN AMERICA: VERY STABLE INTERNATIONALLY
- MIDDLE EAST: FOUR HIGH LIKELIHOOD CASES -- US/USSR (.24); ISRAEL/EGYPT (.24); SURPRISINGLY, IRAN/IRAQ (.21); AND ISRAEL/SYRIA (.14)
- SOUTHEAST ASIA: NONE
- SOUTH ASIA: SURPRISINGLY HIGH LIKELIHOOD IN INDIA/CHINA CASE (.23)
- SUB-SAHARAN AFRICA: SURPRISING CASE IN ETHIOPIA/SOMALIA (.10)

*U.S. is, by definition, involved in General War Cases

4.0 TECHNOLOGICAL FORECASTS

(U) Technological forecasts were a means to an end in this study, and for the most part were drawn from previous STC study efforts and updated for use here, or consolidated from relevant sources. They provided the basis for characterizing CMF forces, threats, and operating environments in the 1990's. The forecasts constructed a broad framework within which scenario development and shortfall analysis would be accomplished. Additionally, they defined the initializing bases and the general technological context from which R&D initiatives could be generated.

(U) As indicated above, appropriate technological forecasts were drawn from prior STC study efforts or from other qualified sources. These forecasts fall into the following broad areas:

- Weapons Inventories: the numbers and types of equipment in the inventories of major actors in international affairs
- Military Potential: the capability of countries to develop and support military forces
- Arms Manufacturers and Suppliers: the major builders of weapons systems and sources of arms supplies

These three forecasting areas were supported by extensive surveys of:

- Current weapons inventories and weapon characteristics
- U.S. R&D programs currently underway
- U.S. military long-range planning and objectives documents
- U.S. force concepts and basing posture for the 1990's

(U) The forecasting problem was broken into two broad areas - adversary-related forecasts and U.S. capability forecasts - with some elements

common to both. For adversary-related forecasts, heavy emphasis was placed on general military potential and gross assessments of inventories to provide threat data. Emphasis was placed on reviews of current R&D programs, Service and DOD long-range plans, and basing issues for U.S. capability forecasts.

(U) To varying degrees, each of the Services develop and maintain their own long-range R&D planning documents and a compendium of long-range R&D objectives. This procedure is best illustrated by the U.S. Marine Corps' long-range study, "MARCOR 90", which is updated at five year intervals, and the "Marine Corps Long-Range Plan (MLRP), 1 December, 1971," which sets forth R&D objectives. While the U.S. Army does not maintain long-range study and R&D objective documents identical to those of the Marine Corps, Army long-range study efforts and R&D objectives are reflected in the "Joint Research and Development Objectives Document" (JRDOD).

(U) Currently held long-range concepts and objectives were reviewed; these were used as the baseline for forecasting U.S. CMF capabilities and trends.

(U) Five GPF weapons types consistently rose to the surface of all system-related tasks - both those occurring in parallel with other forecasts and those which occurred later - as being particularly significant and worthy of more in-depth examination:

- Main Battle Tanks
- Anti-Tank Weapons
- Close Air Support Systems
- Armored Personnel Carriers
- Tactical Air Transport

A comparative survey was conducted of current and near-historical weapons inventories and characteristics in an attempt to gain insights into apparent trends in these five systems.

(U) Table 2-15 briefly summarizes findings from this survey in a series of trend observations. The systems of the U.S., USSR, and Western

Europe were selected for review to provide as broad a cross-section as possible of design philosophies, doctrinal considerations and technological advancements. Only a few of Table 2-15's observations are controversial. However, when taken in combination, these trends pose a severe problem to a CMF - surmountable only with a determined R&D program.

(U) TABLE 2-15: TECHNOLOGICAL TRENDS (U)

WORLDWIDE (THREAT)

- Mechanized Equipment Readily Available From Multiple Sources; Mechanized Infantry Will Become the Rule
- Intense Armor vs Anti-Armor Competition Continuing With Anti-Armor Systems Having More Ways to Win
- Most Organized Adversaries With an Attack Helicopter Capability
- Laser-Designated Line of Sight Man-Portable Weapons Widely Available
- Advanced SAM Capabilities Present a Severe Threat to Current Close Air Support Systems - Both the Spotter and Weapons Delivery Vehicles

USA R&D MOMENTUM

- Continued Movement Toward Heavy, Sophisticated, and Extremely Expensive Systems Deployed in Small Numbers
- Little Emphasis on Atomic, Biological, or Chemical Defenses
- Trend Toward Centralization of C^3 and Intelligence Capabilities
- Trend Toward Smaller Quantities of Smarter Man-Dedicated Ordnance
- Proliferation of New Sensor Capabilities, Platforms, and Autonomous Applications
- Continued Emphasis on Small Arms Volume of Fire

(U) TABLE 2-15: TECHNOLOGICAL TRENDS (U) (Cont'd.)

ADVERSARY INVENTORIES

- Reasonable Chances of Facing USA Produced/Designed Equipments
- USSR and West European Equipments Comprise Major Elements of Technical Threat
- Terrorists, Insurgents, and Organized Domestic Opponents With Stolen/Smuggled Equipment Represent an Increased Threat
- Increased Ability of Small Groups to Immobilize Domestic Operations

5.0 SCENARIOS

(U) Five scenarios were derived to serve as the framework for evaluating the three U.S. CMFs:

- A high intensity conflict between the two Koreas
- An insurgency in the Dominican Republic
- An interposition of U.S. forces in the Arab/Israeli context
- A direct U.S./Soviet confrontation in Iran
- A power vacuum and domestic upheaval in the Philippines

For the purposes of this project, a scenario consisted of three parts:

- The setting - type, level, and location of conflict, the threat, the natural environment, and the U.S. role
- The military situation - the mix of missions/objectives for the three CMFs in the particular setting; a specific threat in a specific deployment on a tactical military map
- The event models - the conduct of operations (e.g., entry, movement, attack, etc.) for each CMF, in each military situation, against specific threats; and the evaluation of CMF performance to identify deficiencies

(U) The five scenarios were distilled from a base population of some 1300 candidates. Three criteria drove the selection process:

- Likely - They had to be highly likely conflict situations, with highly likely U.S. involvement in a given role
- Representative - The five had to be, essentially, surrogates for as many others as possible - that is, to study one of the five cases is to study many cases
- Challenging - The five had to represent as broad a cross-section of threats, environments, distances, missions and general problems as possible to tax the capabilities of the CMF

(U) Throughout this project no attempt - explicit or implicit - was made to compare the relative worth of the three CMF force concepts. Each CMF was task organized and introduced into each military situation in such a way as to maximize the effectiveness of that force's capabilities and tactics in the face of identical threats and natural environments. In this way, deficiencies in systems could be highlighted, and force differences could be minimized. The scenarios, then, served both to structure a detailed framework for evaluation, and to provide the actual vehicle for performing those evaluations.

(U) Overall, it did prove possible and analytically useful to select five quite specific design cases to serve as surrogates for the broad spectrum of mission tasking that a CMF could expect by the 1990's. While the five scenarios do contain a number of features not included elsewhere, they are neither intuitively surprising nor displeasing. The conflict environment forecast has indicated that the politico-military exposures of the past are not dissimilar from the exposures of the future; that is, some of the higher likelihood cases have been encountered before, and certain of those must be planned for in the future. Table 2-16 outlines the broad observations resulting from the scenario selection process.

(U) Each scenario was derived to cover a high risk aspect of the CMF task spectrum. Specific actors and issue characteristics remained

(U) TABLE 2-16: GENERAL FINDINGS - SCENARIOS (U)

- THE OBJECTIVE/EMPIRICAL DERIVATION OF SCENARIOS DID NOT PRODUCE ANY COUNTER-INTUITIVE OR UNREASONABLE CASES
- ALL FIVE CASES REPRESENT HIGH LIKELIHOOD, HIGHLY REPRESENTATIVE AND HIGHLY CHALLENGING SITUATIONS
- ALL FIVE CASES ARE APPROPRIATE TO THE CONDUCT OF OPERATIONS OF ALL THREE CMF ALTERNATIVES
- THREATS RANGE FROM DIRECT CONFRONTATION WITH SOVIET ARMORED FORCES TO CIVIL DISTURBANCES IN AN URBAN SITUATION
- ALL FOUR CMF-RELEVANT LEVELS OF CONFLICT INTENSITY ARE REPRESENTED
- ALL THREE BROAD CMF ROLES (COMBAT, PEACEKEEPING, DETERRENCE) ARE INCLUDED
- ALL NATURAL ENVIRONMENT CHARACTERISTICS (TOPOGRAPHY, CLIMATE, ETC.) EXCEPT ARCTIC ARE REPRESENTED IN THE 5 SCENARIOS SELECTED
- BOTH DOMESTIC AND INTERNATIONAL SITUATIONS ARE PRESENT

anonymous until the last stage when specific actors, roles, missions, and circumstances were identified. Tables 2-17 through 2-21 highlight the scenario characteristics which emerged as the preferred CMF design set.

(U) TABLE 2-17: SCENARIO 1: TWO KOREAS (U)

- CMF MISSION: REINFORCE SOUTH KOREAN ARMY ON KIMPO PENINSULA
- EXTREMELY HIGH LEVEL OF THREAT
  - Heavy in Armor and Anti-armor
  - Extensive Mechanized Capability
  - Greatly Improved Tactical Air Support
  - Large Numbers of Ground Forces (Especially with Chinese Support)
- SEVERE OPERATING ENVIRONMENT
  - Extreme Variations in Climate/Topography
  - Extensive, Modern Lines of Communication
- EMPHASIZES NEEDS FOR
  - Tactical Transport
  - Better Forcible Entry Capability
  - Protected Ground Mobility
  - Improved Target Acquisition (Especially for LOS) Capability
  - Reduced Logistics Handling

(U) TABLE 2-18: SCENARIO 2: INSURGENCY IN DOMINICAN REPUBLIC (U)

- CMF MISSION: RESCUE U.S. NATIONALS FROM INSURGENTS IN SANTO DOMINGO

- ENTRY REQUIREMENTS
  - Directly from Sea-Base, or
  - From CONUS by Air

- UNIQUE OPERATING REQUIREMENTS
  - Quick-Reaction
  - Limited Size Force
  - Politically Sensitive Operations
  - Urban Environment

- URBAN ENVIRONMENT EMPHASIZES NEED FOR SPECIALIZED
  - Firepower
  - Mobility
  - C^3
  - Intelligence

(U) TABLE 2-19: SCENARIO 3: ARAB/ISRAELI CONFLICT (U)

- CMF MISSION: FORCE SEPARATION BETWEEN EGYPTIAN AND ISRAELI ARMIES
- POTENTIALLY EXTREMELY SENSITIVE PEACEKEEPING SITUATION
- DIFFICULT OPERATING ENVIRONMENT (SINAI) TESTS DURABILITY
- POTENTIAL HIGH THREAT LEVEL
- PLACES EXTREMELY HIGH REQUIREMENTS ON INTELLIGENCE CAPABILITIES

(U) TABLE 2-20: SCENARIO 4: U.S./SOVIET CONFRONTATION (U)

- CMF MISSION: RELIEVE PRESSURE ON IRANIAN MILITARY VIA SHOW OF FORCE AND DEMONSTRATION OF SUPPORT
- POTENTIAL FULL-SCALE SOPHISTICATED THREAT LEVELS FROM SOVIET FORCES
- POSES MAXIMUM THEORETICAL TEST OF CMF FIREPOWER CAPABILITY
- MOST DIFFICULT OF ALL OPERATING ENVIRONMENTS
  - Primitive Area (Soviet-Iran Border) Deep in Interior
  - Extremely Long Lines of Communication
  - Severe Terrain, Logistics Problem
- EMPHASIZES NEED FOR
  - Heavy Firepower
  - Entry, Mobility, Logistics Capabilities
  - Staying Power

(U) TABLE 2-21: SCENARIO 5: PHILIPPINE POWER VACUUM (U)

- CMF MISSION: PROTECT U.S. NATIONALS AND PROPERTY, DETER OTHER POWERS FROM ACTIVE PARTICIPATION IN OR TAKING ACTIVE ADVANTAGE OF UNSTABLE SITUATION

- LOWEST LEVEL TEST OF CMF CAPABILITIES

- TROPICAL ENVIRONMENT AND ILL-DEFINED THREAT TEST CMF ADAPTABILITY

- WIDESPREAD, SENSITIVE URBAN/RURAL OPERATING ENVIRONMENTS POSE SPECIAL REQUIREMENTS FOR
  - Decentralized Intelligence
  - Small-Unit Communications
  - Quick-Reaction Mobility
  - Specialized Firepower

6.0 SHORTFALLS

(U) Shortfalls were the driving force behind the derivation of candidate advanced R&D concepts. All candidate R&D concepts were specifically geared to overcoming one or more of the identified shortfalls in CMF capabilities. Therefore, a major objective of the project was to ensure the defensibility of these shortfalls.

(U) For the purpose of this project, a shortfall is defined as a problem or deficiency in the ability of a CMF to accomplish its assigned mission in the circa 1990 period which is not resolvable by inventoried or programmed capability. Resolution must come from the development of new or improved weaponry, equipment or supplies, through changes in organizational, doctrinal or procedural changes, or through the resurrection of useful systems which have slipped from current inventories. Emphasis was placed upon those shortfalls least likely to be resolved through R&D programs driven by broader General Purpose Forces objectives. Five functional areas were considered: Firepower, C^3, Mobility, Intelligence, and Logistics.

(U) CMF force models were exercised through the tactical events identified in the design scenarios, using manual wargaming techniques. Tactical scale maps were employed to plot dispositions of forces, measure operational parameters, and examine force interactions. Each event constituted a test designed to emphasize certain force characteristics. Outcomes were recorded in terms of the measures of effectiveness in Table 2-22.

(U) Shortfalls nominated during the course of the conflict analysis were debated pro and con by the study group and recorded in terms of potentially contributing and/or resolving factors. A balancing argument was also developed which resulted in a decision to either accept or reject the nominated shortfall. A reexamination of current U.S. R&D programs was performed to assure that the shortfall area was not being extensively researched by ongoing efforts. The surviving shortfalls were then used as the basis for generating R&D initiatives.

(U) TABLE 2-22: MEASURES OF EFFECTIVENESS (MOE'S) (U)

1.	TRANSPORTABILITY	-	A measure of the ability of a CMF to configure for and execute a movement by sea or air so as to respond to a specific mission requirement.
2.	RELIABILITY	-	A measure of the ability of a CMF to maintain mission effectiveness relative to a given adversary and the operating environment
3.	ENDURANCE	-	A measure of the ability of a CMF to conduct operations over a period of time relative to mission life of manpower, equipment and supply resources
4.	FLEXIBILITY	-	A measure of the ability of a CMF to configure for and respond to variable mission requirements
5.	SENSITIVITY	-	A measure of the ability of a CMF to provide only that degree of force required to accomplish the mission
6.	INDEPENDENCE	-	A measure of the ability of a CMF to fulfill mission requirements within the limitations of its organic capabilities

(U) In general, the shortfalls identified in this analysis stem from the need for a CMF to be able to go anywhere, anytime, with just enough force to stop the crisis from escalating out of hand. This poses particularly difficult geographic qualification requirements on the intelligence cadre, transportability limits upon all elements of the force, and sensitivity constraints on combat systems. Frequently without a protected rear area or readily identifiable adversary, CMF bases of operations will be continually harrassed. Due to the sensitive nature of most CMF operations, too much force may be as undesirable as too little.

(U) A CMF is much more likely to become involved in Peacekeeping and Deterrence roles than in Combat. These roles place high demands on intelligence, C^3, sensitivity, and endurance. However, these are areas in which technology can be a definite and significant aid.

(U) Tables 2-23 through 2-27 summarize the surviving shortfalls which served as the basis for R&D concept invention.

(U) TABLE 2-23: CMF SHORTFALLS: FIREPOWER (U)

- ANTI-TANK AND ASSAULT WEAPONS:

  DEFICIENCY IN NUMBERS AND CLOSE-IN (0-500') CAPABILITIES, PARTICULARLY REGARDING BACKBLAST EFFECTS AND SPECIALIZED TRAINING REQUIREMENTS

- INDIRECT FIRE WEAPONS:

  LACK OF ABILITY FOR TRANSPORTABLE WEAPONS TO DEAL WITH A MASSED ARTILLERY/ARMORED THREAT; GUIDED MUNITIONS' RELIANCE UPON FAVORABLE WEATHER AND SENSITIVITY TO COUNTER SYSTEMS; FAILURE TO EXPLOIT THE LARGE NUMBER AND SIMPLICITY OF EXISTING 81 AND 107 MM MORTAR INVENTORIES

- SMALL ARMS:

  UNFAVORABLE TREND IN SINGLE SHOT HIT/KILL EFFICIENCY; EXTREME COST IN LOGISTICS SUPPORT REQUIREMENTS FOR SMALL ARMS AMMUNITION

(U) TABLE 2-24: CMF SHORTFALLS: COMMAND, CONTROL, AND COMMUNICATION (U)

- HOSTILE WEAPONS LOCATION:

  VULNERABILITY, EM EMISSIONS AND DIFFICULT TRANSPORTABILITY OF CURRENT RADAR SYSTEM; NEED TO EXPLOIT PASSIVE, DECENTRALIZED SENSORS; LACK OF CAPABILITY IN URBAN ENVIRONMENT

- SMALL UNIT COMMUNICATIONS:

  DEFICIENT SECURITY TRAINING AND/OR EQUIPMENT SAFEGUARDS BETWEEN SMALL UNITS; INABILITY TO COMMUNICATE IMAGERY TO REPLACE/COMPLEMENT VOICE TRANSMISSIONS

(U) TABLE 2-25: CMF SHORTFALLS: MOBILITY (U)

- PROTECTED GROUND MOBILITY

  DEFICIENT QUANTITIES OF TRANSPORTABLE APC'S TO MANEUVER WITH MECHANIZED ADVERSARY; PROJECTED APC'S TOO HEAVILY ARMORED; INABILITY TO NON-DESTRUCTIVELY MANEUVER IN AN URBAN ENVIRONMENT UNDER HARRASSING FIRE OR CBW ATTACK

- V/STOL AIR TRANSPORT

  DEFICIENT RANGE-PAYLOAD CHARACTERISTICS TO RESPOND FROM AVAILABLE STAGING AREAS; REDUCED ABILITY TO FUNCTION IN UNIMPROVED AREAS UNDER HARRASSING FIRE

(U) TABLE 2-26: CMF SHORTFALLS: INTELLIGENCE (U)

- AREA QUALIFICATIONS AND TACTICAL OOB:

  INABILITY TO MAINTAIN LANGUAGE AND AREA-QUALIFIED CADRE IN ELEVATED READINESS FOR ALL POTENTIAL CMF DEPLOYMENTS; EXCESSIVE RESPONSE TIMES FOR TACTICAL OOB INTELLIGENCE, PARTICULARLY FOR DOMESTIC OPPONENTS AND INSURGENT GROUPS

- COLLECTION, PROCESSING, AND DISSEMINATION:

  REDUCED EFFECTIVENESS AGAINST DOMESTIC OPPONENTS, TERRORIST GROUPS, AND INSURGENTS, PARTICULARLY IN PREDOMINANTLY ECONOMIC AND/OR POLITICAL CRISES; REDUCED UTILITY OF TACTICAL OPERATIONS CENTER TO UNIT COMMANDERS; EXCESSIVE LOGISTIC IMPLICATIONS OF CURRENT DOCTRINE

(U) TABLE 2-27: CMF SHORTFALLS: LOGISTICS (U)

- CARGO HANDLING:

  DEFICIENT CAPABILITY TO INDEPENDENTLY HANDLE MULTIPLE TRANSHIPMENT REQUIREMENTS OF CMF

- SUPPLIES, MAINTENANCE:

  SEVERE PROBLEM CAUSED BY SHEER VOLUME OF TRANSPORT REQUIRED FOR ENDURANCE AND INDEPENDENCE

7.0 R&D INITIATIVES

(U) The final analytical task of this project was the identification, description and evaluation of candidate advanced R&D concepts responsive to CMF-specific requirements. The ultimate purpose of the project as a whole was to provide to DARPA a list of CMF-relevant, parametrically/functionally described, carefully evaluated candidate research initiatives which, if undertaken now, could materially enhance the capability of Crisis Management Forces to perform a broad mix of military missions in the 1990's. The achievement of this broad purpose required the execution of the following steps:

- The postulation and description of candidate concepts, and the initial culling of concepts based on relevance and feasibility tests
- The assessment of concepts' technical achievability; modifications to designs as required; introduction of new candidates; and culling of concepts
- The assessment of candidates' mission effectiveness and overall value

(U) The primary requirement levied on all candidate R&D initiatives was that they be responsive to CMF-specific shortfalls, as derived from the five scenarios. A second concern was that the candidate be plausibly feasibly by the 1990 period. However, rigid technical feasibility was not employed as a qualifying criterion in the concept definition phase. Feasibility determination was left for expert assessment in the concept evaluation step. Thus, the driving criterion for the concept formulation and description phase was that of CMF relevance. Other, previously agreed upon, scoping limitations were:

- Only GPF-related concepts to be addressed (i.e., strategic (e.g., Trident) systems were out of scope)
- Only concepts useful to a division size force
- Doctrinal, Procedural, and Tactical Operations considerations were out of scope

(U) Prior to initiative work on the identification and description of R&D initiatives it was necessary to assure that the shortfalls toward which the R&D efforts would be pointed were indeed significant. This required reviewing each shortfall as it was nominated from the Shortfall Analysis task to ascertain that it reflected:

- CMF-specific deficiencies
- A non-doctrinal, non-TO&E, non-procedural problem; that is, that it was potentially resolvable through technology or studies-related means
- An area of R&D not currently being emphasized somewhere in the community

(U) A method for transitioning from "requirements" to "specific concepts" was devised by viewing the requirements in terms of the broad means available to satisfy them. These means took the form of three types of requirement-satisfying approaches: 1) those related to hardware or system-oriented solutions; 2) those to which hardware was not the answer, but a new approach, human factors, or a research study seemed appropriate; and 3) those which were clearly in the domain of doctrine, procedure, or tactical operations, and not a function of new system requirements. The third approach was noted and then dismissed from further effort as being out of scope for this project. The remaining efforts were focused on the first two approaches, with hardware-oriented concepts receiving the bulk of attention.

(U) Candidate R&D initiatives (i.e., concepts) were derived from a two-step process, both facets of which relied heavily on the utilization of the judgment of weapons/support systems technology experts. These personnel were categorized by functional area of expertise (e.g., C^3, logistics, intelligence, etc.), and addressed only requirements/concepts related to their functional area of competence.

(U) They were provided a listing of the shortfalls pertaining to their area of expertise, the complete scenario descriptions, threat data, and U.S. CMF capabilities data as a framework within which new concepts could be formulated. The only constraints on their efforts were those identified above as scoping limitations. A preliminary listing of new initiatives was thus derived. The initial culling of these concepts was based on three tests: 1) a determination of the gross physical feasibility of the idea, 2) an assessment of the applicability of the idea to CMFs*, and 3) a survey of current R&D efforts to ascertain whether or not the idea had unique features not currently being pursued in ongoing research programs.

(U) The concepts which survived this initial culling (some 50 initiatives from an original list of 120) were then described in consistent terms. Each concept was described in terms of:

- System Concept: A brief statement of what the initiative was expected to do
- Performance Objectives: As detailed as possible a description of desired performance characteristics
- Benefits: A brief statement as to why this concept is better than current and/or alternative systems
- Rationale: Reason for this system being postulated, including appropriate shortfalls and requirements
- Pacing Technologies: Those areas where particular R&D emphasis may be required

(U) Initiative descriptions generally took two forms: functional and parametric. Where the concept was study-related, where the system being postulated was intrinsically imprecise, or where accord could not be achieved in terms of a precise system description the concept was described functionally; that is, in place of precise system performance measures emphasis was placed on

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*This was a two-step assessment: first to assure that the idea fit into the CMF portion of the overall GPF framework, and second to ensure that the idea did not have adverse doctrinal, procedural or tactical operations effects.

general narrative-based descriptions. Where the system under consideration clearly lent itself to measurable descriptions (e.g., weight, speed, range, etc.) it was so described.

(U) Extensive use of expert judgment in a carefully structured and controlled validation and evaluation exercise was the vehicle for assessing the concepts. Nine evaluation criteria were used in this effort. The first two criteria address the issue of feasibility from both a technology and cost perspective. Cost was not measured in monetary terms, but as levels or magnitudes of effort required to achieve the concept. Effectiveness measures are in the same terms as the MOE's used to derive shortfalls. In this case these MOE's focus on the contributions of the specific candidate concepts to the performance of CMF missions. A final criterion, Versatility, relates to the degree to which the candidate concept can find applications outside CMF-specific requirements.

(U) A scaling scheme was devised to allow gradations in judgment to be displayed, without specifically requiring priority rankings. That is, what was desired was an assessment of each candidate in vacuo, not in direct competition with other alternatives. The scaling for Cost and Risk was on an A-F basis, with qualitative descriptions corresponding to each letter entry. The six Effectiveness and the Versatility criteria were also provided an A-F range, but the descriptions appropriate to each entry were quantitative (in percentage terms). Each candidate could have, theoretically, received identical scores because the measures were for any alternative, not just those presented in this listing of candidates.

(U) Two entirely independent groups of experts were involved. The first group was comprised mostly of Westinghouse personnel from various R&D and applied engineering centers. These 26 people reflected a state of the art S&T capability, and their main focus was on the developmental and engineering implications of the candidate initiatives. The second group was drawn from outside Westinghouse, and consisted of personnel from other contractors and consultants. The primary emphasis (and expertise) for this group was in the operational, military science and intelligence implications of the initiatives.

(U) In an attempt to reduce effects of any bias or self-interest factors which may have influenced the balloters, no persons who participated in the identification and description of the candidate initiatives were included in the evaluation of those systems.

(U) A review of the ballot results supports the following conclusions regarding the balloting process:

- Consensus within a group was reasonable (generally less than a point spread and often less).
- The S&T balloters (Round 1) tended to vote slightly higher than the mission specialists
- A slight degree of individual pessimism was noted in a few second round voters

All in all, the findings provide useful support for selection of preferred options from among the derived list of candidate R&D initiatives.

(U) Subsequent to the tabulation of the balloting results, the preferred R&D candidates for which tabulations were summarized were re-evaluated by the study group within the context of each scenario to assess, qualitatively, the potential contribution to reduction of the shortfall areas previously identified. Recalling that shortfall impact was previously measured for each scenario in terms of CMF-unique measures of effectiveness (Transportability, Reliability, Endurance, Independence, Sensitivity, Flexibility), the R&D concept payoffs are measured in the same terms.

(U) On the basis of this analysis of the potential value of the proposed R&D initiatives it is concluded that:

- There are no shortfall areas identified for which there have not been proposed several R&D initiatives which offer a potential for reduction of that shortfall through improved Effectiveness at an acceptable Cost and Risk.

- There are significant cross-benefits to be realized from the pursuance of the recommended R&D initiatives.

(U) Short descriptions of the higher ranking R&D initiatives are contained in the following Tables 2-28 through 2-32; definitions of the nine criteria by which the candidates were evaluated are presented in Table 2-33.

(U) TABLE 2-28. MOST PROMISING R&D CONCEPTS (U)

FUNCTIONAL CATEGORY:
FIREPOWER

R&D INITIATIVE TITLE	CONCEPT	CMF SHORTFALL CONTRIBUTION
INTERMEDIATE RANGE WEAPONS	Improved precision guidance for indirect fire ordnance and extended range of line of sight weaponry	Decreases CMF Vulnerability to massive armor artillery threat; provides increased force Independence and Sensitivity
SMALL ARMS	Improved sighting/firing techniques combined with improved training procedures	Reduces logistic burden, increases force Reliability and Sensitivity
SHORT RANGE ASSAULT WEAPON	Close in ballistic system with quick sighting and reduced backblast	Increases weapons numbers and force Flexibility/ Sensitivity; reduces training and man dedication
COUNTERS TO LINE OF SIGHT (LOS) WEAPONS	Quickly deployable smoke or blinding flash breaks contact with threat	Increases force Reliability
INDIRECT FIRE FROM POINT OF ENTRY	Long range, high precision mass destruction weaponry	Improves force Transportability, Independence and Sensitivity
SHORT RANGE ANTI-TANK WEAPON	Close in ballistic system with quick sighting and reduced backblast, complimentary to costly medium range systems	Increases weapons numbers and force Flexibility/ Sensitivity; reduces training and man dedication
PSYCHOPHYSICAL TECHNIQUES	Introduction of artificial manias, psychoses, etc., to distract, enervate or disable adversary forces	Increases force Flexibility and Sensitivity
LOW COST LOS TERMINAL GUIDANCE	Inexpensive technique for guiding indirect fire ordnance compatible with 81 mm mortar	Decreases logistic burden, increases force Endurance, Reliability and Sensitivity; utilizes existing launch system

(U) TABLE 2-29. MOST PROMISING R&D CONCEPTS (U)

FUNCTIONAL CATEGORY:
C^3I

R&D INITIATIVE TITLE	CONCEPT	CMF SHORTFALL CONTRIBUTION
HOSTILE WEAPONS LOCATOR SENSORS	Alternative techniques for locating hostile weapons	Reduces force Vulnerability and improves Sensitivity
SMALL UNIT SECURE COMMUNICATIONS	Improved equipments and techniques for low echelon secure communications	Reduces force Vulnerability
SMALL UNIT IMAGERY COMMUNICATIONS	Exploitation of imagery transmission techniques to reduce volume of communications	Improves force Flexibility while reducing Vulnerability
SATELLITE MICROWAVE ILLUMINATOR	Bistatic radar transmission from orbit	Improves on force Independence, and reduces radar Vulnerability
RADIOMETRIC SENSOR PLATFORM	Utilizes passive radiometry to detect targets from elevated platforms	Increases force Reliability
BI-STATIC RADAR APPLICATIONS	Radar receiver remotely located from transmitter	Reduces force Vulnerability
LOS WEAPON INDICATOR	Identifies spotter location and/or source of designator energy	Increases force Reliability
HOSTILE WEAPONS LOCATOR (URBAN)	Utilizes various sensor techniques appropriate to congested urban areas	Increases force Reliability and Sensitivity

(U) TABLE 2-30. MOST PROMISING R&D CONCEPTS (U)

FUNCTIONAL CATEGORY:
MOBILITY

R&D INITIATIVE TITLE	CONCEPT	CMF SHORTFALL CONTRIBUTION
ELECTRIC DRIVE SUBSYSTEM	Exploits highpower density electric motor/ generator concept to provide light, flexible power train	Improves Endurance characteristics of force
LIGHT WEIGHT & LOW-COST ARMORED PERSONNEL CARRIER (APC)	Combines wheeled chassis with new armor techniques	Increases Reliability, Flexibility and Endurance of force
ADVANCES WHEEL CONCEPTS (MOON WHEEL)	Non-pneumatic, flexible wheels provide for all terrain trafficability	Improves force Flexibility
HYBRID APC/HELO/ CONTAINER LIFT SYSTEM	Armored ground vehicle or cargo container can be helo-lifted in loaded configuration	Increases force Independence, Flexibility and Endurance
V/STOL MEDIUM TRANSPORT	Provides for short takeoff/landing on unimproved terrains and increased range/payload using new aerodynamics design and improved power plants	Increases force Independence, Flexibility and decreases Vulnerability

(U) TABLE 2-31. MOST PROMISING R&D CONCEPTS (U)

FUNCTIONAL CATEGORY: INTELLIGENCE

R&D INITIATIVE TITLE	CONCEPT	CMF SHORTFALL CONTRIBUTION
LANGUAGE COMPARATOR (OOB)	Small keyboard device assists in translation of OOB terms between operator and native	Improved force Independence, Reliability and Flexibility
CMF APPLICATIONS SATELLITE	Exploits satellite direct access to highland for intelligence sources	Improved force Independence, Reliability and Flexibility
COMBAT & STRATEGIC PHOTO INTELLIGENCE	Improved techniques for direct processing of photo imagery	Increases Reliability
PSYCHOLOGICAL PROFILER	Suite of sensors and behavioral keys to determine subject's recent activities, intentions, etc.	Increases Reliability
NATIONAL SUPPORT TO CMF EFFORTS	Near real time photo imagery through data link with national resources	Increases Independence
HUMAN FACTORS IN INTELLIGENCE (INFORMATION PROCESS)	Determines commander's needs and matches with intelligence product	Increases Reliability
INDIRECT TARGET DETECTION	Compares aerial imagery overlayed on map data to identify likely target locations and movement routes	Decreases Vulnerability and increases Reliability, Sensitivity and Flexibility
HUMAN FACTORS IN INTELLIGENCE (DISSEMINATION & DISPLAY)	Instant visual display techniques are used to provide real time estimation capability	Increases Reliability

FUNCTIONAL CATEGORY:
LOGISTICS

(U) TABLE 2-32. MOST PROMISING R&D CONCEPTS (U)

R&D INITIATIVE TITLE	CONCEPT	CMF SHORTFALL CONTRIBUTION
NOVEL POWER SOURCES	Fuel cells, high temperature ceramics, turbine and other high efficiency power concepts	Improves Endurance, Flexibility and Transportability of force
IN-THEATER POL GENERATION	Utilizes nuclear powered generator to produce gaseous fuels as alternatives to POL	Increases force Independence and improves Endurance and Transportability
WHEELED CONTAINER TRUCK/TRAIN	Standardized containers with strap on wheels can be integrated into trains	Improves force Transportability and Flexibility
LIGHT MODULAR NUCLEAR POWER PLANT	Helium cooled, graphite moderated reactor coupled with a closed cycle turbine	Increases force Endurance and Independence
DISPOSABLE/LIMITED LIFE ITEMS	Exploits low-cost, large volume consumables to reduce cargo handling and maintenance/ repair requirements	Improves force Independence, Transportability and Flexibility
FORWARD SHIP/BASE-TO-FORWARD-AREA CONTAINER	Remotely guided glider homes on forward area beacon for resupply	Increases force Endurance and Flexibility

(U) TABLE 2-33: EVALUATION CRITERIA DEFINITIONS (U)

CRITERIA	
R&D COST	Assessment of magnitude of resources which must be allocated to the development of the system being elevated in terms of manpower, facilities, equipment, etc.
TECHNICAL RISK	Assessment of the ability of U.S. technology to satisfy the stated design objective(s)
EFFECTIVENESS	Degree to which system contributes to CMF mission success or to resolving shortfall in terms of the following measures, as defined in Table 2-22: Transportability, Reliability, Endurance, Flexibility, Sensitivity and Independence.
VERSATILITY	Degree to which system contributes to other GPE or strategic applications