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**MORS WORKSHOP - CHEM-BIO WMD: UNDERSTANDING
THE PROBLEM, OPERATIONS ANALYSIS WORKING
GROUP, LOW SPECTRUM CONFLICT SUBGROUP**

DECEMBER 2001



**CENTER FOR ARMY ANALYSIS
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13. ABSTRACT (<i>Maximum 200 Words</i>) This report documents the insights developed by the Low Spectrum Conflict Subgroup of the Operations Analysis Working Group at the 30 January – 1 February 2001 Military Operations Research Society (MORS) Workshop titled <i>Chemical-Biological Weapons of Mass Destruction (CB WMD): Understanding the Problem</i> . The overall goal of the workshop was to develop a comprehensive and improved understanding of the CB WMD analysis problem confronting the United States at home and abroad and to assess the military operations research community's capabilities to support military and civil CB WMD defense, crisis response, and consequence management efforts. The Operations Analysis Working Group addressed analysis issues ranging from major theater warfare to small-scale contingencies (SSCs), counterterrorism, and homeland security. The Low Spectrum Conflict Subgroup primarily focused on SSCs, to include continental United States (CONUS) civil support missions.				
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**MILITARY OPERATIONS RESEARCH SOCIETY (MORS) WORKSHOP –
CHEMICAL-BIOLOGICAL WEAPONS OF MASS DESTRUCTION (CB WMD):
UNDERSTANDING THE PROBLEM, OPERATIONS ANALYSIS WORKING GROUP,
LOW SPECTRUM CONFLICT SUBGROUP**

SUMMARY

THE WORKSHOP PURPOSE was to develop a comprehensive and improved understanding of the CB WMD analysis problem confronting the United States at home and abroad and to assess the military operations research community’s capabilities to support military and civil chemical-biological weapons of mass destruction (CB WMD) defense, crisis response, and consequence management efforts. This report documents the insights gained by the Low Spectrum Conflict Subgroup of the Operations Analysis Working Group, focusing on issues associated with small-scale contingencies (SSCs), to include continental United States (CONUS) civil support missions.

THE WORKSHOP SPONSOR was the Military Operations Research Society (MORS), with the lead Department of Defense (DOD) proponent being the Deputy Assistant to the Secretary of Defense for Chemical-Biological Defense (DATSD(CBD)).

THE WORKSHOP OBJECTIVES were to achieve a better understanding of the CB WMD defense analysis problem by identifying and evaluating the following:

- (1) Characterization of CB WMD threats and effects by operations research (OR) techniques
- (2) Military OR capabilities to support military and civil authorities
- (3) Current and anticipated CB WMD analytical tools, methodologies, and shortfalls
- (4) CB WMD data sources, data shortfalls, test results, and study efforts

THE SCOPE OF THE WORKSHOP was to examine OR capabilities and shortfalls for the defense against potential adversaries’ employment of CB WMD in military operations spanning the spectrum from major theater warfare to small scale combat to counterterrorism to homeland security.

THE PRINCIPAL FINDINGS of the Low Spectrum Conflict Subgroup are:

- (1) Operational objectives for CB WMD analysis must support the following four functions: prevent (or deter) CB attack, protect against CB attack, respond to CB attack, and restore operations.
- (2) Seven overarching objectives for CB WMD analysis, each of which support one or more of the above functions, are hazard prediction, casualty estimation, system performance,

doctrine development, training, simulation based acquisition, and concept of operations (CONOPS) development.

(3) The following data sources, in priority order, can be used to represent the OR characterization of threats and effects: direct or actual data, simulant data, parametric data, anecdotal data, and professional judgment. In all cases data validity is an issue that must be addressed.

(4) The following shortfalls exist in CB WMD analysis: understanding and prioritization of CB threats, validation and availability of models, data and scenarios, acceptance of DOD models by the civilian community, and resource requirements and capabilities studies supporting CONUS CB defense.

(5) A number of proposed development tools have been identified in this report to address the above shortfalls, ranging from development of algorithms and models to improved data management tools.

(6) Numerous analysis efforts have also been identified in this report to address the above shortfalls, focused on qualitative as well as quantitative analysis. Developing standards is a recurring theme in these proposed efforts.

THE PRINCIPAL RECOMMENDATION is to begin addressing the CB WMD analysis problem by bounding it, defining roles and responsibilities of stakeholders at all levels (strategic, operational, and tactical), increasing communication between the OR and user communities, and prioritizing analysis efforts.

THE PROJECT EFFORT was conducted by Mr. Greg Andreozzi, Conflict Analysis Center, Center for Army Analysis (CAA).

COMMENTS AND QUESTIONS may be sent to the Director, Center for Army Analysis, ATTN: CSCA-CA, 6001 Goethals Road, Suite 102, Fort Belvoir, VA 22060-5230.

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1 WORKING GROUP FINDINGS

1.1 Operations Analysis Working Group

Due to the expected size of the Operations Analysis Working Group and to maximize participant interaction, we split this working group into two subgroups: the High Spectrum Conflict Subgroup and the Low Spectrum Conflict Subgroup. Colonel Rich Hanley of the Air Force Studies and Analysis Agency (AFSAA) chaired the High Spectrum Conflict Subgroup and Mr. Greg Andreozzi of the Center for Army Analysis (CAA) chaired the Low Spectrum Conflict Subgroup.

Together, the two subgroups were designed to cover the full spectrum of operational contingencies. The primary focus of the High Spectrum Conflict Subgroup was at the major theater war (MTW) level while the Low Spectrum Conflict Subgroup's primary focus was the small-scale contingency (SSC) level, to include continental United States (CONUS) Civil Support missions. The intention was for each subgroup to leverage and integrate chemical and biological (CB) weapons of mass destruction (WMD) defense analysis issues, solutions, and lessons learned from the full spectrum of operational contingencies.

This report details the insights developed by the Low Spectrum Conflict Subgroup.

1.2 Low Spectrum Conflict Subgroup

Dr. Allen	IDA/SED	MAJ McCreedy	AFSAA
LtCol Ahmed	MD ANG	Mr. McCreedy	USCG R&D Center
Mr. Andreozzi	CAA	Ms. Milchling	SBCCOM
LT Aucott	First Coast Guard Dist.	Mr. Norman	BAH
LTC Beam	MDW	Ms. Razulis	SBCCOM
Mr. Cherry	Logicon	Mr. Ryan	ITT
LTC Cummings	CoMPIO	Mr. Sands	MITRE
Mr. Dickson	MANSCEN	Mr. Sergio	BAH
Mr. Dunaway	Noesis, Inc.	Mr. Slavinski	CMI-Services
Mr. Hall	CAA	Mr. Tehee	MSIAC
LTC Hill	USANCA	Mr. Thornton	HQ AFCESA/CEXR
Ms. Harlow	JHU/APL	Mr Gene Visco	Synthesis group
Ms. Hoeber	AMH Consulting	Mr. Wallis	IDA
MAJ Laughridge	MDW DCSOPS	Mr. Zielinski	DTRA
LT Lechthaler	USCG ACTNY		

Figure 1. Low Spectrum Conflict Subgroup

The Low Spectrum Conflict Subgroup was comprised of a combination of government and industry personnel involved in chemical and biological WMD defense issues. Most of the group worked in the civil support area, and thus much of our discussion was focused on CONUS civil support rather than outside continental United States (OCONUS) small-scale contingencies and MTWs, although overlaps were recognized. Many of the participants worked in program development and analysis areas, while some are potential users or customers of these programs and analysis.

1.3 Low Spectrum Conflict Subgroup Agenda

31 January 2001		
0800 – 0850	* Impact of CB Weapons on Joint Operations in 2010	Ms. Hoeber, AMH Consulting
0900 – 0950	Military Support for Civil Response to Attacks using Weapons of Mass Destruction	LTC Cummings, CoMPIO
1000 - 1050	CMI-Services	Mr. Slavinski, Battelle
1100 - 1150	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA
1200 – 1300	Working Lunch	
1300 – 1350	* WMD Issues for the QDR	Mr. Schultz, IDA
1400 – 1450	Improved Response Program	Ms. Milchling, SBCCOM
1500 - 1700	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA
1 February 2001		
0800– 0950	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA
1000 - 1050	* CB Web Site Demo	Mr. Zimmers, DTRA
1100 – 1150	Subgroup Discussion / Working Session	Mr. Andreozzi, CAA

Figure 2. Low Spectrum Conflict Subgroup Agenda

The 2 days of working group sessions were evenly divided between a series of information briefings and subgroup discussions. Three briefings, identified by asterisks in Figure 2, were provided to the combined Operations Analysis Working Group due to their applicability to both High Spectrum and Low Spectrum Conflict. Ms. Amie Hoeber of AMH Consulting provided a summary of the October 1997 study on the “Impact of CB Weapons on Joint Operations in 2010,” Mr. Doug Schultz of Institute for Defense Analysis (IDA) presented an IDA study he led which looked at how CB should be quantified in the upcoming Quadrennial Defense Review (QDR); and Mr. Walter Zimmers of the Defense Threat Reduction Agency (DTRA) introduced participants to DTRA’s classified and unclassified web sites supporting CB data requirements.

Three additional briefings addressing civil support programs and issues were provided to the Low Spectrum Conflict Subgroup separately. LTC Edna Cummings of the Consequence Management Program Integration Office (CoMPIO) briefed on “Military Support for Civil Response to Attacks using Weapons of Mass Destruction,” Mr. Art Slavinski of Battelle provided a briefing on the “Consequence Management Interoperability (CMI) Services” effort the Marine Corps is currently working; and Ms. Suzanne Milchling of US Army Soldier and Biological

Chemical Command (SBCCOM) provided an overview of the “Improved Response Program” which included recommendations for future analysis efforts.

Remaining working group time was spent in subgroup working sessions, addressing key analysis issues outlined in the workshop terms of reference, with insights presented in the following slides.

1.4 Stakeholders

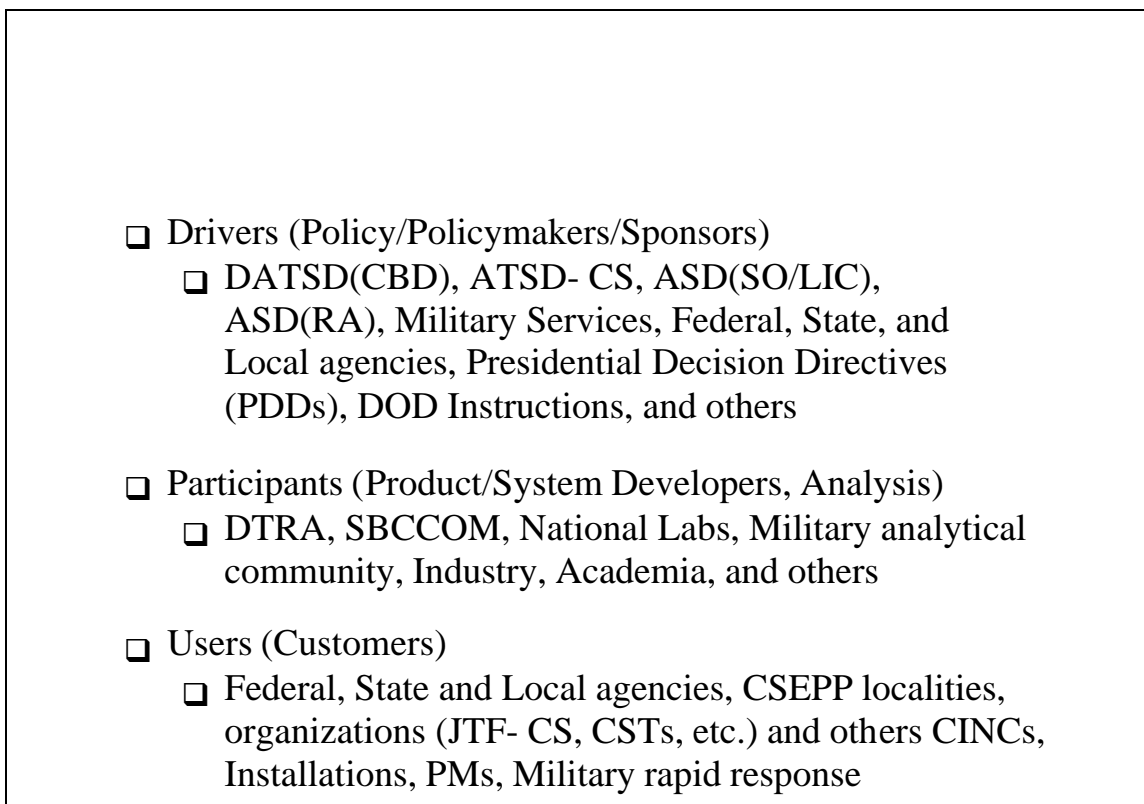
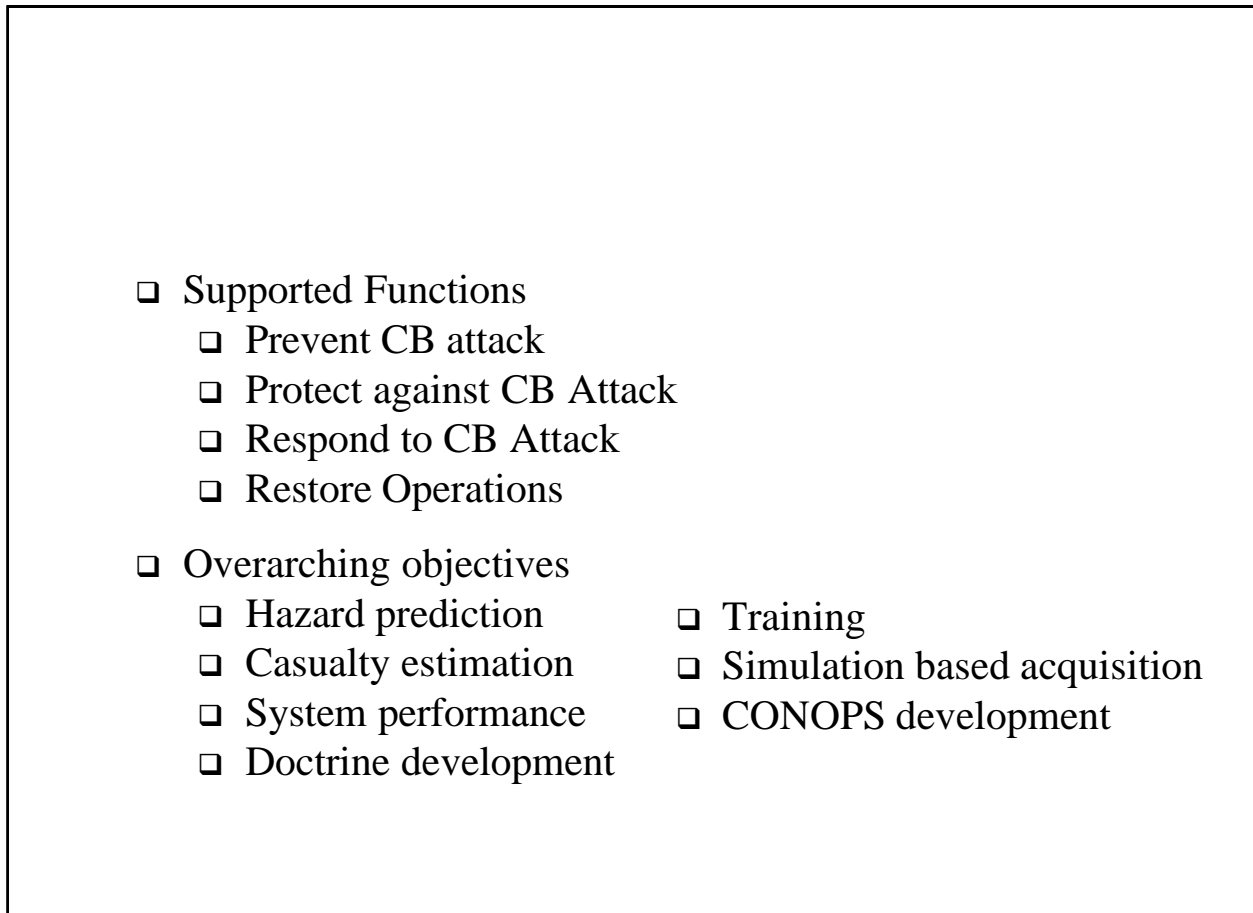


Figure 3. Stakeholders

Numerous stakeholders exist in CB WMD Defense Analysis with varying roles. The Low Spectrum Conflict Subgroup attempted to subdivide the stakeholders into three levels - Drivers (Policy/Policymakers/Study Sponsors), Participants (Product/System Developers, Analysis), and Users (Customers). Shown above is a representation of the stakeholders at the three levels. It should also be pointed out that organizations can appear at more than one level. For example, a Driver can also be a User or Customer of a product that a Participant develops. A common theme among all these stakeholders is the need for clearer definition of roles and closer integration.

1.5 Operational Objectives for CB WMD Analysis



- ❑ Supported Functions
 - ❑ Prevent CB attack
 - ❑ Protect against CB Attack
 - ❑ Respond to CB Attack
 - ❑ Restore Operations
- ❑ Overarching objectives
 - ❑ Hazard prediction
 - ❑ Casualty estimation
 - ❑ System performance
 - ❑ Doctrine development
 - ❑ Training
 - ❑ Simulation based acquisition
 - ❑ CONOPS development

Figure 4. Operational Objectives for CB WMD Analysis

In order to best address the operational objectives for CB WMD analysis, the Low Spectrum Conflict Subgroup first felt a need to define the functions that operational objectives must support. The four supported functions identified were to prevent (or deter) CB attack, protect against CB attack, respond to CB attack, and restore operations.

Seven overarching objectives, each of which support one or more of the functions identified above, are hazard prediction, casualty estimation, system performance, doctrine development, training, simulation based acquisition, and concept of operations (CONOPS) development. If necessary, each of these overarching objectives can be broken down into subobjectives for more detailed analysis.

1.6 OR Characterization of Threats and Effects

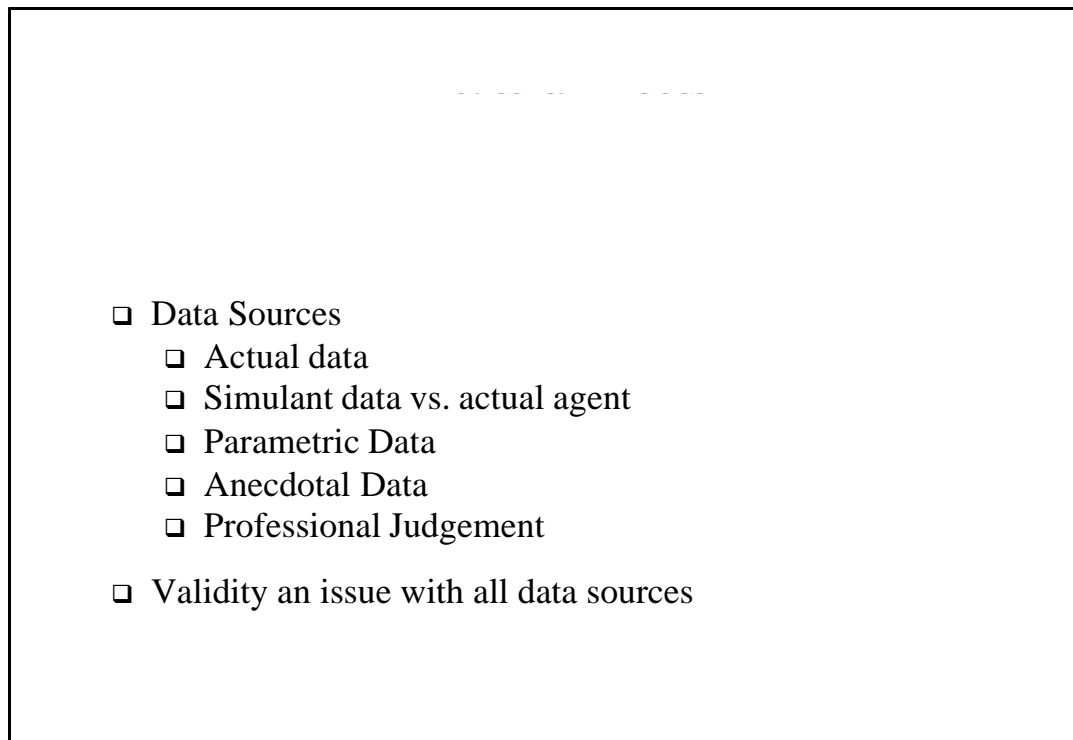


Figure 5. OR Characterization of Threats and Effects

We chose to represent the operations research (OR) characterization of threats and effects through the identification of data options. The first choice in the characterization is the use of direct or actual data. Because of existing data gaps, we must find alternative means to represent threats and effects. The subsequent options listed (simulant data, parametric data, anecdotal data, and professional judgment) may be available. In all cases, data validity is an issue that must be addressed.

1.7 Current Analysis Efforts and Developments in Analysis Tools

- ❑ Improved Response Program (e.g., Modular Emergency Medical System)
- ❑ HLA as an IEEE standard
- ❑ Incorporation of complex urban terrain into laptop models
- ❑ Model validation (e.g., IDA work on Transport and Dispersion models)
- ❑ Use of wargaming to analyze CB defense
- ❑ Equipment standardization and test methodology efforts (e.g., IAB and others)

Figure 6. Current Analysis Efforts and Developments in Analysis Tools

Provided in Figure 6 are some of the efforts and tools currently being worked to address CB WMD defense analysis. They range from hardware and software improvement and standardization efforts to qualitative analysis efforts. They are just a small sample of the analytical work being done to improve our understanding of critical issues in CB WMD defense.

1.8 Shortfalls in CB WMD Analysis

- ❑ Understanding and prioritization of CB threats
- ❑ Validation and availability of models, data and scenarios
 - ❑ Identifying best data providers
- ❑ Acceptance of DOD models by civilian community
- ❑ Resource requirements and capabilities studies supporting CONUS CB defense

Figure 7. Shortfalls in CB WMD Analysis

In order to effectively prioritize future CB WMD defense analytical efforts, we must first gain a better understanding of CB threats. Analysis can also be better focused if threats can be prioritized. Validating our models, data, and scenarios is critical to sharing them within DOD, and when appropriate, with our foreign coalition partners and the US civil community. We need to establish the lineage of our models, data, and scenarios. There must be an audit trail for model algorithms and data. The ability to share information within and outside DOD is extremely critical, and we must ensure our potential partners are cognizant of our products and comfortable with their use. Another area that deserves special attention is developing a clear understanding of resource requirements and capabilities (force structure, equipment, etc.) to support CONUS CB defense.

1.9 Proposed Developments in Analysis Tools

- ❑ Develop joint service models
- ❑ Develop combined agents effects models (C&B)
- ❑ Develop deployment and resource model(s) to track resource availability and flow between SSCs, MTWs, and CONUS CB incidents
- ❑ Develop MOEs to evaluate utility of existing models (e.g., risk assessment, civilian requirements)
- ❑ Develop mission degradation algorithm
- ❑ Develop tailored terrain databases (e.g., infrastructure, multidimensional cloud features, demographic data)
- ❑ Develop and make available a catalog of available scenarios
- ❑ Develop knowledge management system (e.g., SBCCOM, CMI-Services accessible to stakeholders)
- ❑ Use data mining tools to capture and assess salient data for specific analysis (e.g., exercises, war games, CALL, BDA, JULLS)

Figure 8. Proposed Developments in Analysis Tools

A number of proposed development tools have been identified by the Low Spectrum Subgroup to address the shortfalls addressed in the previous slide. They range from development of algorithms and models to improved data management tools.

1.10 Proposed Analysis Efforts

- ❑ Conduct efforts to gain outside acceptance of DOD Models (option for MSCA is use of National Response Team (NRT))
- ❑ Conduct exercises, simulations and experiments to validate assumptions, verify capabilities, and identify resource requirements
- ❑ Examine availability of CB resources to support CONUS CB incident(s) in conjunction with execution of SSC(s) and MTW(s)
- ❑ Continue to examine RC/NG requirements and capabilities in CONUS WMD response
- ❑ Develop a prioritization of threats to facilitate the planning, programming, budgeting process
- ❑ Develop interoperability standards and common terms of reference between
 - ❑ Military combat operations and MSCA
 - ❑ DOD and civil community (Federal, state, and local as required)
 - ❑ US and coalition partners
- ❑ Develop standard operating procedures for sharing sensitive information with civil community (Federal, state, and local as required)

Figure 9. Proposed Analysis Efforts

As with proposed development tools, numerous analysis efforts have also been identified on the following two figures to address the previously mentioned shortfalls. These efforts focus on qualitative as well as quantitative analysis to gain a better understanding of the CB WMD defense problem. Developing standards is a recurring theme in these proposed efforts.

1.11 Proposed Analysis Efforts (cont)

- ❑ Examine realistic capability of current technology
- ❑ Determine required reliability and specificity (e.g., detectors, PPE)
- ❑ Backtrack capability for meteorological detection in urban environment (identify source for criminal investigation and determining infected population)
- ❑ Research applicability of non DOD industrial chemical modeling of DOD use (e.g., TICS and TIMS)
- ❑ Determine DOD CONOPS for industrial hazards (e.g., personal protective clothing assessments)
- ❑ Analyze mass casualties from CW and BW attacks
- ❑ Update dose response data for both C & B
- ❑ Assess medicine and vaccine deployment throughout the US (military & civilian)
- ❑ Analyze human factors (e.g., psychological, physiological, hostile intentions, both military and civilian)

Figure 10. Proposed Analysis Efforts (cont)

1.12 How Well Do We Understand the Problem?

- Key Insights -

- ❑ Need to improve our understanding of
 - ❑ The behavior of C & B agents (e.g., toxicity, cloud behavior, operational degradation)
 - ❑ The physical environment (e.g., urban, suburban, subterranean, hydrology, meteorology)
 - ❑ Human factors (e.g., psychological, physiological, hostile intentions)
 - ❑ Political realities (Congressionally mandated authority and funding of special units and equipment)
 - ❑ Legal realities (Posse Comitatus, Title 10 and Title 32)
 - ❑ CB WMD response resource requirements
- ❑ Shortfall of CB knowledgeable OR analysts

Figure 11. How Well Do We Understand the Problem?

There are several areas in CB WMD defense where we must improve our knowledge, ranging from the behavior of chemical and biological agents, to the impacts of the physical environment on agent behavior, to the human factors involved. As we examine these issues, we must also be cognizant of and work within existing political and legal realities.

Finally, we cannot ignore the need for quality analysts with an understanding of CB. Creative programs must be established to develop and maintain these analysts.

1.13 Recommendations to Improve Our Understanding

- ❑ Bound the problem
- ❑ Define roles and responsibilities at all levels (Strategic, operational, and tactical)
- ❑ Improve OR and user interface to identify requirements and obtain products
- ❑ Prioritize analysis efforts

Figure 12. Recommendations to Improve Our Understanding

The Low Spectrum Conflict Subgroup in previous figures proposed numerous development efforts. Determining where to start can be aided by bounding the CB WMD defense analysis problem. Some focus and prioritization must be established. This can be made easier through a clear definition and understanding of roles and responsibilities of stakeholders at all levels. Forums like this workshop serve as great interface vehicles between the operations research and user communities at all levels--policymakers, developers, and operators.

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APPENDIX A PROJECT CONTRIBUTORS

1. PROJECT TEAM

a. Project Director

Mr. Gregory P. Andreozzi, Conflict Analysis Center

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Mr. Howard Hall, Conflict Analysis Center

c. Other Contributors

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LTC Cummings, CoMPIO
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Mr. Norman, BAH
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Mr. Sands, MITRE
Mr. Sergio, BAH
Mr. Slavinski, CMI-Services
Mr. Tehee, MSIAC
Mr. Thornton, HQ AFCESA/CEXR
Mr Gene Visco, Synthesis group
Mr. Wallis, IDA
Mr. Zielinski, DTRA

APPENDIX B REQUEST FOR ANALYTICAL SUPPORT

P *Performing Division:* **Account Number:** 2001014
A *Tasking:* Verbal **Mode (Contract-Yes/No):** No
R *Acronym:* MORS CB WMD
T *Title:* MORS Workshop Support - Chemical-Biological WMD: Understanding the Problem
1 *Start Date:* 05-Oct-00 **Estimated Completion Date:** 28-Feb-00
Requestor/Sponsor (i.e., DCSOPS): SECDEF **Sponsor Division:** MORS
Resource Estimates: a. *Estimated PSM:* 2 b. *Estimated Funds:* \$750.00
c. *Models to be Used:* N/A

Description/Abstract: MORS is hosting a workshop on Chemical-Biological Weapons of Mass Destruction (CB WMD): Understanding the Problem, from 30 Jan - 1 Feb 01. We have been asked to serve on the organizing committee for the workshop and serve as Co-Chair of the Operations Analysis Working Group.

Study Director/POC Signature: **Original Signed** **Phone#:** 703-806-5665
Study Director/POC: Mr. Gregory Andreozzi

If this Request is for an External Project expected to consume 6 PSM or more, Part 2 Information is Not Required. See Chap 3 of the Project Directors' Guide for preparation of a Formal Project Directive.

Background: Understanding the comprehensive analysis problem of CB WMD threats to the United States is increasingly complex and difficult. CB WMD is not just a military battlefield threat. There is renewed interest in defending against WMD missile and terrorist threats to the US Homeland and worldwide US facilities. This workshop will examine the analysis problems associated with military operations and military support to civil authorities in the context of CB WMD.

P

A

R **Scope:** This workshop will examine the analysis problems associated with military operations and military support to civil authorities in the context of CB WMD. Based on our involvement with the Homeland Security Initiative (HLSI), we have been asked to serve on the organizing committee for the workshop and serve as Co-Chair of the Operations Analysis Working Group, with particular emphasis on civil support aspects. Other Working Groups are Training Simulations and Models and Sim-based Acquisition.

T

2 **Issues:** (1) Characterization of CB WMD threats and effects by OR techniques (2) Examine military operations research capabilities to support military can civil authorities (3) Identify and evaluate current and anticipated CB WMD analytical tools, methodologies, and shortfalls (4) Identify CB WMD data sources, data shortfalls, test results, and study efforts

Milestones: (1) Participate in bi-monthly organizing committee meetings (2) Identify prospective plenary and working group briefers and workshop participants (3) Develop Operations Analysis Working Group concept (4) Co-chair Operations Analysis Working Group, 30 Jan - 1 Feb 01

Signatures **Division Chief Signature:** **Original Signed and Dated** **Date:**

Division Chief Concurrence: Mr. John Elliott

Sponsor Signature: **Original Signed and Dated** **Date:**

Sponsor Concurrence (COL/DA Div Chief/GO/SES): **Original Signed and Dated**

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GLOSSARY

AFSAA	Air Force Studies and Analysis Agency
ASD(RA)	Assistant Secretary of Defense for Reserve Affairs
ASD(SO/LIC)	Assistant Secretary of Defense for Special Operations and Low Intensity Conflict
ATSD-CS	Assistant to the Secretary of Defense for Civil Support
BDA	battle damage assessment
BW	biological warfare
C&B	chemical and biological
CAA	Center for Army Analysis
CALL	Center for Army Lessons Learned
CB	chemical-biological
CB WMD	chemical biological weapons of mass destruction
CINC	commander in chief
CMI	Consequence Management Interoperability
CoMPIO	Consequence Management Program Integration Office
CONOPS	concept of operations
CONUS	continental United States
CSEPP	Chemical Stockpile Emergency Preparedness Program
CST	civil support teams
CW	chemical warfare
DATSD(CBD)	Deputy Assistant to the Secretary of Defense for Chemical-Biological Defense
DCSOPS	Deputy Chief of Staff for Operations and Plans
DOD	Department of Defense
DTRA	Defense Threat Reduction Agency
HLA	High Level Architecture
IDA	Institute for Defense Analysis
IEEE	Institute For Electrical and Electronic Engineers
JHU/APL	Johns Hopkins University Applied Physics Laboratory
JTF-CS	Joint Task Force for Civil Support
JULLS	Joint Universal Lessons Learned System

MANSCEN	US Army Maneuver and Support Center
MD ANG	Maryland Air National Guard
MDW	Military District of Washington
MOEs	measures of effectiveness
MORS	Military Operations Research Society
MSCA	Military Support to Civil Authorities
MTW	major theater war
NRT	National Response Team
OCONUS	outside continental United States
OR	operations research
PDD	Presidential Decision Directive
PM	program manager
PPE	personal protective equipment
QDR	Quadrennial Defense Review
R&D	research and development
RC/NG	Reserve Component/National Guard
SBCCOM	US Army Soldier and Biological, Chemical Command
SSCs	small-scale contingencies
TICS	toxic industrial compounds
TIMS	toxic industrial materials
USANCA	US Army Nuclear and Chemical Agency
USCG	United States Coast Guard
WMD	weapons of mass destruction