MILITARY OPERATIONS RESEARCH SOCIETY

WORKSHOP:

JOINT REQUIREMENTS OVERSIGHT COUNCIL PROCESS

October 17-18, 1994
Arlington, Virginia

Date of Report: February 28, 1996

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FOREWORD

Special meetings enhance the quality and effectiveness of military operations research by providing forums, in addition to the annual symposia, for professional and peer criticism among practitioners and users of military operations research.

The Joint Requirements Oversight Council Process Workshop held October 17-18 and November 28, 1994 was an excellent example of the benefits of the outstanding relationship between MORS and its sponsors. This workshop was initiated at the request of the Vice Chairman of the Joint Chiefs of Staff, Admiral William A. Owens, following discussion raised by MORS Joint Staff Sponsor, Mr Vince Roske, at the annual MORS symposium in June 1994. The other five MORS sponsors provided full support as proponents and participants.

We want to congratulate an outstanding team of MORS volunteer members, led by Mr Roske, LTC Jim Cooke and Mr Fred Hartman, who organized and executed the workshop program in record time. Due to the timeliness of the topic and the responsiveness of this MORS team, the workshop had record attendance.

We also extend special thanks to the members of the Joint Staff Joint Warfighting Capabilities Assessment teams for their cooperation and insights. They have the responsibility to respond to Admiral Owens' challenge to "envision what the warfare environment will be in the year 2002." They were generous in taking time from the pressing issues of the day to spend time working on longer range analysis options.

Finally, we wish to express the appreciation of the MORS community to Admiral Owens for encouraging us to join his team, and to explore opportunities for the development and enhancement of this "extraordinary analytic process" that he envisions will support the JROC.

Brian R. McEnany
President

Jacqueline R. Henningsen
Vice President for Meeting Operations
MORS Workshop Advisor

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PART I

OVERVIEW

Lieutenant Colonel James C. Cooke and Frederick E. Hartman

On 17 and 18 October, 1994, MORS conducted a workshop with the Joint Staff. The objective of the workshop was to provide an opportunity for the military analysis community and the Joint Staff to come together to explore the philosophy, policies, processes and methods of evaluation and analysis useful to the Joint Requirements Oversight Council (JROC) process. Each of the MORS sponsors also supported, participated in and contributed to the success of this important effort. MORS took the opportunity to revitalize its roots by including inputs from a broad range of disciplines.

At the final session for the JROC workshop on 28 November 1994, ADM Owens expressed his appreciation to the MORS community and stated that "your membership is contributing greatly to an extraordinary analytical process that will support the JROC process and ultimately Goldwater-Nichols." He also generated a challenge, which is quoted here:

> "How can we best envision what the warfare environment will be in the year 2002? And what could the impact on doctrine be of fielding our emerging capabilities? How can we be creative in our analytical techniques that support the complex budget decisions that will get us there? In this regard, I caution the analytical community against an over reliance on historical data and to avoid measuring tomorrow's warfighting capabilities by fighting yesterday's war. We need new perspectives, analytic approaches, and models — the MORS community could be key in generating them."

Genesis

During the 62nd MORSS Sponsor's luncheon in June 1994, a proposal was made to conduct a symposium or workshop on the new JROC processes particularly as they apply to the new concept of Joint Warfighting Capability Assessments (JWCA). This proposal had immediate support from all the MORS sponsors, and an enthusiastic second from the Joint Staff (J-8) which organizes the JROC-JWCA process.

Background

The JROC-JWCA process is a relatively new addition to the business of the Joint Staff. The Goldwater-Nichols Act established the Chairman and the Vice Chairman of the Joint Chiefs of Staff as spokesmen and authorities for a joint military perspective.

To perform these roles the legislation called for the Vice Chairman to head a special council on military requirements — now known as the Joint Requirements Oversight Council — and for the Chairman to "submit to the Secretary of Defense alternative program recommendations and budget proposals." The JROC includes the Service Vice Chiefs of Staff and has emerged as a key forum in which the senior military officials address military requirements from a joint perspective.

Moving the JROC procedure into a more central position requires major changes in the staffing and analytical support for JROC deliberations. The Joint Staff has established ten assessment areas, charged separate Joint Staff offices with coordinating the assessment in each, and invited participation from a wide range of organizations and research establishments. The assessment areas are nine topics (Strike; Ground Maneuver; Strategic Mobility and Its Protection; Air Superiority;Deterrence/Counterproliferation of Weapons of Mass Destruction; Command and Control and Information Warfare; Intelligence, Surveillance and Reconnaissance; Overseas Presence and Joint Readiness) and Integration. The assessment process integrates key war fighting areas across traditional defense functions to gain insights. The process supports a climate that fosters innovation and intellectual synergism that can lead to conceptual breakthroughs.

Organization

The workshop set records for attendance, speed of organization and gestation from concept to creation, a reflection on the professionalism of the MORS volunteers and staff. One of the key concepts was to support the underlying JWCA focus on supporting conceptual innovation with a return to the earliest roots of military operations research — the invitation of a diverse group of eclectic philosophers in literature and science to participate in the OR process. As Gene Visco, MORS Army Sponsor's Representative observed when helping to scope and shape the working group, the origins of OR gained significant insights by using a mixed team concept combining mathematicians and engineers with agronomists and psychologists. When forming this workshop, the organizing committee invited twenty renowned leaders from widely diverse backgrounds — authors, statisticians, musicians, economists, lawyers, etc.— in order to break from the standard group of quantitative emphasis which represents the typical MORS grouping of military and defense civilians. The invitees were receptive and honored to be included in this effort, and welcomed the opportunity to give input to a subject of this magnitude and importance. Several of these individuals had previously served in the government and the armed forces, and provided an objective perspective from many decades of experience. They are included as honorary members for the next 3 years of MORS, and expressed a desire to participate in this fashion again should the need arise. The process worked well and will be repeated — it has great benefit for and serves to vitalize both the military operations research and other disciplines.

The balance of the attendees included service representatives, and Defense and non-defense functional and analytical experts. Although constrained by the size of the meeting facility and the workshop format, attendance of 296 set a record! The workshop was

organized into eleven working groups, one for each of the ten JWCA areas (described earlier), plus a Synthesis Group. Each group was chaired by a seasoned representative of the military operations research community, and co-chaired by senior representatives of each assessment area proponent — Joint Staff JWCA functional experts (one general officer, the rest Commander-Lieutenant Colonel/Captain-Colonel).

The Workshop

Objectives of the workshop were to:

- Educate military operations research analysts and decision makers about the purpose, organization and functions of the Joint Requirements Oversight Council process;
- Identify military OR analyses, methods and products that may support the JWCA process; and
- Provide insights on the JROC process for widespread dissemination.

The workshop approached these objectives through a variety of complementary means.

The first day consisted of general sessions and parallel working group sessions. During the initial planning session Admiral Owens provided a keynote for the forum on his expectations for the new JROC process and for the workshop. Following the keynote there was a briefing on the current integration methodology among the JWCA assessment areas.

For the remainder of the first day and the next morning the participants worked in their eleven groups in parallel sessions where individual assessment areas were discussed in depth. These sessions included informal presentations, discussion, formulation of issues, and identification of approaches to those issues. In the afternoon of the second day, each group developed conclusions and recommendations on its topic and presented them to the entire workshop in plenary session. The presentations were varied in nature — some directing their findings more towards strategies, others towards support mechanisms, and others toward research ideas. This provided the mix/diversity in ideas that was hoped for.

Achievements

The workshop was successful in achieving the objective of familiarizing the military OR community with the purpose, organization and function of the expanded JROC process. Understanding and enthusiasm for the JROC/JWCA process as an idea whose time had come was evident. Discussions among participants indicated a rapid assimilation of the concepts and vision promulgated by the VCJCS in his keynote address, and facility with the JWCA process and goals.

The workshop had mixed success in identifying military OR methods and products that might support the JROC process. Within the two days of the workshop, definition of analysis methods for the JWCAs varied across the working groups. Some working groups produced crisp, implementable recommendations. Others arrived pretty much where they started within the existing JWCA approach. The differences in output may be attributed to differences in the composition of the groups as well as different challenges and levels of complexity in the subject areas. In all working groups it was clear that the participants' mental energy was high, that interest had been stimulated and that further involve-

ment and methodology recommendations could be expected.

From a MORS perspective, the workshop was particularly productive in three ways. First, it introduced the standing members of the JWCA groups to the wealth of tools, experience, and general expertise available to assist them in making tough choices under adverse conditions. The great majority of the JWCA members were not knowledgeable about either MORS or military OR. Second, it introduced members of the MORS community to a group dealing with issues and concerns of fundamental importance to the future national security of the US, with a current need for OR expertise. Third, by incorporating non-MORS, non-DoD personnel, MORS participants gained fresh insights from perspectives that challenged fundamental assumptions, and established relationships for continued interaction.

Post Workshop

MORS will integrate the JROC JWCA challenges into the Working Group structure at the next annual Symposium at Annapolis. The theme for the 63rd MORSS, to be conducted at the United States Naval Academy on June 6-8, 1995, is "Joint Analysis for Joint Operations." The challenges provide a framework against which we can be measured. MORS, in its role as a catalyst for the analytical community, is an appropriate organization to disseminate the purpose and functions of the new process and to elicit feedback and provide objective analytic insights to enhance it. By contemplating and returning to the basic concepts of "Operational Analysis" we can help forge a link to the future of joint and combined operations.

PART II

WORKING GROUP REPORTS

1. *STRIKE*

Captain Lawrence L Dick, USN

The MORS JROC Strike Working Group specifically examined the following assessment attributes: definition, process, scope, analytical tools and methodology, metrics, and prioritization. As a precursor to prepare the group for this task, a review of assessment concepts and what has historically been construed as assessment support was first undertaken. To accomplish this, material presented at the 26 September 1994 Expanded JROC Seminar was distributed as a read ahead package. Then, following introductions of the participants, specific assessment related concepts and opinions presented in this seminar as well as the Navy JMA process were used to stimulate the group. This then set the stage for group discussions to understand the role and define the purpose of a Joint Warfare Capability Assessment (JWCA).

The Strike Working Group defined a JWCA as "A structure or vehicle with which to gauge capability and illustrate requirements in terms of military effectiveness and utility, identify shortfalls and overlaps, and propose alternatives". In this definition, the phrase "to gauge" implies a measurement or quantitative assessment. Group opinion was that JWCA scope should not be limited to identifying only shortfalls or deficiencies but should also consider excess capability which may result from overlaps with other JWCAs. A final discussion point centered around whether or not the proposed alternatives were optimal. Consensus was the outcome or alternatives were not always optimal in terms of either capability or cost.

The formal definition of strike as developed by the Strike JWCA reads, "An attack which is intended to inflict damage on, or destroy an objective". Using this definition and an overview of the evolvement of the Strike JWCA presented by the JWCA leader, a subgroup was formed and tasked to review the process and scope of the JWCA. The preceding strike definition is a modified version of the JCS Pub 1-02 definition of strike. The JWCA eliminated the term "to seize" because it concluded seizing an objective was the role of the Ground Maneuver JWCA. Accordingly, with removal of "seize", the MORS working subgroup concluded the term "objective" was too broad. Their recommendation, to reduce confusion, was to replace "objective" with "target". The subgroup further opined that within the strike arena, the JWCA was well defined but that the relation across other panels was not so visible. This relationship is considered essential to identify and address areas of overlap and to establish the overall analysis framework structure.

The goal and current focus of the Strike JWCA was extracted from the participating JWCA members. A goal had never been formally defined by the JWCA. The MORS subgroup interpreted the Strike JWCA goal to be: "to determine which 'strike' systems best contribute to the end-to-end process of decide, detect, deliver, combat assessment methodology of attacking targets to disable or destroy". During group plenum, this goal was later refined to read, "to

determine what mix of capabilities best supports the mission objective of strike".

There was considerable debate over what constituted the realm of strike. JWCA members had initially attempted to characterize the strike universe by systems (e.g., all aircraft fixed wing and rotary, any missile or system which was used beyond the FLOT). This attempt was thwarted based on the following rationale of the group: (1) it would too narrowly focus the JWCA and (2) the realm should be more appropriately described by functions rather than systems. Examples of ground attack helicopters (i.e., Apache) and SOF or Marines being used in a strike role were given. The consensus was that realm should remain broad and somewhat ambiguous, akin to Admiral Owens' intent of vague JWCA names, to help alleviate the tendency for "stove piping" and foster cross-pollinization across the JWCAs to better get at efficiencies and overlap.

When the Strike JWCA stood up, it had several immediate advantages over some of the other JWCAs. First, as evidenced above, strike was fairly well and easily defined. Furthermore, this definition was generally widely accepted. Thus, the JWCA did not have to spend a considerable amount of time and energy figuring out "just what strike was all about". Secondly, there were a number of recently completed or ongoing studies relating to strike which provided an abundance of analysis for which the JWCA could construct an initial assessment, and (3) the JWCA team leader not only had a good strike background but also considerable experience in studies and analysis. Consequently, the Strike JWCA was well ahead of many of its peer JWCAs in this evolutionary JROC process. It, in fact, was the only JWCA to have completed an initial assessment, according to the team leader, and in doing so had developed specific areas for which to focus future effort. These specific areas included (1) Munitions; (2) Intelligence; (3) Recapitalization (4) and Joint Strike Integration which encompasses Intelligence, Surveillance and Reconnaissance (ISR), Command, Control and Communications and Intelligence (C3I), Battle Damage Assessment (BDA), Planning, Target Acquisition, and finally, Weapons Employment. This focus is the impetus to drive the JWCA over the course of the next few months towards the development of its February 95 review and input to the Chairman's program recommendations in the Joint Military Net Assessment (JMNA) to the Secretary of Defense during the spring of 1995. As a result of the specific areas of focus, there should be some examination of efficiencies gained from other JWCAs (C2/IW and ISR) in this process. However, the relationship with the Strike JWCA and its other two core battlefield cousins, Air Superiority and Ground Maneuver, is not evident. Nor is there any apparent attempt to characterize the effect of the overarching JWCA, Overseas Presence, on the Strike JWCA process.

Another important aspect examined during this workshop was the method in which operational concepts are introduced into the JWCA process. It was evident this area is not yet very mature. Therefore, the subgroup derived a list of operational concepts which were key to strike. These were (1) survivability, (2) lethality (3) deployability (4) interoperablity and (5) affordability. While this is certainly not an all inclusive list and remains unprioritized, it should be expanded and factored into the JWCA process.

Nevertheless, several questions remain unanswered. Just how do new and innovative concepts get introduced into the JWCA? Is the JWCA simply telling an old story over again or is it introducing revolutionary or evolutionary ways to achieve objectives? This aspect of the process is key to the building of new requirements by harnessing the revolution in military affairs brought about by technological changes.

A second subgroup examined the analytic support needed to build an assessment or, in laymen's terms, "What kind of tools are needed in the toolbox?" The subgroup first focused on scenarios. The 2MRC nearly simultaneous Defense Guidance Scenario is commonly used today largely because it is (1) the most stressing of the DPG planning scenarios and (2) it is a believable scenario in the near term. But what about the longer term? Even as we speak, the intelligence community has expressed difficulty in using this scenario in the ongoing Nimble Dancer analysis for a 2005 time frame. What is needed is a range of plausible planning scenarios to support both near term as well as long term or strategic planning (i.e., 20-30 years hence) analyses. Consideration might be given for a big threat or reemerging superpower scenario, radically alternative scenarios (particularly in the out years) which provide a way to introduce new concepts or technology by an adversary, and even non-defense scenarios (e.g., use of military in drug interdiction & sweeping role). Finally, to be useful in an analysis, such scenarios must be developed at a significantly greater level of detail than provided in the DPG. There is no official process today at the Joint or DoD level. Nevertheless, the Department of the Navy has developed a set of Naval Planning Scenarios at this level for use in Naval assessments and COEAs. While these have been distributed to other services for comment, they are not DoD level approved. They could, however, be useful in supporting JWCA analyses in the near term.

Closely related but clearly a unique and even more difficult problem is the availability of Joint data bases to support JWCA analyses. To avoid the "garbage in - garbage out" syndrome, the ultimate goal is common, joint data bases which have been *validated* and *verified* by the producer and *certified* by the user. Today most models either come with an organic data base or dictate that the data be hand loaded, a time consuming, duplicative and expensive process. While some recent progress has been made in this area, the first step is for the Joint Staff and Services to break down the proprietary barriers and make data available to each other. Only then can Joint VV&C'd data repositories be developed.

Given the right scenarios and correct data, the assessor's primary analytical tool then becomes his model(s). He will likely desire a high level of fidelity and a varying range of resolution to support large, campaign level analyses on one hand and detailed scoping analyses on the other. He will ant a model which provides a good representation of the study issues and the combat process involved such as tactics and CONOPS. His problem is a lack of Validated, Verified, and Accredited (VV&A'd) Joint models. Most are severely deficient in representing all aspects of a truly joint force and focus either on land or naval aspects. They also tend to lack an intrinsic C2/Surveillance capability. In many instances, it is very difficult or prohibitively expensive to perform a complete VV&A on

legacy models. The relevant issue then becomes "What is enough?" and how do we achieve acceptability criteria for a model to be used in analyses to support the JWCA process?

An emerging new tool is the use of Advance Distribution Simulation (ADS) in the JWCA process. With the ability to integrate live as well as virtual and constructive systems, ADS has the potential to "test the water" far beyond what has been possible using traditional wargaming techniques. This capability will continue to expand with the development of the Joint Simulation System (JSIMS) which will enable an architecture to develop a distributed analysis capability in the foreseeable future.

Notwithstanding the ongoing effort in modeling and simulation, the key remaining ingredient is the portrayal of the analysis to the decision maker. Suffice to say, a book of numbers or a table of red, yellow and green is insufficient. The decision maker must clearly understand the critical assumptions associated with the alternatives which are presented to him. He needs to comprehend how a system operates, what the sensitivities are, where the tradeoffs are, and the synergies with other systems. Modern graphics technologies can greatly assist in this area. Use of state of the art silicon graphics to describe a system or engagement (e.g., TBMD engagement) can provide a much better visualization to the decision maker.

The effort to characterize metrics for the Strike JWCA generated a number of valid discussion points. First, metrics or Measures of Effectiveness (MOEs) must be a measurable quantity with some sense of variability (risk) across the space or dimension framed by the assumptions and scenarios. This risk characterization must then be defined. The relation of the metric to system performance is also important. For instance, measuring ordnance in terms of tons over time may have been adequate for level of effort modeling using dumb bombs and artillery in the strictly Lanchester sense; however, this is a clearly inappropriate metric for smart and/or precision weapons. The metric(s) need to be consistent across applications and should be a contributable quantity to the warfight or outcome. This outcome again must be defined since factors such as non-lethality, minimizing collateral damage, survivability, etc., may drive a completely different set of metrics. Finally, how do factors such as situational awareness, battle damage assessment, and connectivity (e.g., sensor-to-shooter) relate to the metric(s)?

A candidate set of Strike MOEs must first take into account the hierarchy of analysis from the one-on-one single engagement to battle to campaign. Engagement level MOEs can delineate differences in performance parameters between specific systems.

At the battle level, what is the number of targets damaged or destroyed per unit time and cost. How do different types of systems, changes in tactics, etc., affect this rate? At the campaign level, what is the strike contribution to the total effort? How did the FLOT move in relation to sortie rate? Did we win or loose? Care must be taken to ensure MOEs are not chosen such that the battle is won but the campaign is lost. Such traditional, operations research types of metrics provide quantifiable capability measurements for the JWCA output.

The working group was unable to ascertain any sort of prioritization scheme for the JWCA. While the stoplight techniques used in the assessment provide an indication of deficiencies in current capability (does green indicate no deficiency or an excess of capability?), there is no sense of the relative importance of these deficiencies in the different categories. What changes or new systems provide the greatest improvement or rather return on investment if affordability is a consideration? One approach which lends itself to this area is the use of a Delphi process to establish bins or quartiles which correspond to increased marginal utility (i.e., adding resources), new technologies, or alternative force structures.

The Strike JWCA is off to a good start having completed its first assessment and having identified areas for future focus. Efforts should now be undertaken to better integrate across other JWCAs and to attempt to identify any areas of overlap and efficiencies. Working group discussions indicated few interactions between the JWCAs. A first step in the integration process could be a cross-fertilization scheme which facilitates not only an increased awareness but also exchange of ideas and methods. Subsequent efforts could include multiple JWCA seminars or wargames. However, if integration across the JWCAs is to be attained at the working level, clear, visible relations between the JWCAs need to be established. This requires a common analysis framework, a common thread or linkage such as affordability, and an overarching prioritization scheme.

A common analytical framework is a fundamental prerequisite toward improving integration across the JWCAs. Detailed joint scenarios which provide the "hooks" for the JWCAs are the basis for common analysis. Implicit in these detailed scenarios is a sufficient description of the size, movement and reinforcement of forces, friendly and enemy, to permit analysis down to the engagement level. Commonality of joint tasks, standards, and conditions is also necessary. This includes common assumptions, tactics and decision logic, and, at least at the campaign level, common metrics.

Methods to inject innovation in warfare or new concepts into the JWCA have yet to be realized. Current JWCA efforts have little new to offer. Their focus has been on highlighting what's wrong (shortfalls). They have no roadmaps to explore new avenues which could radically change warfighting within or across JWCAs. They have little or no communication with industry which could help solve this problem by applying its own R&D or introducing COTS technologies. As a start, Concepts and Technologies Wargames and JWCA sponsored seminars or symposia (e.g., a Strike JWCA Industry Day) could be of tremendous value in linking the JWCA and industry. Other opportunities include JWCA involvement in the annual Joint Warfare Interoperability Demonstrations (JWID) or commercial organizations such as NSIA which not only offers forums for exchange of ideas but studies and analysis opportunities as well.

Admittedly the learning curve has been steep as this change has been brought onto the JROC process. Many JWCAs have struggled with their own identity crisis. All have focused most of their effort on the next step with little time or thought given to developing a long term vision or goal. The time is right for the

Strike JWCA to lead the way for the other JWCAs. Using the areas it has identified for further focus, a Strike JWCA Studies and Analysis Plan should be developed to carry the JWCA forward into POM98 and beyond. Such a plan could still leverage off existing studies which are in progress by giving additional guidance or direction to satisfy the Strike JWCA objectives as well as laying out new studies to undergo. Consonant with this S&A plan, should be a roadmap or strategic plan which looks further out into the future to develop planned versus reactionary avenues. These efforts do not come free. The JWCAs should be afforded the resources necessary to fulfill their analytical needs. Then, through better tools brought about by the M&S community, the JWCAs can provide the decision makers the best possible information on which to make their decisions.

2. *Ground Maneuver*

Dr. Patricia A. Sanders

Introduction

Ground Maneuver, as defined in Joint Pub 1-02, is the "employment of forces on the battlefield through movement in combination with fire, or fire potential, to achieve a position of advantage in respect to the enemy in order to accomplish the mission." The Ground Maneuver Working Group's focus and goal was the identification of the key issues in this joint warfare capabilities assessment (JWCA) area and methodologies and tools for performing assessments to address these issues.

The Ground Maneuver Working Group was composed of selected individuals possessing either a vastness of analytical expertise from a variety of disciplines or exceptional operational experience related to the ground maneuver warfare area (or both). All services were represented as well as both government and industry civilians.

The Working Group began by examining the current process as presented by Lieutenant Colonel Mike Kirby, the leader of the Ground Maneuver JWCA team, considering its strengths to be built upon, and areas where improvements could be made. The recommendations for assessment methodology were based on addressing the Ground Maneuver JWCA issues that the Working Group identified.

Issues

The Working Group identified a number of issues of importance to the Ground Maneuver JWCA. The principal ones were:

- Recapitalization of ground maneuver forces and the impact of modernization levels on long term readiness.
- Fragility of intelligence capability for the maneuver commander. This including aspects of information distribution, interoperability, and planning.
- Fragility of supporting command, control, communications, and computers (C4) and logistics. Encompassed in this were the issues of intransit visibility and distribution.
- The blurring of the distinction between deep and close battle and its implications for (1) redundancy of capability/coverage; (2) close air support; (3) situation awareness; and (4) fratricide.
- Capabilities for early/forcible entry.
- Sustainability/supportability of the force.
- Strategic mobility capabilities.
- Capabilities for the reserve component.

General Conclusions/Observations

The Working Group's overall findings which led to its recommendations were the following:

Ground maneuver interactions are extremely complex. They include various aspects of combat (halting invasion, counteroffensive, establishing lodgements, post-conflict operations...) and operations

other than war (OOTW) (peacekeeping, show of force, humanitarian assistance, disaster relief, ...). There are numerous variables such as forces (heavy, light, special operations, combat, combat support, combat service support), force mix (joint, coalition, active/reserve component), environments (permissive/nonpermissive, terrain, infrastructure), and time frames (current, FYDP, FYDP+). The force elements were many also: maneuver, fire support, prepositioned forces, special forces, combat engineers, logistics,...

Integration and coordination with other JWCAs is a major challenge. Ground Maneuver is a "consumer" of the capabilities of virtually all other JWCAs. Many critical issues tend to be at the "seams" where Ground Maneuver interfaces with other warfighting capabilities.

Because of these complexities and because of the need to react quickly to provide input to key decisions, the current tendency is to focus on individual systems versus overall warfighting capabilities. Similarly the current focus is on the capabilities of a single service versus being on joint capabilities and potential synergies.

The absence of an adequate assessment framework inhibits the ability of the Ground Maneuver JWCA to address long term issues as well as its responsiveness to immediate questions. Taking the time and effort to build a robust analytical framework would pay off in both quick turn efforts and longer planning assessment.

Availability of analytical tools is not a limiting factor. This is not to say that all the analytic tools to perform Ground Maneuver Joint Warfighting Capability Assessments exist. Rather that the development of these tools is not perceived as being out of reach. Also the sense of the Working Group was that with the proper assessment framework, much could be done even with current tools.

The single most important key to future success is a joint organizational and operational concept and context for assessment. The Working Group very definitely felt that the Ground Maneuver JWCA--and all of the other JWCAs--could not perform adequate capability assessments unless they had such a joint context--in particular, a joint doctrinal context, for doing so. For example, they felt it would be virtually impossible to address issues related to possible redundancies in capability for deep battle unless a joint doctrine for deep battle were developed.

Near Term Recommendations

The Working Group recommended the following near term actions:

Gain a senior level support for the definition of a joint operational context for assessment. In order for a joint operational context to be developed--including the joint doctrine underpinning--top level direction will be needed. The group envisioned a sort of "Louisiana Maneuvers" for joint warfighting as a foundation for the development. USACOM was suggested as one possible agent for developing the joint context, although the group did not decide to specify one responsible organization.

Employ an end-to-end analysis methodology with a strategy-to-task functional breakdown of the Ground Maneuver warfare area. This would continue the work already being undertaken by the Ground Maneuver JWCA and endorsed the value of such an approach.

Assess measures of effectiveness that address

joint warfighting capabilities. These measures need to be identified at the appropriate level to support an assessment in a joint context and across JWCA seams. Some specific measures suggested by the Working Group are:

- Contribution to meeting the national strategy.
- Probability of success in a particular mission, including cost to succeed and likelihood of occurrence of the mission.
- Risk of failure in a particular mission, including cost of failure and likelihood of occurrence of the mission.
- Vulnerability/flexibility/robustness of the capability--particularly at the seams. Existence of critical nodes.
- Sustainability/supportability of the capability.

Focus on a "manageable subset" of ground maneuver to develop and refine methodology while continuing to address all JWCA issues with the current process. As the Ground Maneuver JWCA transitions to a more robust and comprehensive assessment methodology--and develops the capability to do so--the Working Group felt that a pilot assessment using the proposed methodology should be undertaken. This will be discussed below.

Proposed Pilot Assessment: Early/Forcible Entry

The Working Group proposed that the early/forcible entry subset of the Ground Maneuver warfare area be used to perform a pilot assessment. The basis for this proposal was that it would be easier in the near term to start off by biting off a smaller piece of the overall JWCA area rather than trying to tackle the overall mission. The specific rationale for selecting early/forcible entry was:

- It is the first phase in the joint warfight and the beginning of the strategy-to-task breakdown of Ground Maneuver.
- It is clearly a joint capability.
- There is a relatively mature joint doctrine for early/forcible entry.
- It crosses both internal Ground Maneuver and JWCA seams.
- An assessment of early/forcible entry would address many near term resource issues and decisions, e.g., strategic lift, amphibious lift, intelligence for the tactical commander, etc.

The Working Group felt that by addressing this more manageable subset of Ground Maneuver, the desired process could be energized and then built upon for a more comprehensive treatment of broader JWCA issues.

Far Term Recommendations

For the longer term, the Working Group recommended:

Development of a true joint organizational and operational context for assessment. Having obtained the requisite senior level attention and direction to do so, proceed with the development of the joint doctrine, and operational context, in the specificity needed to support JWCA assessments.

Applications of the assessment methodology across the entire ground maneuver warfighting area. Using this joint context--and building on the proposed pilot assessment--proceed to apply the methodology across the breadth of the Ground Maneuver warfare area.

Development of analytical tools as necessary to implement the methodology and/or incorporate the joint operational context into existing tools. These would include simulations to replicate/represent the joint operational context as well as scenarios, data bases, and other tools as required.

3. *Strategic Mobility and Its Protection*

Colonel Gregory S. Parnell, USAF and Lieutentant Colonel James T Moore, USAF

Purpose

The purpose of the Working Group was to:

- Identify the most significant Strategic Mobility and Its Protection (SM&IP) *issues* facing senior defense decision makers. *Viz*:
  - Joint warfighting capabilities
  - Military requirements for defense acquisition programs
  - Doctrine for joint employment of forces
  - Roles, missions and function changes
- Develop an *ideal plan* for the SM&IP JWCA assessment
  - Identify military OR methods, techniques and products with potential to improve the SM&IP net assessment
- Compare with the *current plan* for SM&IP net assessment
  - Identify short term plans
  - Identify longer term plans

Working Group Motivation

A wise man has great power, and a man of knowledge increases strength; for waging war you need guidance, and for victory many advisors.[1]

[1] Proverbs 24:5-6.

Ideal JWCA Plan

The purpose of Figure 1 (next page) is to establish a framework for this JWCA.

We began by dividing the JWCA into six functions. The first function, *Identify Force and Minimize the Logistics Footprint*, is unique because it establishes the requirements for strategic mobility. Each function was further defined by identifying its missions. The missions that are assigned to other JWCAs are identified by asterisks.

The framework can be expanded to identify the force qualities, measures of performance (MOPs), measures of effectiveness (MOEs), and measures of operational outcome (MOOs). The ideal measures are force closure and battle outcomes.

The size of the boxes identifies the scope of the ideal analysis architecture. Key JWCA assumptions are across the bottom.

Current JWCA Plan

Figure 2 (next page) uses the same framework as the previous figure for the Ideal JWCA Plan. The size of the boxes identify the scope of the currently planned studies. The scope of the current studies addresses most of the JWCA mission areas. As before, key JWCA assumptions are across the bottom.

Figure 3 is a pictorial representation of the current plan. The foundation is the Defense Planning Guidance (DPG). However, signifi-

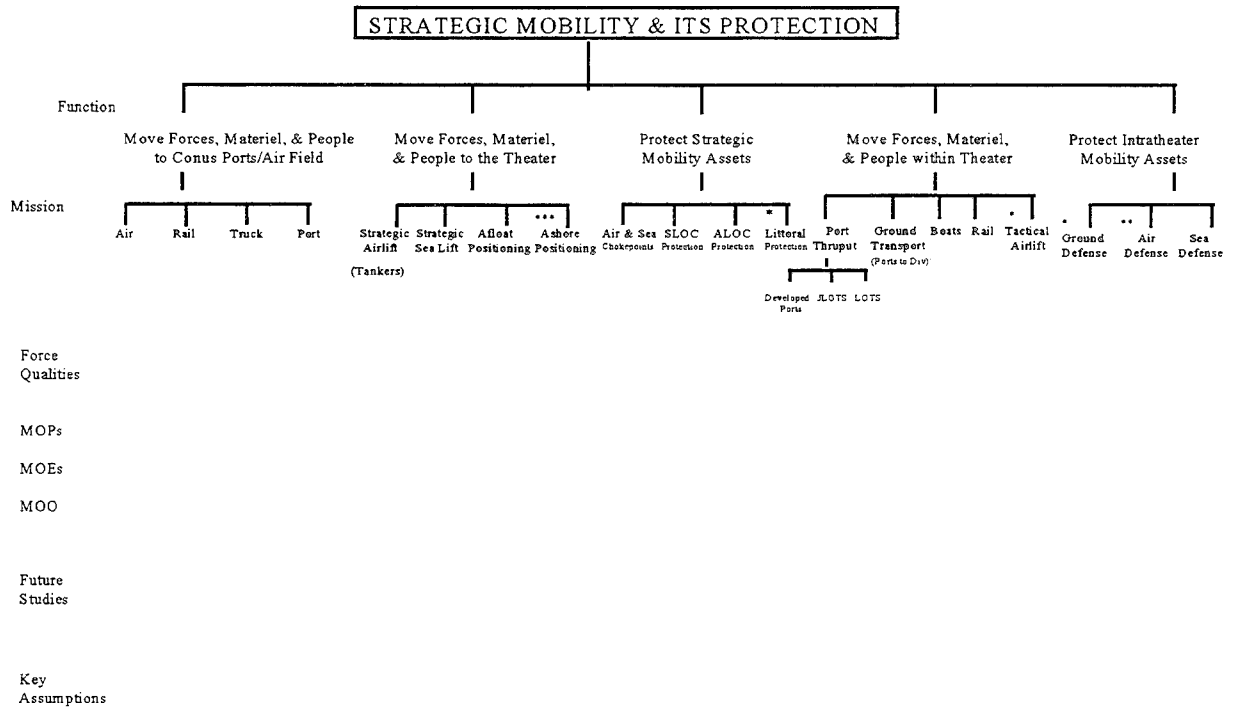

Figure 1. Ideal JWCA Plan

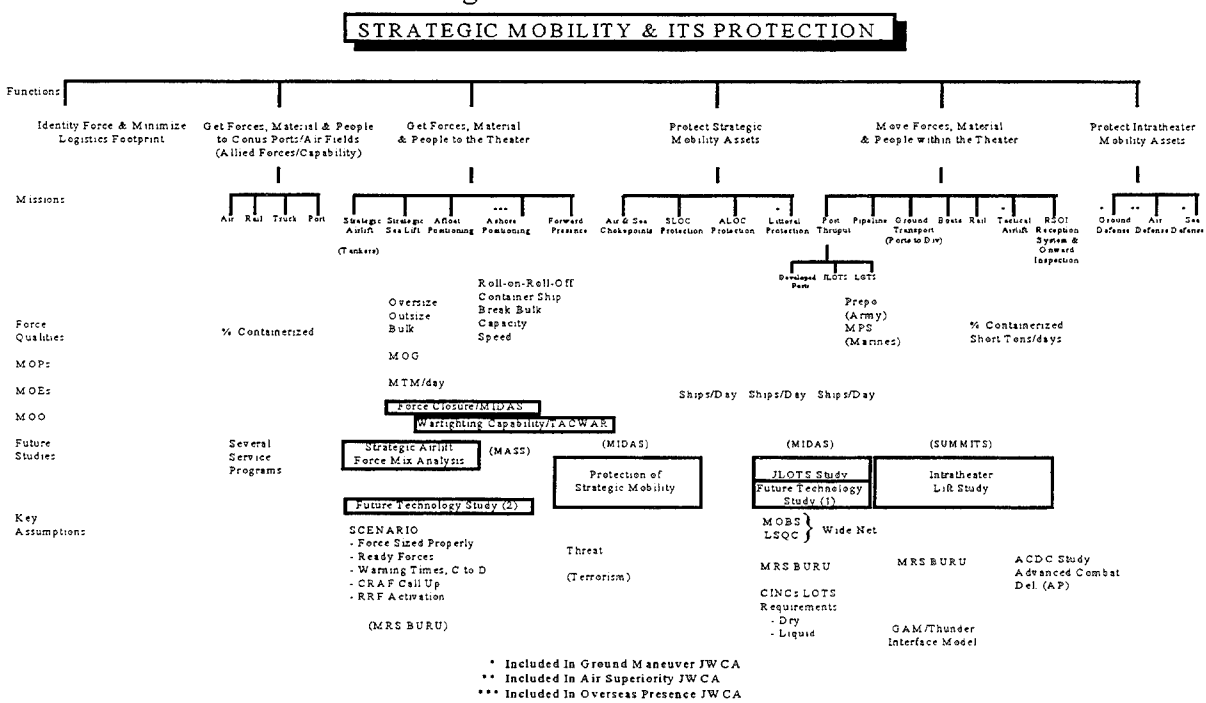

Figure 2. Current Plan

cant data must be obtained from the services to perform the analyses with TACWAR and support the Mobility Requirements Bottom Up Review Update (MRS BURU). This effort has been a major step forward in assessing the contribution strategic mobility forces provide the warfighters. MRS BURU is the foundation for four of the five studies currently planned. The future technologies study is more related to the DPG. One key issue that is *not* currently being studied is the impact of Operations Other Than War on strategic mobility. The fundamental constraints on the current plan are people and time.

Planned Studies

During the working group sessions, nineteen issues were raised by the participants. The following approach was used to examine each issue. First we asked if the issue was adequately addressed in a current study plan. If not we considered if it would be appropriate to include this issue in the study.

Four of the first nine issues were especially critical:

- The identification of the future forces to be moved
- The threat to strategic mobility forces.
- The strategic mobility MOEs/MOOs
- The huge data requirements for strategic mobility analyses.

Observations

The workshop participants concluded that the SM&IP JWCA had developed a good near term plan.

- MRS BURU is the foundation
- Workshop identified 19 potential SM&IP JWCA issues
- We systematically compared the issues with the study plans and concluded that many could be incorporated in current studies
- We did not have time to review the study methodologies; this would be a logical next step

A long term plan is needed.

- The workshop developed a framework for a long term plan
- Need a plan to get data for the next MRS BURU update

<table>
<tr><td>Strategic Airlift Force Mix Analysis (SAFMA)</td><td>Intratheater Study</td><td>JLOTS Study</td><td>Protection Study</td><td rowspan="3">Future Technologies Study</td></tr>
<tr><td colspan="4">MRS BURU Study</td></tr>
<tr><td colspan="4">Moderate Risk Assessment and TACWAR Analyses</td></tr>
<tr><td colspan="5">Defense Planning Guidance</td></tr>
</table>

Figure 3. Current Study Plan

A key concern is the resources needed to meet the near term plan.

- J-4 has very limited analysis and assessment personnel and the near term schedules are very tight
- Consider Operations Other Than War.

Recommendations

The Joint Staff Director J-4 needs a procedure to insure that the services regularly update the MRS BURU data bases due to changes in

- The Defense Planning Guidance
- The service force structures
- The time-phased deployment plans
- Modify study plans to address the issues identified in the workshop.
- Review the methodologies of the planned studies, especially the Future Technologies Study.

Possible Next Step

The working group did not have time to examine the methodology for each of the planned Strategic Mobility studies. A possible next step would be to

- Examine key study issues
- Review the current study methodologies
- Assess the critical study methodologies
- Make recommendations to improve the methodologies and their underlying assumptions

4. *Air Superiority*

Daniel P. Barker

Introduction

The Air Superiority Working Group focused on how to support the Air Superiority JWCA with analysis. The group felt that the current analysis approach was acceptable in the short term, but that several issues undermine the long term goals for the JWCA process. First there is a need to build a foundation for joint context analyses. The group felt that the best way to support the JWCA process is to ensure that all of the components can conduct relevant analyses within a recognized joint context. The next issue is to ensure that the joint staff has the ability to conduct quick turn, spreadsheet type analyses that build on previous efforts. Another need is a coherent agenda for getting analyses done in time to support the Air Superiority JWCA. The group also wrestled with the challenge to address the need for JWCA to support innovative thinking and concluded that the key to innovation is how people are empowered.

Joint Context Analyses

Our group included people from the joint and service staffs; operators; effectiveness analysts from government and industry; intelligence analysts; and cost analysts as well as two individuals with little defense exposure–an economist and an architect. In all we had thirty-one participants. The singularly unifying issue identified by the participants was a critical need for a paradigm that supports joint context analyses. The group agreed that a lack of joint data is the primary problem today with any attempt to conduct joint analysis. Analysts frequently joke that we can get more detailed threat data or allied data before we can get data from another service. The lack of a good understanding of the broader joint environment[1] has frequently led to models having service unique algorithms hard coded into the logic so that they are inherently unable to support a joint context analysis.

While discussing the current environment's intrinsic weaknesses, the group identified the effort being made to support the JAST program as the correct prototype for a joint context paradigm for analysis; a suite of models has been identified which will be reviewed to ensure that their algorithms allow a joint representation of systems, tactics, and doctrine. Joint data is being developed for all of the systems that are going to be included in a family of scenarios for JAST analyses. The intelligence community is developing the data for the threat and gray systems, and is helping to develop the scenarios. The primary limitations of the JAST effort for the JWCA process is that the scope of the effort is focused on the needs of that specific program. Currently, there is no mandate for the joint context analytic environment developed under the JAST auspices to be used anywhere else.

One joint context issue raised by the group was that the Strike, Ground Maneuver, and Air Superiority JWCAs are inextricably

[1] This applies to systems, tactics, and doctrine.

linked because of the common force application focus. These three JWCAs have so much in common that integrating their assessments could prove impossible unless there is an up front integration in the data and scenarios supporting their underlying analyses.

The group's suggestion to establish a new paradigm to support a joint context analysis capability across DoD also incorporates the rest of our working group's observations.

Quick Turn

A spreadsheet in the hands of a gifted analyst can produce amazingly quick results in support of assessments. Our group brain stormed how three possible air superiority issues could be analyzed in the current JWCA environment. Two common insights could be drawn from these three cases: you need good data and analyses as the starting point for a quick spreadsheet analysis effort and you need to make several simplifying assumptions that are acceptable for the issue that is being considered.

The joint staff can hire good analysts[2] and powerful desktop computers are available at relatively modest prices with suitable commercial-off-the-shelf software. Relevant analyses and data have been much harder to obtain because the current process is so young. This year, the Air Superiority JWCA has requested that the services provide a taxonomy of relevant analyses with the responses due after the MORS workshop. Several people in the working group identified studies that may be useful during the current assessment effort.

Going back to the earlier concern about a joint context analysis capability, the group was concerned that several simplifying assumptions will have to be made about how to interpret service analyses in order to combine their results in spreadsheets to support the assessment process. For instance, munitions resupply and distribution assumptions have to be made before engagement analysis results can be used to determine the sufficiency of current inventories to meet a defined threat. These specific items would be quite different for sea and land based air assets.

There is a danger underlying efforts that rely on analyses done elsewhere. Namely, the limitations of the analyses may not be understood by anyone other than their originator. An otherwise capable individual may, under the pressure to be responsive, innocently extend the external analysis results in an improper manner. While innocent, it could damage the credibility of the assessments. A sage once lampooned a misguided statistician by saying, "He uses statistics as a drunken man uses lamp-posts—for support rather than illumination."[3] Part of the reason for establishing a paradigm for joint context analyses is to minimize the potential misuse of analysis results.

Coherent Agenda

In order for analysis to help the JWCA process, it must be timely and focused on the

[2] In fact, analysts from the joint staff have won several MORS prizes that recognize outstanding analysis efforts.

[3] Andrew Lang (1844–1912), Scottish author. Quoted in: Alan L. Mackay, The Harvest of a Quiet Eye (1977).

issues. Analysis efforts are going on all over DoD and industry in response to their customer's interests. These efforts are not focused on illuminating specific Air Superiority JWCA issues. Schedules may not support the desire to influence PPBS decisions early in the process. The time frames, scenarios, and threats in these analyses may be inconsistent with the Defense Planning Guidance because they were not necessarily undertaken to support resource allocation decisions.[4] Still, some of these analyses may be useful to the Air Superiority JWCA and should be reviewed. However, the JROC should not count on luck to provide suitable analyses to support JWCA. There needs to be a proactive, coherent agenda for JWCA analyses.

The group examined the JWCA schedule and compared it to typical analysis timeliness. As a result, it is suggested that an annual study plan should be developed between the joint staff and services with formal terms of reference that charters specific efforts by the services and joint organizations.

The current fiscal environment along with today's threats provide sufficient resolution to establish a core study plan for the Air Superiority JWCA that calls for results in time to support the next cycle. Each JWCA cycle, as it enters integration, should produce a new study plan to support the next cycle. The analyses conducted under this study plan would obviously benefit from the joint context analysis capability called for earlier.

Innovation

Our working group was happily imagining various analysis empires to support the exploration of innovative concepts when one of our exogenous members introduced a measure of reality. He reminded us that organizations do not innovate, people innovate. Furthermore, organizations such as the military tend to stifle innovation because failure must be weeded out. Organizations that foster innovation have done so by rewarding successful innovations and tolerating some level of mistakes. Once the group was confronted with this insight, it quickly coalesced on a relatively modest proposal--a special environment needs to be created to empower individuals to pursue innovation on behalf of the JWCA process. To use a term from the air superiority community--senior leadership must provide "top cover" within the communities that foster innovation.

Recommendations

By far, the key recommendation from our MORS working group was that a joint organization be responsible for establishing a joint context analysis paradigm. This charter would make them responsible for certifying that a model's algorithms reflected a joint warfare environment. The organization should collect system data from the services and work with the intelligence community to obtain data for threat and gray systems. This organization should possibly be responsible for the joint context analysis framework for all of the force application JWCAs because of the need to lay a common foundation for the Strike, Ground Maneuver, and Air Superiority JWCAs. Part of this foundation would be laid by this

[4] Incidentally, the biggest customers for the analysis community are the system developers and logisticians. In fact, the best example of an effort to establish a joint context analysis capability is from the JAST program.

organization's coordination of a family of scenarios for joint context analyses.

Our working group consciously avoided resource and policy issues associated with establishing an organization to be responsible for a joint context paradigm. It was felt that any level of sanctioned effort was better than where we are today so there isn't a minimum level of effort. Clearly, more is better–up to a point. However, this is not a simple task that will be implemented through exhortations. Various CINCs, elements of the Joint Staff, and elements of the analytic community have tried to collect joint data and develop appropriate models in the past. These efforts have fallen short because there hasn't been a consistent, compelling need for jointness across enough of the analysis community to ever get the job done adequately. Service specific analysis has typically been sufficient to support program development and acquisition in the past.

With this caution, the group tried to make suggestions about how the organization should function. It was felt that several additional responsibilities should be given to the organization so that they become a customer of the joint context capability they are called upon to engender.

After some debate, a consensus was reached that the organization should not be a model developer by first choice. It should work on certifying a suite of models which would be nominated, and maintained, by the components. The suite needs to cover various levels of analysis–engagement, raid, and theater. The components would have to furnish the source code for models nominated for the suite, and agree to modify the model to support a joint context. This concept keeps the organization from focusing on development of some dream model that would solve all of today's analysis problems at some future time that never seems to arrive. It also means that every model in the suite would have an existing support base in one of the components.

The process of certification is rather problematic and the group did not have time to explore the issue fully. It is not clear if a model, with its joint data, might be certified for a limited period of time or for only a set of specified scenarios/problems. The group did agree that the organization's primary responsibility was coordination of the process for creating a repository of joint models and data.

A lot of our group's discussion focused on exploring various joint operational concepts to support the Air Superiority JWCA. We felt that the same organization should be assigned a small cadre of war college fellows on short tours to study these concepts. War college fellows have the right experience base to support such studies and the academic freedom to consider ideas that are outside today's conventions. A specific area they would be assigned to explore is the need for new joint operational concepts as a response to emerging threats or new technological opportunities. This part of the recommendation is patterned off of Newport's Technologies Initiatives Game.

The capstone for this recommendation is that the organization conduct at least one of the joint analyses in the annual JWCA study plan. By requiring it to produce analysis before the next JWCA, we are reassured that

"better" will not be the enemy of "good enough". One effort the group discussed for this organization was an Air Superiority for 2015 analysis that is needed as soon as possible. It could be put in a terms of reference study plan published this February.

Another benefit derives from having real analysis underway at the same organization responsible for establishing a joint context paradigm for DoD. It is understood that analyses that do not account for U.S. capabilities currently covered by special access programs may yield incorrect results. By having JWCA analysts with the appropriate clearances actively using the models, there is an explicit quality control function within the organization. Another quality control function would be to have the organization responsible for the joint context paradigm support the modeling and data requirements for the CINC's analysis cells.

Once a joint context paradigm was established, it would become the standard for analyses within DoD. The reason is that every major weapon system requires joint support to survive in this fiscal environment. Once a service makes the investment for its major weapons systems to provide a joint analysis capability, other economies suggest that the same framework would be used to examine any other issue where a joint context was appropriate.

This proposal is consistent with the principals underlying the Defense Modeling and Simulation Office, but it well beyond the DMSO charter. It also provides the services, joint staff, and CINCs a paradigm outside of the direct JWCA issue environment where they can discuss analytic issues. In the absence of this paradigm, a joint context analysis capability would only be built by fits and starts across DoD at much greater cost and without the same level of success.

The working group spent some time debating whether the proposed organization could work in the Pentagon. Generally, it was felt that such an organization would have its focus shifted to other priorities that tend to drive activities within the Pentagon. It was decided that it could be at National Defense University or at one of the CINCs among other places. It was felt that ACOM could be a natural location because of the proximity of several key Army, Navy, Air Force, and Marine assets there in the Tidewater area. It may be possible to combine this organization with the JWFC, but that is not crucial to the recommendation.

Within the joint staff, there needs to be an analytic capability within the cell responsible for the Air Superiority JWCA.[5] It takes an analyst to discover the limitations of efforts conducted elsewhere. By paying careful attention to recruitment, the analysts assigned to this cell should know most of the air superiority analysis community and call upon them for help as needed. However, the primary JWCA expectation is that this analyst would do desktop efforts that involve logical thinking that organizes large amounts of input information as opposed to simulation modeling of combat systems under varying conditions.

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[5] There are many pros and cons for a centralized versus distributed analysis capability within the joint staff. The group didn't try to resolve the issue. Instead, the group focused on the needs of the Air Superiority JWCA cell.

While simulation analysis at the engagement, raid, and theater level is needed to support the Air Superiority JWCA, it doesn't need to be conducted directly by members of the Air Superiority JWCA cell. However, the cell does need direct, day to day, access to the simulation analysts. Further, the cell needs to be considered a primary customer by the simulation analysts.

One other idea we had to foster innovation was to create a cadre with an individual from each service, which could be augmented from academia, that would report directly to the Vice Chairman. This cadre would be responsible for running down the details behind various ideas and exploring their implications. They should function as a crucible for ideas with the stronger ones surviving until they can be given to the staff.

Working Group Approach

The Air Superiority working group explored "the philosophy, policies, processes, and methods of evaluation and analysis useful to the JROC activities."[6] While we reviewed the scope of tasks included in the Air Superiority JWCA, we discussed them in order to scope their analysis needs. It appears that air superiority has a great deal of overlap and influence with other JWCA areas which means that good integration of the ground rules for the assessments will be critical. Trying to integrate these efforts after the fact will limit their ability to generate the kind of consensus among the military that is one of the JROC goals for JWCA.

Workshop Content and Schedule

The working group used the first morning to discuss the levels of analysis needed for this JWCA. We discussed the component missions for air superiority and the generic tasks that are required for these missions. An exercise was used during lunch to focus our minds on what it takes to do credible air superiority analyses.[7] In the afternoon we divided into two groups. The first group focused on how the joint staff can find and use quality analyses. One of the aspects we tackled was how to get timely analysis for the JWCA issues. The other group specified the kinds of analysis capabilities needed, discussed appropriate databases, and identified existing models that may be of some use to the JWCA team.[8] The second day, we discussed the implications of our first days deliberations and went back into two groups. The first group explored how air superiority analyses are chartered today and discussed ways to integrate them with the JWCA process. The second group focused on ways the joint staff might be able to leverage existing analyses using spreadsheets or simple models to study some of the issues. They took three existing Air Superiority JWCA issues and designed an analysis approach to support them. The role and importance of "spreadsheet" like models was clearly

[6] Mr Roske's letter dated September 9, 1994, sent with the workshop invitations

[7] The group was asked to prioritize the following factors for their impact on analysis for future air superiority JWCAs: threat definition, scenarios, time frames, joint representation in models, play of gray systems, representation of special access capabilities, and any other factors they wanted to identify.

[8] The group did not propose a particular modeling architecture. The model review helped identify process issues that need to be addressed.

demonstrated for two of the three issues.

Levels of Analysis

The group consensus was that the primary analysis problems for the air superiority JWCA will be capability assessments. Cost analysts expressed concerns about getting independent and responsive estimates into the issue assessments, but the general consensus was that the current process is adequate where the services provide cost data to the joint staff.[9]

The group clearly feels that the air superiority JWCA will have to use analyses that cover the engagement, raid, and theater level.[10] A general consensus was that theater level analysis is needed to address questions of quantity, and raid level analysis is needed to support quality issues. The chief concern of the group was making sure that joint data is used in the analyses and that the algorithms in the models represent the differences among the services.[11] As the group prepared for the out brief at the end of the workshop, they strengthened the wording that recorded their concern about the lack of "availability of Honest-Broker for joint data to support joint analysis." The group definitely felt that it will take JROC attention to resolve this issue for JWCA.

[9] Another area rejected by the group was how you may need to analyze air superiority operations outside of conflict such as in a show of force.

[10] Engagement analyses typically have a limited number of platforms that are modeled in great detail so that performance parameters can be linked to the measures of effectiveness. Raid level analyses attempt to cover all of the platforms that might be included in support of a single mission. While they typically continue to model engineering principles, they begin to have varying levels of fidelity for the platforms that are modeled and limit the area of coverage. Theater level models abstract the engineering principles of the platforms by relying on inputs from multiple engagement and raid level models. This allows the area of coverage, and number of missions, to be increased along with a significant increase in the number and types of platforms included. Theater level models typically simulate several days of a major campaign or war.

[11] A similar concern was expressed that the models not represent the threat as a mirror image of ourselves.

5. *Deterrence/Counter Proliferation of Weapons of Mass Destruction*

Alfred Lieberman, FS, Fred S. Nyland and Dr Robert G. Batcher

General

This report summarizes the content and findings of Working Group 5, Deterrence and Counterproliferation of Weapons of Mass Destruction, which met on October 17 and 18, 1994. The meeting was sponsored by the Joint Requirements Oversight Council and the Military Operations Research Society with the aim of contributing to analyses that could be of use in the Joint Warfighting Capabilities Assessment (JWCA) Process. The Chairman of the working group was Mr. Alfred Lieberman of the U.S. Arms Control and Disarmament Agency. His Co-Chairman was Lt. Col. Thomas Poulos Jr. (USAF) of the Joint Staff.

The views expressed in this report are those of the authors and contributors, and may not reflect the views of any Department, Agency, or other organization within the U.S. Government.

Current Definition and Content

The purpose of Working Group 5, Deterrence and Counterproliferation of Weapons of Mass Destruction (WMD), is to assess and prioritize programs in support of Counterproliferation.

The definition of counter proliferation accepted within the Department of Defense (DoD) was stated in the Report on Nonproliferation and Counterproliferation Activities and Programs, Office of the Deputy Secretary of Defense, May, 1994, also known as the "Deutch Report."

> "Counterproliferation: Activities of the DoD across the full range of U.S. efforts to combat proliferation, including diplomacy, arms control, export controls, and intelligence *collection and analysis, with particular responsibility for assuring that U.S. forces and interests can be protected should they confront an adversary armed with weapons of mass destruction or missiles.*"

Even though the distinction between Counterproliferation and non-proliferation is not clear, the underlining has been added to emphasize direct interest and primary direction of the working group.

Overview of Focus and Goals

The goal of this working group is to identify, develop, or improve analytical methods to support a process: the Joint Warfighting Capability Assessment (JWCA). The focus is on deterrence and countering the proliferation or use of weapons of mass destruction. Weapons of mass destruction include nuclear, chemical, biological and toxin weapons. Other potential forms of WMD

include radiological weapons and weather modification.

The working group, as part of the conference sponsored by the Joint Staff and the Military Operations Research Society, was tasked to address a variety of subjects with direct relevance to providing deterrence and countering proliferation. The goal was to exchange information between the Joint Staff and MORS to foster innovative approaches to the JWCA process. In particular, the methodological approaches and experience of the military operations research analysts participants furnishes a foundation for process improvements.

Discussion of Working Group Approach

To provide the opportunity for innovation, a series of briefings and discussion was structured. The intention of each briefing was to exchange information and foster focussed discussion. The briefings worked through several phases: background information, relevant policies and activities of the U.S. government, available analysis tools, current JWCA processes, data requirements, and the development of observations and conclusions. These subjects included methods of analysis, policy issues including central deterrence, extended deterrence, the role of the intelligence community, and selected military operations against adversaries with WMD. Each topic covered in each presentation was discussed by the group members in an effort to identify or provide an outline for present and future analyses.

The presentations provided to the working group for this purpose are noted below.

- Introduction, Alfred Lieberman
- Regional Problems and Threat, Ralph Hallenbeck
- National Guidance, Steve Day
- Attacking WMD Capabilities & Responding to Use of WMD, Roger Molander
- Futures to Strategies to Tasks to Acquisition, Sydell Gold
- General Deterrence, Fred Nyland
- Optimal Selection of Proliferation Targets, Tony Ciervo
- Novel Methods, Stephen Hill
- Methodological Overview, Peter Purdue
- Current JWCA Method, Lt.Col. Tom Poulos
- Data Requirements (Intelligence), Maj. Jerry Fisher

In addition to offering introductory remarks as the Working Group Chairman, Mr. Lieberman also explained the constraints that the members should consider. These constraints were two-fold: budgets and active arms control (START I, START II, ABM Treaty, INF Treaty, and others related to WMD).

During these presentations, members discussed a number of critical issues. The material in the discussion to follow provides an overview of these issues. Lists of detailed observations are contained in the Annex.

Central Issues for Counterproliferation

The national security strategy of the U.S. has changed since the end of the Cold War. One aspect of change has been the inclusion of Counterproliferation. Government activities of interest to Counter proliferation include the Nuclear Posture Review, the Report on Nonproliferation and Counter

proliferation Activities and Programs, and meetings conducted by the Committee on National Security.

The focus of deterrence before the end of the cold war was on countering the Soviet Union. With the collapse of the Soviet Union, the U.S. must still be concerned with deterring a nuclear strike against the Continental United States (CONUS), i.e. central deterrence. Our nuclear forces of missiles and bombers supply this deterrence. Extended deterrence, that is protecting our allies and friends against attack, needs to be expanded. This form of deterrence will involve conventional weapons as a first priority, but some reliance on a nuclear deterrent may exist in special cases. Deterring the use of weapons of mass destruction will be a primary goal and will rely heavily on military capabilities.

Many military missions and capabilities could be useful in countering the proliferation of weapons of mass destruction. Under the JWCA process, nearly all of these capabilities are the responsibility of other working groups (strike, air superiority, etc.). Members of the working group on deterrence and Counterproliferation formulated a matrix to ensure that mission areas across the range of working groups was well understood (see Figure 4). The left hand column contains a list of missions broken into a number of categories. This list is not complete as indicated by the dots at the end of each category. The names of the working groups are listed across the top of the chart. This chart will need to be filled in later and will serve as one mechanism for integrating the needs of countering proliferation across the scope of U.S. military capabilities.

Intelligence plays a critical role in deterrence and counterforce aspects of Counterproliferation. Political decisions to project U.S. military power, early in the peace/ conflict spectrum, in the face of substantial WMD (or even small numbers of nuclear weapons) are likely to require a high confidence of success, and low military risk and casualties. Currently, there is a large disconnect between the political requirements and the military capability. The critical shortfall is the intelligence capacity to locate and identify WMD capabilities of potential enemies. Without this intelligence the most robust attack capability would have limited impact. Fixed underground targets also require development of weapons capable of destroying these facilities, and substantial intelligence to locate critical compartments, and to assess damage.

Methods of Analysis

An extensive list of analytical methods applicable to aiding decisions about Counterproliferation was examined. During the meeting, many methods surfaced as part of some briefings, while other briefings were directed at methodology. First, we review the scope of analysis methods, and then briefly describe a few of the more promising methodologies.

One of the plenary JCS speakers likened the JWCA search for analysis tools with shopping in a local hardware store. The variety is extensive, and the shopper must select the tools that apply to specific problems. Table 1 illustrates this variety as a simple listing of items whose complexity varies enormously. Principles which contribute to effective analyses were discussed. For example, early and clear understanding of the problem must be established between the analyst and decision maker, assumptions should be explicitly stated, and uncertainty should be treated directly.

NOTIONAL CROSS-COVERAGE MATRIX FOR DETERENCE AND COUNTERPROLIFERATION										
MISSION AREAS / JWCAs		Deter & CP	Strike	Gnd Maneuver	Strat Mobil	Air Sup	C2 & NW	Intel, Surv, Recon	Overseas Pres	Joint Readi
Counterforce	Hard Target Kill									
	Prompt Target Kill									
	Agent Defeat									
	--									
	--									
C4I	Detect, Identify, Characterize									
	--									
	--									
Passive Defense	Vaccine/Antitoxin Prod'n									
	Personnel Protective Clothing									
	Equipment Decontamination									
	Nuclear Hardening									
	--									
	--									
Active Defense	Theater Missile Defense									
	--									
	--									
NPR Implementation	Reduction In Force Struct									
	--									
	--									
	--									
	--									

Figure 4. Notional Cross-Coverage Matrix

Table 1
A Sampling of Analysis Tools and Methods

Planning tools	Data manipulation/ analysis
Spreadsheets	Probability theory
Decision theory	Utility theory
War games	Markov models
Resource allocation models	Network interdiction models
Simulations	Campaign analyses
Influence diagrams	Stochastic analyses
Cost/Benefit analyses	Arms race analyses
Chaos theory	Catastrophe theory
Fuzzy logic	First strike stability
Combat models	Logistics models
First Strike Stability	Weapon allocation
Hunter-quarry models	Missile defense models
Air defense models	Target characterization
Process flow models	Nodal analysis
Reliability analysis	Meteorological models
Transport/diffusion models	Medical models
Commercial off the shelf software (all kinds)	

Results should be presented in a timely manner in a form understandable to a decision maker. The measures of effectiveness used in the analysis should have a clear relationship to a particular decision. Obviously, there are many other guiding rules, and many of these surfaced in our review.

Two analysis packages reviewed during the group meeting have promise for examining issues of importance in the Joint Warfighting Capabilities Assessment process.

The first is an analysis framework for integrating national security goals and the systems needed to achieve these goals (see Figure 5). It is called Futures to Strategies to Tasks to Acquisition (FSTA) and is in use by the Air Force. FSTA is a logical framework for thinking about the long term and provides linkage among policy, operations, architectures, systems, technologies, programs and budgets. It is an extension of Strategies to Tasks. A broad set of possible futures, strategies and scenarios is considered, so that stressing military tasks and the desirable characteristics for their technical solutions can be identified. These are developed into system and program solutions that can be linked back to futures and strategies. Unlike missions and/or systems can be compared to develop funding priorities. Beginning with Futures is important to help formulate Strategies in today's uncertain world.

A second model supports the selection of targets and attack options that will slow the process of building and producing weapons of mass destruction. It is based on network theory and critical path analysis. An extensive data base provides the technological options for producing nuclear, chemical, or (poten-

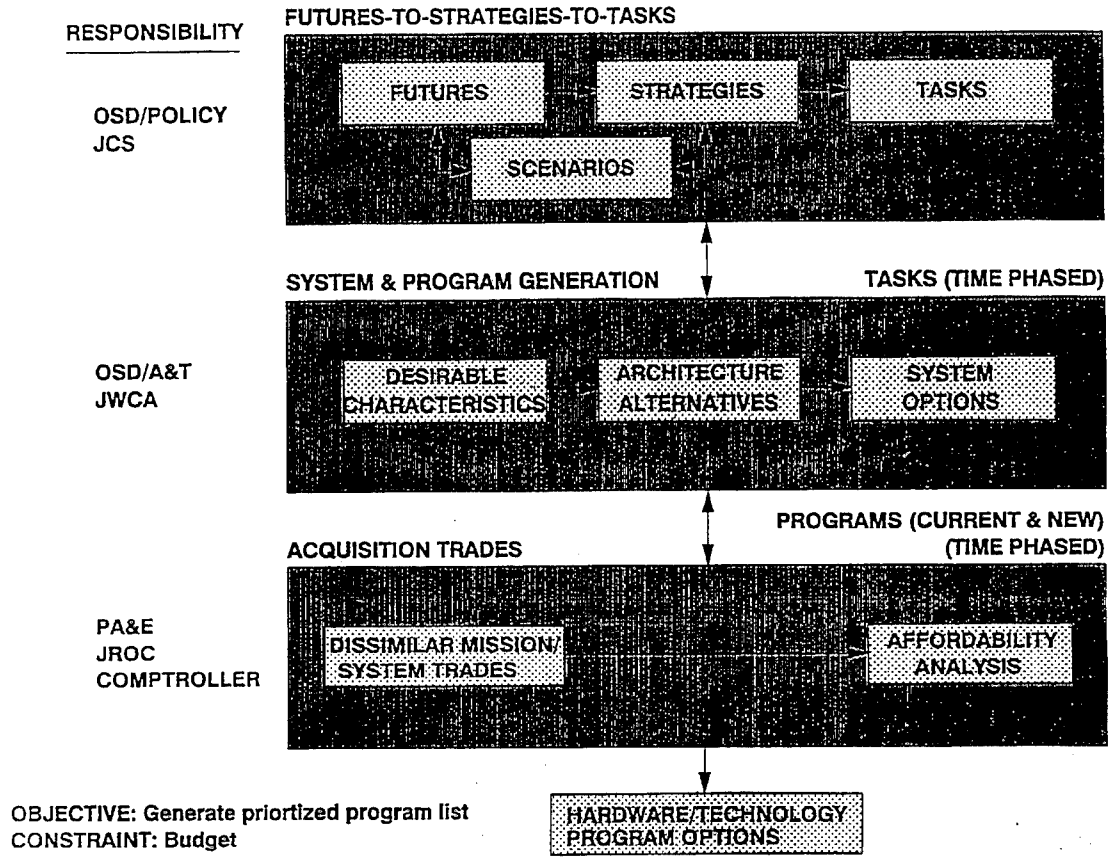

Figure 5. Futures to Strategies to Tasks to Acquisition

tially) bacteriological weapons for the country in question. The particular production process is examined and facilities, along with attack options, are selected. The criterion for target selection is to find the targets which, if destroyed or damaged, would cause the longest time delay in the acquisition of weapons of mass destruction while simultaneously minimizing collateral effects.

Additional methods that appeared to have potential, but which were not fully explored include:

Optimization/Decision Theory: mathematical formulations of goals, constraints and decisions that can be used to emulate complex decisions within a simulation or decision process, or structure and solve a resource allocation decision process.

Influence Diagrams: graphical representations of complex system interactions that provide a framework in which experts and decision makers can discuss problem structure and dependencies.

Exercises and War Games: forums for predicting battle outcomes or political decisions that incorporate the human

element (including examining the question "What deters whom?") and flexibility.

Finally, the U.S. Navy's experience in carrying out Joint Mission Analyses over the past three years could serve as a guide for the JWCA process.

Measures of Effectiveness

General measures of effectiveness are suggested in this discussion. The military missions suggested earlier form a useful framework. The missions include operations such as providing intelligence information, offensive, defensive, and support.

One of the main objectives of intelligence gathering and analysis is to supply targeting data for offensive operations. This task involves the detection, location, identification, and characterization of fixed, movable, and mobile targets of all kinds. Uncertainty will be a major part in measuring the effectiveness of intelligence process. Another task for the intelligence community will be to provide warning of attack for defensive operations. The thrust of the attack and its timing must be identified. The effectiveness of defensive operations must be estimated with and without all elements of warning information.

Offensive operations often involve attacks on a finite set of targets. Measuring the effectiveness of such operations in terms of the number of targets damaged or destroyed has been a traditional task, and would not be new in Counterproliferation activities. What may be new is the prior estimation of the number of targets not killed. For aircraft or cruise missile attacks by friendly forces, estimates of attrition or vehicle losses is a measure of operational risk.

Defense activities could be either active or passive. In the case of an active air or missile defense employed by the U.S. or its allies, defense effectiveness is usually measured by estimating the number of penetrating weapons for hostile attacks under a variety of conditions. Uncertainties arise because pre-attack estimates may be based on theory and test results. In combat, the attacking weapons may be different from those used in tests. The effectiveness of defenses should be examined by varying a number of key parameters ahead of time. These parameters could include interceptor kill probability against different types of targets, reaction times, number of available interceptors, and the allocation rules for interceptor commitment.

Measures of effectiveness related to support, particularly logistics operations, involve measuring the efficiency of transportation modes, and availability of supplies needed for the particular situation at hand. Logistic support functions usually involve the largest cost in projecting forces abroad.

These MOEs are general in nature. They are far from complete. What is being suggested, however, is that analyses of offensive, defensive, and support operations are not new, and should be brought to bear in the new mission applications arising from a new policy -- Counterproliferation.

Figure 6 illustrates the dynamic nature of Counterproliferation MOEs. Four generic MOEs are defined concerning the proliferant (his extra cost or time setback) or U.S. Forces (the degradation of U.S. operational capability or casualties). In developing a budget, it is

necessary to choose between diverse technology options (e.g., earth penetrators, biological sniffers, masks, etc.) that have different impacts on each of these measures. Thus to define the overall importance of each program it is necessary to define, at least conceptually, a composite MOE that weighs each of the individual MOEs. The figure suggests that the emphasis placed on each MOE depends on what phase the proliferant's WMD program is in: Pre Initial Operational Capability (IOC); Post IOC - in Peacetime; Post IOC - during Crisis; or, substantial Employment capability. At one extreme, the proliferant's status is Pre IOC, and the emphasis is high on extending his cost and time. At the other extreme, the U.S. is engaged with an enemy with deployed WMD capabilities and the emphasis is primarily on measures of the degradation of U.S. operational capability and casualties. Because the U.S. is concerned with world wide threats, not just individual countries, the emphasis placed in the MOEs must balance across the threat and will change as proliferants move up the development timeline.

Process Evolution

The process used in the initial "Deterrence and Counterproliferation of WMD" JWCA process was an outstanding effort given the time and resource constraints. It progressed through a series of logical steps from a vague definition of the Counterproliferation warfighting area to the identification of issues:

- Establishment of an "End-to-End" methodology
- Data Collection
- Identification of Essential Capabilities
- Determination of Shortfalls
- Prioritization of Programs/ Projects
- Identification of Counterproliferation Issues

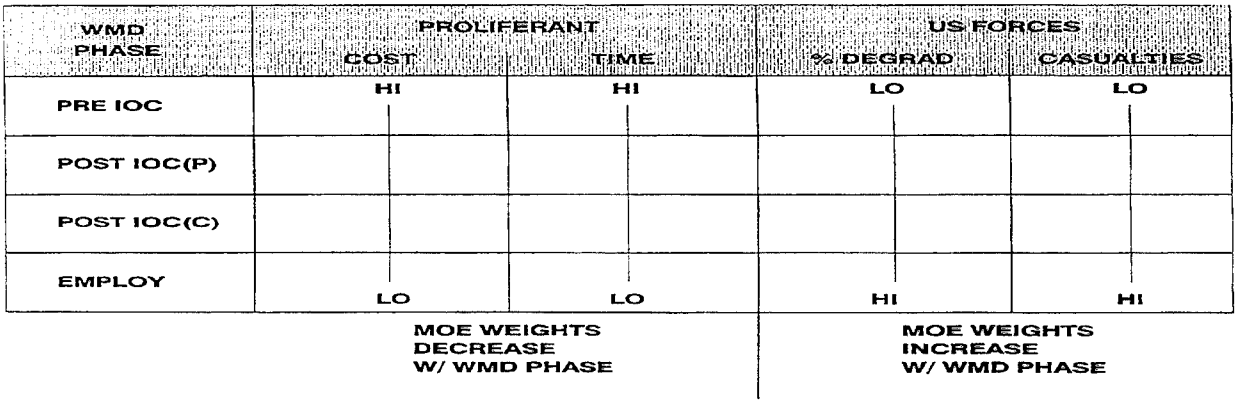

Figure 6. Measures of Effectiveness

Like all the JWCAs processes, this process was Ad Hoc, resource driven and governed by strict functional stove pipe definitions. The purpose of the workshop is to help transition to a future process, that will continue to be resource constrained, but assessment driven. The future process should have a front to end integration for continuous JWCA assessments and have smooth horizontal integration. Although the specifics of such a future process were not defined, progress was made in identifying methods and measures.

The treatment of Counterproliferation requirements is an evolving process as it is not a traditional warfighting area. The military missions assigned to this area have generally been treated in the past in other contexts. Several missions have been uniquely assigned to this JWCA (principally defensive operations in an nuclear, biological and chemical environment). However, many of the most important military requirements are contained in the purview of other JWCAs. This presents a particular challenge to integrate the needs of countering proliferation across the JWCA boundaries (see Figure 1 above).

A better appreciation of the connection between the importance placed on deterrence and Counterproliferation at the level of national guidance and the definition of military requirements is needed. A better understanding of the likelihood of encountering an opponent possessing WMD now and in the future will provide the need to establish and support Counterproliferation programs in a timely manner.

Up to this point the focus of the JWCA on Counterproliferation suggests that central deterrence is not an area that requires intense JWCA analysis. However, with the conclusion of the National Posture Review, this JWCA will focus more on this area. The programmatic decisions on nuclear capabilities to achieve central deterrence are addressed in the context of strategic force reductions under START II and the Nuclear Posture Review. The Nuclear Posture Review also addresses tactical nuclear force reductions.

Summary and Conclusions

The conclusions of the working group address strategies, issues, models, measures of effectiveness (MOEs), and the JWCA process.

Current national strategies concern central deterrence of the Republics of the Former Soviet Union and China, and extended deterrence. The role of central deterrence will continue to be crucial as long as these major powers still possess substantial arsenals of nuclear, chemical, and biological weapons. The framework for extended deterrence must be expanded to include confrontations in other areas of the world.

Threats to the United States, its forces deployed abroad, and its friends and allies will include the activities of lesser countries in the future. The most likely threats will be regional. The role of the U.S. will be to deter the use of weapons of mass destruction, and where needed, to discourage their deployment and proliferation.

Collecting and analyzing intelligence data from a much larger portion of the world will be of paramount importance. The intent, capabilities, and assets of nations in the third world call for increased capabilities. For use in combat, targets will have to be detected,

identified, their vulnerabilities determined, and information forwarded to commanders and other users in a timely fashion.

Military operations may be needed to support Counterproliferation initiatives. These operations include offense, defense, and support. Other missions (e.g., Special Forces) specifically tailored to unique situations probably will be needed as well. The missions considered by the working group were itemized in a partial manner earlier in this report, and will serve as guidelines for future analyses.

Many models currently exist for examining combat operations. Measures of effectiveness must be chosen, along with measures of risk to evaluate the success or lack of it in many different combat situations. In some cases preemptive operations will need specialized analyses. In other cases, new capabilities will need consideration as new demands are made on the military for carrying out other missions not considered here. The FSTA model should be of help in these cases. When interdiction is needed to delay the procurement of WMD, we have suggested a model for optimizing the target selection process.

With regard to the JWCA process, we find that many of the missions applicable to Deterrence and Counterproliferation are the primary responsibility of other working groups, such as Strike, Air Superiority, Global Mobility, etc. The role of Working Group 5 will be to insure the integration of its interests concerning Counterproliferation into the agendas of the other working groups. There are some missions that will be the sole responsibility of Working Group 5, and these will form the basis for another set of activities. In addition to these processes which are internal to the JWCA process, there are other coordination activities proceeding across the entire breadth of the U.S. Government. The outcomes of these efforts will affect the Department of Defense, and must be accounted for in the JWCA process. Because analysis often influences the decision making structure, the working group believes that it is essential that analysts be included in the effort from the start. In the short term, simple analysis tools can be used, particularly when there is uncertainty. In the longer run, simulation and more complicated models can be made available.

Finally, all future military activities will be constrained by the declining budget and arms control initiatives. The arms control constraints will include treaties in effect, those about to be put into effect, and negotiations that arise in the arena of non-proliferation.

ANNEX

Detailed Observations

Observations emerging from presentations and discussions are presented here in highlight form. Other observations might be made by other working group members, but these were felt to be important enough to present in this report. Speakers, their affiliation, and subject are noted. Only a few of the most important observations were presented as conclusions during the out-brief on this project.

Regional Problems and Threats.

Dr. Ralph Hallenbeck (SAIC) highlighted region specific WMD proliferation issues. Some observations made relative to this talk are noted below.

- The new threat is region specific.
- U.S. is concerned with nuclear weapon proliferations by friends as well as enemies.
- BW/CW warheads may be attractive to some proliferators in lieu of HE warheads.
- We must pay greater attention to aircraft for delivery of weapons of mass destruction (WMD).
- Proliferation potential increases with industrialization (availability of dual use items).
- Other countries with WMD may oppose our power projections. Will this deter us from intervening?
- Is Counterproliferation concerned with deterring production of WMD? with possession? or their with use?
- The military threat to CONUS from overt military attack is no longer a paramount issue.
- Mutual Assured Destruction may not be at all important in some third world countries. We must understand what proliferators will try to achieve through possession as well as use, and how thy will try to do this.
- There is a tendency to start with scenarios, but we must step back and explore the regional incentives from WMD prolifeation, possession and use.

National Guidance (& other Government activities).

Dr. Steve Day (ACDA) discussed the status of non-/counter-proliferation national guidance and the institution of new U.S. Government coordinating committees. Some observations made relative to this talk are noted below.

- The defense environment has changed (less money!).
  - National security strategy calls for flexible forces and contending with two regional conflicts simultaneously.
  - Countering WMD is a primary issue.
  - Nuclear Posture Review resulted in reduced nuclear forces.
  - Conventional responses are appropriate to countering WMD.
- The "Deutch" report (Report on Nonproliferation and Counterproliferation Activities and Programs, May, 1994) as the first step in identifying Counter-

proliferation needs. There are many shortfalls that were not addressed.

- The Committee on National Security has been characterized as a "virtual agency" integrating the whole government on science and technology policy.
- The Department of Defense must take the activities of other agencies into account.

Responding to WMD, Attacks, and other Military Operations in a WMD Environment.

Roger Molander (RAND) discussed the results of Counterproliferation policy exercises, known as "The Day After ...," as well as consequences of military operations in the presence of enemy WMD. Some observations made relative to this talk are noted below.

- We need to face the tyranny of small numbers of nuclear weapons.
- Gaming exercises have shown that countries with small numbers of nuclear weapons can be creative in their application.
- Early pre-emption is favored, but not likely to be permitted. "Go or No Go" criteria are expected to be very demanding.
- Countering proliferation is mostly an intelligence problem.
- Major advanced systems are vulnerable to nuclear effects.
- Lean forward with intelligence collection. Find hidden targets.
- Some countries are right at the threshold of developing nuclear weapons.

Futures to Strategies to Tasks to Acquisition (FSTA).

Dr. Sydell Gold (SAIC) described the FSTA process being used in the Air Force to define requirements. Some observations made relative to this talk are noted below.

- Link policy, operations, architectures, systems, technologies, programs, and constraints (affordability, feasibility). (Analysis method described.)
- In the Cold War period we understood requirements well enough to start with Strategies, but in today's uncertain world, we need to start with Futures. These Futures focus on possible threats and do not try to predict the future.
- Similar processes generally jump from tasks to systems, but the FSTA interposes a "desirable characteristics" step between tasks and systems that has proven very helpful.
- The number of System Options tends to grow very large, and this requires acquisition trades including mission/system trades and affordability analyses.
- Analyses are accomplished using a roster of scenarios that are designed to stress fundamental processes: survey, assess, command & control, generate, and engage. The Air Force has found that this can be done with a set of fourteen or fewer scenarios.
- The approach gives insight into the relative merits of dissimilar missions and/or systems within overall force capability; helping with the "apples and oranges" tradeoff problem.
- An affordability analysis tool was built to define how to pay for needs under a budget cap.
- FSTA gives a logical framework and a check list that could be useful for the JWCA process. The JWCAs could be embedded into the FSTA framework. It can also be employed within the

more restrictive framework of Deterrence and Counterproliferation of weapons of mass destruction.

General Deterrence Now and in the Future.

Fred Nyland (ACDA) discussed post-Cold War concepts of deterrence reflecting both central and regional conflicts, and all forms of WMD. Some observations made relative to this talk are noted below.

- Central deterrence is well in hand.
- Extended deterrence needs to be expanded.
- Stability and missions for third world operations need definition.
- There are several forms of stability and it is necessary to identify the form under consideration in any discussion.

Optimal Selection of Proliferation Targets.

Dr. Anthony Ciervo (Pacific Sierra Research) described a process for establishing targeting priorities against a proliferation network. The Capabilities Acquisition Process (CAP) models define the status of a proliferant's progress towards developing a WMD weapon. The models can be used to identify targets and attack options that would maximize the impact on a WMD program while minimizing collateral effects. Some observations made relative to this talk are noted below.

- Find targets that will slow the production and spread of WMD.
- The models, in their present form may be helpful to the CINCs' targeting, but are too specific for the JWCA process.
- There was some speculation on a "CAP-like" model that would show some promise in organizing and linking Counterproliferation requirements.

Novel Methods and New Sciences.

Dr. Stephen Hill (TASC) discussed the application of "New Sciences," including chaos theory, catastrophe theory and self-organizing/ complex adaptive systems, in military analyses. Some observations made relative to this talk are noted below.

- Immediate applications for chaos and catastrophe theories are not apparent at present, and need more development to specific scenarios.
- Accident theory and fuzzy logic are additional "new sciences" that may have similar application.

Methodological Overview.

Dr. Peter Purdue (Naval Postgraduate School) described how the analyst can help the JWCA process and surveyed operations research analyses techniques to identify what is available to help with this process. Some observations made relative to this talk are noted below.

- Analysis can structure the decision process.
- Operational Research analysts should be team members from the start. They, however, play a support role.
- Think about and quantify risk.
- Keep models simple particularly when uncertainty is great.
- Today's optimization software can handle large problems.
- There is a need for relatively simple models, incorporating uncertainty and including non-traditional military and non-military areas.
- Decision analysis, including influence diagrams, will play a major role.

Support to Counterproliferation Operations.

Major Jerry Fisher (National Air Intelligence Center) discussed the intelligence requirements needed to support Counterproliferation operations. At present, appropriate data seems to be lacking, and collection capabilities may need to be directed at the new objectives suggested in other presentations during this meeting.

General Discussion Points.

Some observations made in the general discussion are noted below.

- Non-proliferation is different from counter-proliferation.
- Counter-proliferation consists of DoD activities: defusing, deterrence, offense, and defense.
- Counterproliferation has no advocate in the services.
- Means of countering proliferation must be integrated into considerations by other JWCA groups.
- The presence or capabilities of an adversary's WMD force may not be known until late in an evolving crisis.
- Any country backed against the wall can be expected to try to acquire nuclear weapons.
- Arms control activities have had and will continue to have an impact on U.S. military forces.
- To compare dissimilar situations, analysts and decision makers must raise their MOEs and measures of risk to a common ground; e.g., winning the conflict versus killing targets.

6. *Command and Control and Information Warfare*

Dr. Stuart H. Starr

Agenda

On 17-18 October 1994, the Military Operations Research Society (MORS) convened a workshop on the new Joint Requirements Oversight Council (JROC) Process, in response to a request from Admiral William Owens, Vice Chairman, Joint Chiefs of Staff (VCJCS). This report documents the deliberations of Working Group 6, the Working Group on Command and Control (C^2) and Information Warfare (IW).

The final report of the Working Group on C^2 and IW is divided into five sections. The first section provides an Executive Summary of the Working Group's deliberations by citing its major findings and recommendations. The second section defines the key terms that are used throughout the report. The third section identifies and discusses the nature of the Joint Warfare Capabilities Assessment (JWCA) problem for C^2 and IW. It discusses similarities and differences between the two activities, discusses key attributes of the Planning, Programming, and Budgeting System (PPBS), identifies key substantive issues that the Joint Staff is confronting, and discusses the relative attributes of the tools that could be brought to bear to address those issues. The fourth section of the report briefly summarizes the current approach that the Joint Staff is pursuing to deal with near- and longer-term problems. The report concludes by identifying and discussing a revised approach to these problems. It identifies impediments to change, suggests actions to support integration and coordination across the nine Joint Staff mission areas, and recommends a set of near-, mid-, and longer-term actions.

Findings: Challenges

The Working Group addressed three interrelated activities: Command and Control (C^2)[1], Command and Control Warfare (C^2W)[2], and Information Warfare (IW)[3]. The Working Group found substantial differences in the

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[13] In JCS Pub 1-02 (ref. 1), C^2 is defined as "The exercise of authority and direction by a properly designated commander over assigned or attached forces in accomplishment of the mission. C^2 functions are performed through an arrangement of personnel, equipment, communications, computers, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission." Furthermore, the Working Group noted the distinction raised by Lt.Gen. W. A. Shoffner (USA-Ret) that Command is primarily an art (and the business of the commander), while Control is primarily a science (and the business of the staff) (ref. 2).

[14] In JCS MOP No. 30 (ref. 3), C^2W is defined as "The integrated use of operations security (OPSEC), military deception, psychological operations (PSYOP), electronic warfare (EW) and physical destruction, mutually supported by intelligence, to deny information to, influence, degrade or destroy adversary C^2 capabilities, while protecting friendly C^2 capabilities against such actions."

[15] In the Report of the Defense Science Board (DSB) Summer Study Task Force on Information Architecture for the Battlefield (ref. 4), the following draft DoD UNCLASSIFIED definition of IW is cited: "Actions taken to achieve information superiority in support of national military strategy by affecting adversary information and information systems while leveraging and protecting our own information and information systems."

analysis community's level of understanding of the activities, the availability of methodologies and tools to analyze key issues in the activities, and the level of security sensitivity associated with each activity.

- **Level of Understanding**. The analysis community has been systematically addressing C^2 for the last twenty five years. During that period, it has developed conceptual frameworks for addressing C^2 issues, developed and applied measures of merit (MoMs) to many of those issues, and conducted many mission-oriented analyses of C^2 that have provided important insights into the nature of the problem. However, due to the complexity of the problem, the highly dynamic nature of the problem (e.g., technology advances, expansion of missions of interest, evolving doctrines), and the difficulty in dealing with the human element in the C^2 process, the Working Group assessed the challenge in this mission area as "moderate".

  In the area of C^2W, substantial analytical effort has been invested in defensive actions ("C^2 Protect"). However, there is far less understanding of many of the key facets of offensive actions ("Counter-C^2"). This is due, in part, to the dearth of knowledge about the C^2 doctrine, processes, and systems associated with potential adversaries. Consequently, the Working Group assessed the challenge to the analysis community in this mission area as "significant".

  IW is in its infancy. At this stage there is only a vague understanding of what the key issues are in the areas of capabilities and infrastructure. Many of these issues fall outside the normal realm of military analysis (e.g., political, economic, social). An enormous amount of work remains to be done to structure and analyze these issues. Consequently, the Working Group assessed the challenge to the analysis community in IW as "very significant".

- **Availability of Methodologies and Tools.** Over the last twenty five years, the analysis community has developed and applied a variety of methodologies and tools to a broad set of C^2 issues. In particular, variations of the mission oriented approach (or the strategy-to-tasks paradigm) have been developed and applied with appreciable success. J-6 currently employs a variant of this methodology in its Global C^4 Assessment. The Working Group identified several specific tools that could be used in concert with the Global C^4 Assessment to illuminate many of the issues identified by the J-6 staff (e.g., combat identification, space launch). These tools were drawn from the categories of expert elicitation, constructive modeling and simulation (M&S), virtual M&S, live M&S, and lessons learned from actual conflict. However, work is still needed to refine, verify, validate, and accredit (VV&A), and orchestrate these tools to address the problems of interest. In addition, to satisfy the goals of the JWCA, the selection and orchestration of these tools must reflect the unique information demands imposed by the PPBS (i.e., type of information;

responsiveness). Consequently, the Working Group assessed the challenge to the analysis community as "moderate".

In the area of C²W, the analysis community has made less progress. There are a variety of tools available to assess technical issues associated with C² protection (e.g., vulnerability of friendly systems to jamming and attack), but significantly fewer tools to assess Counter C² (particularly in relating the attack of C² to its impact on adversary effectiveness). Consequently, the Working Group assessed the challenge to the analysis community as "significant".

In the area of IW, the Working Group could not identify existing methodologies or tools that would be adequate to deal with the major issues of interest. However, there are initial efforts that might serve as useful starting points for further work in the area. For example, in the Naval Studies Board Information Warfare Study (ref. 5) first order vulnerability analyses were performed for selected information systems. In addition, the RAND Strategy Assessment System (RSAS) began to address the issue of modeling the cognitive processes of the National Command Authorities (NCAs) of competing nations. The Working Group observed, however, that near term efforts in this area should be cerebrally intensive vice computationally intensive (i.e., think out the problem carefully before embarking on the development of large scale simulations). Consequently, the challenge to the analysis community was assessed as "very significant".

- **Level of Security Sensitivity.** Security sensitivity was identified by the Working Group as a factor that could adversely affect the analysis community's ability to support the JWCA process. There do not appear to be substantive security issues in the area of C², but the problems become progressively more severe for C²W and IW due to compartmentation of key activities. This issue is addressed in the Working Group's recommendations.

Overall, the Working Group found that these activities are highly inter-related and tightly coupled to most of the other mission areas in the JWCA process. Consequently, it anticipates great challenges in conducting meaningful individual mission analyses and in integrating the results that might arise from individual analyses. The Working Group has several recommendations for addressing this issue.

Recommendations: Near-Term

In the near-term, the J-6 and J-33 face a daunting task, with very limited time and resources available. In view of those constraints, the Working Group recommends that the Joint Staff emphasize expert elicitation approaches. There are a variety of expert elicitation techniques available that have the advantage of being broadly applicable to a variety of sensitive issues and requiring limited resources and limited time to use. For example, a trained facilitator, using recent developments in groupware (e.g., shared decision support tools), can help a group of domain experts identify the critical actions that the Joint Staff might wish to highlight in the Defense Planning Guidance and perform initial rank order assessments of Program Objective Memorandum (POM) issue alternatives.

Specific steps should be taken to enhance the credibility of these results (e.g., extensive use of sensitivity excursions to establish the robustness of any conclusions). In addition, adaptations of more focused expert elicitation tools could prove of value, particularly in the area of IW. As an example, RAND has used "The Day After ..." methodology to illuminate issues associated with "discontinuous" problems (i.e., the threat of first use of nuclear weapons by an adversary with a very limited nuclear stockpile). Using a variation of this technique it should be possible to identify and illuminate many of the key policy issues associated with IW.

As another near-term activity, efforts should be undertaken to tap C^2 and IW lessons learned from crises/conflicts more effectively. These lessons learned should be pursued from multiple perspectives: Blue (e.g., as recorded in the Joint Universal Lessons Learned System (JULLS)) and from other national points of view (e.g., Russian, Chinese, and Iranian papers on the lessons that they have learned from recent conflicts like Desert Shield/ Desert Storm). The latter perspectives will be of specific value to the IW community.

The Working Group observed that several award-winning MORS papers have been generated recently that address C^2 issues that the Joint Staff had identified (e.g., combat identification (ref. 6), space launch (ref. 7)). It is recommended that the Joint Staff build upon these results as they continue to explore these issues.

To deal with the problem of integrating across the JWCA mission areas in the near-term, the Working Group recommends that Integrated Process Teams be established for the major JWCA military activities (i.e., strike, ground maneuver, air superiority, IW). Each of these teams should be populated by domain experts from the supporting activities (e.g., C^2; Intelligence, Surveillance, and Reconnaissance (ISR), joint readiness; overseas presence). In this manner, the analyses would reflect, to a first order, the major relationships that cut across the JWCA mission lines.

Recommendations: Mid-Term

In the mid-term, consideration should be given to expanding and adapting the J-6 mission oriented framework to the total JWCA process. Once the current mission oriented framework is modernized and expanded (e.g., to treat IW explicitly), its structure could provide a useful template for selecting a new set of consistent mission areas. The mission-oriented framework would facilitate the integration of the results of individual analyses, help identify key issues that require more in-depth analysis, and provide a unified mechanism for displaying the relative "health" of the individual mission areas, consistent with broad strategic goals and objectives. To take fuller advantage of this enhanced mission oriented approach the Working Group recommends that the participants in the assessment be expanded (e.g., include individuals who are involved in formulating plans for IW; solicit inputs from individuals with a long term perspective) and the breadth of the assessment be broadened (e.g., emphasize sensitivity analyses and employ a very broad array of scenarios to clarify the robustness of preliminary issues and findings).

The Working Group observes that selected existing constructive M&S may be of value in addressing some of the specific issues that were identified by the J-6 (e.g., air defense

C^2) and some of the issues that may emerge from the enhanced Global C^4 Assessment. The Working Group identified several recent initiatives where the community has integrated several constructive M&S to relate improvements in C^2 to enhanced mission effectiveness (e.g., activities in the Electronic Systems Command's (ESC's) Modeling, Analysis, and Simulation Center (MASC)). It may be possible for the Joint Staff to gain access to some of those orchestrated, constructive M&S tools to address selected issues of interest. It should be noted, however, that even when a useful constructive M&S tool exists, it is often time consuming to assemble the needed data and to exercise the tool properly. The complexity of these tools is such that they generally call for a well trained analyst to apply them properly.

The Working Group observes that the ability of the J-6 and J-33 to perform JWCAs would be enhanced considerably if well trained analysts are assigned to those organizations. These analysts could prove invaluable in framing the problem, applying a broad spectrum of relevant tools, and taking advantage of related activities in the analytic community. With respect to the latter, these analysts could provide the core of a new MORS Working Group on JWCAs.

Recommendations: Longer-Term

Over the longer-term, the Working Group has several additional recommendations. First there is a need to develop an "intellectual reservoir" upon which to base future IW activities. If such an "intellectual reservoir" is to be created it will require a continuing, highly capable, multi disciplinary team (e.g., political scientists, computer scientists, anthropologists, operations analysts, societal analysts) with access to **all** relevant information. As one potential organizational model, one might consider the Phase One Engineering Team (POET), which draws on personnel from FFRDCs and not-for-profits to support analyses of ballistic missile defense issues. If such an organization is created there are a number of high priority tasks that should be assigned to it. These include the development of new tools and databases to enhance substantially our ability to analyze IW issues; the systematization of methods for developing lessons learned from crises and conflicts (e.g., decide what data we want to collect, how we will collect it, and how we will process it); and support efforts to enhance our understanding of human behavior and our ability to model it.

The second major longer-term recommendation relates to the obstacles posed by the PPBS itself. In the near term, the JWCA must conform to the characteristics of the PPBS (e.g., nature and timing of products). In the long term, the JWCA might be the catalyst to recast the PPBS so that it provides the necessary visibility into the most critical problems that the national defense community will face over the next decade (rather than the problems that it used to face in the preceding three decades).

Glossary

The following section introduces and discusses the key terms that are used throughout this report.

Command. In Joint Pub 1-02 (ref. 1), Command and Control (C^2) is defined as "The exercise of authority and direction by a properly designated

commander over assigned or attached forces in the accomplishment of the mission. C^2 functions are performed through an arrangement of personnel, equipment, communications, computers, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission."

In a recent article (ref. 2), Lt.Gen. Wilson A. Shoffner (USA-Ret) observed that "[The] acronym seems to suggest that "command and control" is one word. Command and Control is *not* one word. Each word is different and carries with it significantly different meanings, ideas, and responsibilities."

Lt.Gen. Shoffner goes on to observe that "Command is primarily an *art.* ... Command is commander's business." The facing chart identifies a selected set of functions that the commander must perform as he exercises his art.

Control. Lt.Gen. Shoffner goes on to say that "Control, on the other hand, is a science of regulating forces and functions on the battlefield to execute the commander's intent. Control is a more precise means through which staffs support their commander's intent and work with other staffs. Control performs the functions shown in [the facing page] and is primarily staff's business. Commanders anticipate change, and staffs project change. While command focuses the organization, control regulates the functions of the organization."

Consistent with these distinctions, the Working Group concurred on several key points. First, most of the C^2 systems of interest in the PPBS support control. Second, since command is strongly a function of individual style, it is not generally amenable to assessment. Conversely, control, with its scientific roots, is more amenable to systematic assessment. However, in both instances, the human is an integral element of the equation and must be considered in any meaningful assessment.

Command and Control Warfare. The group found it important to introduce and discuss the concept of Command and Control Warfare (C^2W). The term is formally defined in the Chairman of the Joint Chiefs of Staff (CJCS) Memorandum of Policy (MOP) No. 30 (ref. 3).

C^2W consists of the integrated use of five principal military actions: operations security (OPSEC), military deception, psychological warfare (PSYOP), electronic warfare (EW), and physical destruction. It should be noted that selected aspects of operations security (e.g., encryption) and electronic warfare (e.g., protection of friendly combat capability) are frequently subsumed within the rubric of C^2 and Counter C^2, respectively.

The purpose of C^2W is to deny

information to, influence, degrade, or destroy adversary C² capabilities, while protecting friendly C² capabilities against such action. Thus C²W is frequently decomposed into offensive actions (i.e., Counter-C²) and defensive actions (i.e., C² Protect). In addition, it is important to note that the definition stresses the support provided by intelligence. MOP 30 goes on to say the C²W applies across the operational continuum and all levels of conflict.

C²/C²W/IW Battlespace. One of the fundamental problems faced by the Working Group is the security sensitivity associated with compartmented C²W and IW activities. For example, many of the Counter C² and offensive IW programs are compartmented. To deal with that difficulty, the Working Group elected to view IW as an overarching strategy that subsumes and goes beyond many of the activities associated with C²W.

As a working definition the Working Group referred to the following draft DoD UNCLASSIFIED definition of IW: "Actions taken to achieve information superiority in support of national military strategy by affecting adversary information and information systems while leveraging and protecting our own information and information systems."

IW deals with a broader set of targets than C²W, both to attack and to defend against (e.g., it could conceivably engage a broader array of political, economic, or physical infrastructure targets). In addition, IW could potentially be invoked earlier in the combat timeline than C²W, while our relationship to an adversary could still be well into the "competition" stage (vice on the verge of, or into, military conflict).

Relationships

Based on these definitions, the Working Group observed that there were interesting overlaps among the activities of interest. For example, IW is viewed as an overarching strategy while C²W is perceived to be the military strategy which implements IW on the battlefield. In addition, C², C²W, and IW have close relationships to the other Joint Staff mission areas (particularly ISR).

In particular, C² includes support to C²W, IW, and ISR planning and execution. In addition, key segments of the C² system provide critical support to military operations (e.g., strike, ground maneuver, air superiority, military operations associated with weapons of mass destruction) and selected support operations (e.g., strategic mobility, distribution of intelligence, support of logistics).

As noted above, activities associated with C²W have some overlap with activities normally associated with C² (e.g., design of C² systems to enhance their resistance to adversary actions such as jamming or exploitation). In addition, selected aspects of Counter-C² (e.g., jamming, deceiving or destroying key elements of an adversary's C² system) can be seen to fall within the domain of IW. In addition, the broadened array of targets of interest in IW leads to activities outside the bounds of C² or C²W.

Furthermore, the Working Group observed that the missions of joint readiness and overseas presence both impact and are impacted by C^2, C^2W, and IW.

These observations led the group to question the proposed decomposition into the nine Joint Staff missions of interest. In light of the very close coupling among these mission areas it suggests that they can not be meaningfully assessed in isolation, nor can the ensuing results be easily integrated. This issue will be revisited later in the report.

An Old Problem

The objective of this Working Group was to identify military Operations Research (OR) analyses, methods, and products to support the Joint Staff assigned to assess C^2 & IW in the expanded JROC process. The Working Group also formulated a set of recommended actions that the Joint Staff could pursue in the near-, mid-, and longer-term.

The Working Group made three observations about these objectives. First, the task of assessing C^2, C^2W, or IW is quite difficult. Second, getting beyond that barrier does not fully resolve the problem: it is still necessary to inject the results into the PPBS to influence the allocation of resources. Finally, it is important to emphasize that this is not the first group that has tried to assess C^2 in an attempt to influence the PPBS. Although this latest initiative has important new ingredients (e.g., very high level support, the opportunity to build on earlier efforts), it is still a daunting task with uncertain prospects for success.

Nature of the Problem

The Working Group felt that it was vital to discuss and understand the nature of the problem prior to suggesting methodologies or tools for analyzing the missions of interest and injecting the results into the PPBS.

With respect to the subject area, several aspects were raised about C^2, C^2W, and IW that must be considered in any meaningful assessment . First, each of the activities involves actions that are *highly interactive.* This suggests that tools that consider only Blue activities are inadequate. It is necessary to deal with Red (and probably other participants, such as Gray) activities and the interactions among them. Second, the Working Group observed that the effectiveness of C^2, C^2W, and IW is highly dependent on *human behavior.* This can range from the performance of isolated individuals, under stress, deprived of sleep and food and exposed to the elements to distributed teams of individuals, with mixed levels of training and competency, under pressure to make decisions while confronted with fragmentary and frequently contradictory information. It is generally difficult to deal with this vital human element, credibly, in an assessment (e.g., predict their response, *a priori*). Finally, it is important to stress that the underlying technology associated with these activities is changing dynamically. Projected changes in information technology promise more capable systems at lower prices. Consistent with current acquisition directions, these systems will incorporate an increasing percentage of commercial-of-the-shelf (COTS) products. This trend may pose new opportunities as well as new vulnerabilities to guard against.

In the area of IW, several additional factors must be stressed. First, the great sensitivity of the issues makes it difficult to

have a frank discussion of the subject. This limited the Working Group's ability to discuss the key issues of interest and prompted several recommendations on ways to cope with this factor. Second, high technology may not be absolutely required to support IW. Many techniques that were used effectively in prior conflicts could still be used to advantage. Finally, IW issues transcend the normal military sphere (e.g., they involve economic and cultural factors as well the traditional military issues). This suggests that a very broad set of skills and experience will be required to address IW issues credibly.

With respect to the PPBS, the Working Group observed that it is characterized by two key attributes that must be considered in any effort to influence it. First, the individual phases of the PPBS are characterized by very different time scales (e.g., there may be many months available to perform assessments to influence the Defense Planning Guidance; there may be several weeks or days available to assess POM issues; there may be days or hours available to do analyses to support finalization of budgetary numbers). These differences in time scales will have a profound influence on the suitability of methodologies and tools that can be brought to bear. Second, the structures employed in PPBS products (e.g., POMs, Issue Books) tend to reflect national security perspectives that have prevailed for many decades (e.g., separate sections for strategic operations with no specific call out of IW). This structuring may impede the injection of assessments of these activities into the PPBS.

Observations on the Nature of the Problem

Based on the Working Group's discussion of the nature of the problem, it made several observations. First, due to the inherent attributes of C^2, C^2W, and IW (e.g., interactive nature, critical role of humans), it was felt strongly that consideration of those activities could not be an "after the fact, add-on" to existing tools. Consideration of those factors must be built in, *ab initio*, as key tools are conceived and implemented.

Second, there was the realization that there were significant differences among the three activities. As one progresses from C^2, to C^2W, to IW, the problem becomes progressively less understood, there are fewer credible tools available, and the issues become more sensitive.

Finally, the complexity and sensitivity of C^2W and IW suggested special action. Extended, in-depth analysis appeared warranted by individuals with adequate access to sensitive information. At the same time, it was recognized that care would be needed to provide protection of sources and methods. This issue is addressed further in the recommendations.

Major Issues of Interest

To focus the Working Group's discussions, the representatives from J-33 and J-6 identified the key issues that they are addressing in their assessments.

Due to the sensitivity associated with IW, the discussion of issues was limited to a generic characterization. These generic issues were divided into the categories of "capabilities" and "infrastructure." In the area of "capabilities" the following areas were identified where MORS could potentially be of assistance:

- Systems issues. Do we have the

systems to meet our vision? What systems are most important for us to acquire or divest ourselves of?

- Support issues. What types of intelligence does IW require? In particular, how can we perform battle damage assessment?
- Defensive issues. Are we capable of protecting friendly assets against the projected threat? In particular, are there technology transfer initiatives that can be undertaken in support of this activity?
- Technology development issues. In view of the on-going revolution in information technology, how can we keep pace with technology developments (e.g., new encryption algorithms/ devices; expanded use of fiber communications; world-wide expansion of timely media coverage of events; the emergence of global networks; the increasing use of the Global Positioning System (GPS) for civil applications)?

In the area of "infrastructure" the following areas were identified where MORS could potentially be of assistance:

- Organizational issues. How can the IW community learn about projected technology changes (e.g., track developments in industry laboratories)?
- Acquisition issues. How can the IW community best do acquisition, in support of both offensive and defensive activities (e.g., influence the industrial base)?
- Specialization issues. What is the appropriate strategy for allocating IW responsibilities (e.g., establishing Service areas of concentration? creating centers of excellence? establishing mechanisms to identify and eliminate duplication?)?
- Integration issues. What steps should be taken to support the integration of IW-related activities (e.g., enhance the operations-intelligence support interface)?
- Oversight issues. What level of verification, validation, and accreditation (VV&A) should be performed on the tools supporting IW? Who should perform these functions?
- Human element issues. What steps should be taken to deal with critical human element issues in IW (e.g., training/ educating personnel about IW considerations; considering IW in personnel management actions)?

The representatives from J-6 identified several specific issues that are of particular interest:

- Sensor-shooter issues. Of highest priority is the need to assess the C^2 implications of proposed linkages among programmed and proposed sensor systems and weapons systems (e.g., precision guided weapons). This suggests the need to coordinate closely with analyses being pursued by the ISR and Strike mission areas.
- Common Joint Task Force (JTF) C^2. Recently, there has been an increase in the formation of JTFs to deal with contingency operations. Currently, individual Commanders-in-Chiefs (CINCs) have very different approaches to the creation and support of these JTFs (e.g., establish standing JTFs; create ad hoc JTFs; evolve JTFs

from component headquarters). There is a need to assess options to develop and implement common approaches to provide C^2 support.

- Other key issues. There are several additional C^2 issues that warrant in–depth assessment. These issues share several common features. First, there is a need to assess C^2 in the context of the mission that it is designed to support. In most of these assessments there is interest in formulating and analyzing balanced packages of C^3I and weapons systems consistent with mission needs. Second, many of the issues are architectural in nature. There is interest in formulating a goal architecture and identifying preferred options for evolving to those goals. Finally, the Working Group indicated knowledge of several packages of tools that were potentially germane to many of the mission areas of interest. Those candidate tools are identified and discussed later in this report.

In addition to these mission-specific issues, the Working Group observed that PPBS deliberations also require credible programmatic tools (e.g., means of dealing with cost and schedule issues). It was noted that significant changes are occurring in the acquisition of systems to support IW and C^2. For example, acquisition approaches are turning to evolutionary acquisition, concurrent engineering, and extensive use of COTS products. Since programmatic estimates have traditionally relied extensively on extrapolation from historical experience, this suggests that new tools will be required to provide credible projections.

The Problem of Formulating Measures of Merit (MoMs)

In order to identify the tools that are appropriate to address the issues of interest it is necessary to understand the measures that will be used in the assessments. For the purpose of this Working Group the term "Measures of Merit" (or MoMs) was introduced to subsume all of the measures of interest. These include (but are not limited to) Measures of Performance (MoPs) to characterize a system's performance (e.g., the range of a sensor or the capacity of a communications link); Measures of Functional Performance (MoFPs) to characterize the ability of sets of systems to perform key functions (e.g., the time delays associated with the detection and identification processes); and Measures of Force Effectiveness (MoFEs) to assess the impact of mixes of systems (e.g., C^2 and weapon systems) on overall force effectiveness (e.g., loss exchange ratios for M-on-N combat).

The selection of MoMs is an art form. They can frequently be ambiguous. In addition, the selection of an incomplete set of MoMs can result in a distortion of the intended process whereby efforts are made to optimize over the selected MoMs at the expense of other important (but unspecified) MoMs.

MORS recently sponsored two workshops on the subject of C^2 MoMs (ref. 8, 9). As a consequence, the Working Group decided not to discuss the issue further at this time. For completeness, the major findings of those workshops are summarized briefly:

- MoMs are defined by the level of analysis and the context in which they are measured.
- MoMs have the attributes of a name,

category, system reference (boundary), a function reference (purpose), units of measure, value measured, and threshold value (goal). [Note: this list of attributes is not exhaustive].

- There are some major MoFPs for C^2 systems that should be considered in evaluating the system. These include the ability to: maintain multiple views of enemy courses of action; formulate and evaluate multiple friendly courses of action; configure and re-configure rapidly for new situations (flexibility); identify and assess 'ground truth' and infer from it; and be easy to train on and use. [Note: the measure of "flexibility" was highlighted in Desert Shield/ Desert Storm where many C^2 systems were used effectively to support actions for which they were not explicitly designed].
- Alternative C^2 systems manifest greater changes in MoPs than MoFEs.

Spectrum of Evaluation Techniques

The Working Group identified and discussed the characteristics of the spectrum of evaluation techniques that the Joint Staff could conceivably employ to address the issues of interest. The techniques were aggregated into five categories:

- Expert elicitation (e.g., use of structured means to elicit judgments from experts);
- Constructive M&S (e.g., fast-time, computer simulation);
- Virtual M&S (e.g., real people operating simulated systems);
- Live M&S (e.g., real people operating real systems)
- Real crises/combat (e.g., deriving lessons learned based on results of actual operations).

To understand the appropriateness of these techniques, given the nature of the issues and the characteristics of the PPBS, they were evaluated against six measures: their cost (both to create and use), the needed lead time (create/use), the breadth of application, the ability to use them to treat sensitive issues (such as IW), the ability to replicate results, and the credibility of their results.

In general, several broad trends are apparent (with some notable exceptions). As one goes from expert elicitation to real crises/combat the general trend is to go from preferred characteristics to less preferred characteristics in four areas: cost, lead time, breadth of application, and ability to treat sensitive issues. However, no consistent trend is apparent for the areas of replicability (where the capability is limited for expert elicitation, fully achievable for constructive M&S, and then diminishing across the spectrum of techniques) and credibility (where the tendency is to increase as one goes from expert elicitation to real crises/ conflict, although the actual credibility can depend sensitively on which experts are used and the extent to which tool VV&A is performed).[4]

The Working Group observed that no single evaluation technique is likely to be sufficient for many of the issues of interest. This suggests the need to formulate and implement a strategy that selects and orchestrates a set of techniques consistent with

[16] In addition, piggybacking on a training exercise can introduce so many artificialities that its use for analysis is problematical, at best.

the nature of the issue and key constraints. This concept is discussed at length in the recommendations.

IW MoMs

Since the assessment of IW is in its germinal stages, the Working Group elected to generate a set of strawman MoMs to focus future analyses in this mission area. The Working Group employed a tree-like structure for the proposed MoMs. At the highest level they are decomposed into "Attack" (offensive actions) and "Protect" (defensive actions). The "Attack" MoMs are further decomposed into three periods of hostility (i.e., pre-traditional, traditional, post-traditional) and measures of functional performance are proposed for each. Note that the proposed offensive measures relate to an adversary's decision making process and the ability of Blue to perturb it (e.g., affect quality, speed). Additional work is required to relate these Measures of Functional Performance to overall Measures of Mission Effectiveness.

Subsequent to the workshop, one of the panelists has proposed a complementary set of MoMs for IW that would emphasize its relationship to C^2. The proposed MoMs include:

- Connectivity
- Support to friendly decision making
- Ability to protect Blue C^2 (e.g., resiliency to an adversary's IW actions)
- Ability to conduct offensive IW activities (e.g., deception)
- Compatibility with the C^2 technical architecture (e.g., Interoperability)

Clearly, this area is in its infancy and a great deal of additional study is required.

Candidate Tools

Drawing on the experiences of the panelists, candidate tools were identified that had the potential to respond to the issues raised by the Joint Staff participants. These tools were grouped into the categories cited earlier. There are several facets of these tools that warrant special comment.

Applicability. The bulk of the tools cited have been employed to address selected C^2 issues. However, very few have been applied to IW issues and it is estimated that significant investment would be needed to enhance them to treat the full range of IW issues credibly.

Flexibility. The tools in the expert elicitation category are potentially the most flexible. For example, groupware provides an environment where a facilitator can use decision support tools (e.g., multi-attribute utility tools) to brainstorm, structure options, rank order alternatives, and subject the findings to sensitivity analyses. If individuals can be brought to bear with the proper expertise, they can quickly shed light on key C^2 or IW issues. However, it is frequently desirable to consider such an activity as a precursor assessment which should be followed up by more in-depth analysis using selected sets of other classes of tools.

Orchestration. Trends are emerging wherein many organizations are orchestrating tools within tool technique lines. For example, in the area of constructive M&S, the Air Force's ESC has electronically linked the Extended Air

Defense Simulation (EADSIM), a theater-level simulation, to TAC BRAWLER (an M-on-N air combat simulation) and to Project Model (a very detailed model of a sensor). This makes it possible to assess more credibly the impact of sensor changes on theater outcome. Other efforts to orchestrate within tool technique categories have been done by Aerospace (i.e., for Ballistic Missile Defense and Space Launch), TRADOC White Sands Missile Range (i.e., orchestrated use of JANUS and CASTFOREM to assess the impact of alternative sensor options on force effectiveness), the Intelligence Community (e.g., orchestration of NAPA, Pegasus/ Corvus, and Rasputin to assess the balance within the intelligence cycle), and RAND (i.e., orchestration of JANUS and MADAM to assess land combat). In these cases, attention is generally given to orchestrating MoPs, MoFPs, and MoFEs.

Similarly, efforts are underway to orchestrate across tool technique lines. For example, the Joint Air Defense Operations/ Joint Engagement Zone (JADO/JEZ)[5] program has explored the orchestration of EADSIM (a constructive tool), Theater Air C^2 Facility (TACCSF) (a virtual tool), and live flights in an instrumented range in an effort to refine and VV&A EADSIM. Although this task has proven to be onerous, it suggests the interest in the community of orchestrating tools to take advantage of their strengths while minimizing their weaknesses.

Ancillary Tools. Although the Working Group's discussion focused on tools that can support the assessment of mission performance and effectiveness, it was noted that a broader set will be needed to address the full range of issues of interest and affect PPBS processes. Since many of the J-6 issues involve the problem of inter-operability, the family of inter operability tools developed by MITRE may be of value (e.g., Interoperability Management Information Tool, Technical Interoperability Network.) In addition, a spectrum of programmatic tools will be needed to support assessment of program cost, and schedule. The Space Acquisition Methodology System (SAMS) is an interesting prototype tool for space systems that employs the strategy-to-task methodology to support tradeoffs among performance/effectiveness, cost, and schedule.

In addition, the nature of the IW problem is such that it requires models that incorporate political, economic, and societal effects. Currently, these effects are generally not considered in MORS models, but they may be available in the models generated by other disciplines (e.g., economics, political science, or sociology).

[17] JADO/JEZ has recently been renamed as the All Service Identification Evaluation Team (ASIET).

Current Approach

To provide a point of departure for the Working Group's recommendations, the Joint Staff representatives briefly reviewed the approach that they had used in the first stage of the JWCA process and the plans that they had for near-term activities.

The J-6 representative observed that they employed the Global C^4 Assessment process to elicit CINC inputs on key issues. In this process a variant of the Mission Oriented Approach is employed to decompose broad CINC goals (by level of conflict) into military mission areas, sub-missions, functions, and ultimately, C^2 systems. A computer-based tool has been developed and applied to support the eleven key organizations participating in the process (i.e., the regional CINCs, CINC NORAD, and the National Military Command and Control System (NMCCS)). This process provides a means of identifying shortfalls at each level and for identifying pervasive needs that cut across the individual CINCs. In addition, the J-6 is contemplating the use of more focused tools tailored to the specific issues identified above (e.g., sensor–to–shooter issues).

Conversely, the J-33 has relied more on relatively unstructured expert elicitation techniques. It was noted, that since IW is in its infancy, that the needed expertise is still evolving. In the near-term, a team from the Center for Naval Analyses (CNA) is working with the J-33 to help structure the problem and to identify critical issues.

Proposed Evolution of Approach

Based on the Working Group's understanding of the nature of the problem and the Joint Staff's planned approach, a proposed evolution of the approach was developed. Central to this revised approach is an adaptation of the Mission Oriented Approach that the J-6 currently employs. There was a broad consensus that this framework had the potential to support the central objectives of the C^2 and IW JWCA (i.e., assess them in the context of the missions that they are designed to support). However, in order to meet that objective, it is important to modernize the existing J-6 framework to have it better reflect New World Disorder operations (e.g., operations other than war) and to extend it to incorporate missions associated with IW.

Once the framework is updated and expanded, steps should be taken to enhance its usage. Currently, participants in the assessment process tend to have a relatively near-term focus. This should be modified in several dimensions. First, the participant pool should be expanded to include individuals who are involved in formulating plans for IW. Second, participation should be solicited from individuals that have an inherently longer term perspective. For example, Senior Fellows at the National Defense University (NDU) could provide a valuable complementary point of view. In addition, it is important to emphasize sensitivity analyses and a very broad array of scenarios to clarify the robustness of preliminary issues and findings.

The Working Group felt strongly that no single framework, tool or MoM was sufficient to deal with the full set of issues of interest. The challenge was to select and orchestrate the needed tools and MoMs to reflect the substantive issues in question and to be responsive to the processes that are to be affected (e.g., planning, POM issue analysis, budgetary decision).

The Need for Accredited Scenarios

The Working Group had several observations to make about the scenarios that might be employed in JWCAs. First it was observed that the choice of scenarios can easily drive the analyses. Since some scenarios have dubious parentage, it is important to develop and implement an accreditation process for the scenarios of interest. However, the Working Group stressed that this process should not be used to limit severely the numbers and types of scenarios that are employed. This is particularly true of the IW area where there is great value in considering a very broad set of alternatives, even if the likelihood of any particular scenario is low. Thus, the challenge is to balance the accreditation of scenarios while not fettering the imaginations of the IW community.

Impediments to Change

There are several impediments to change that will have to be overcome if the proposed approach is to be successful.

- Limited analysis resources. Currently, the CINCs that participate in the Global C^4 Assessment have very limited analysis resources (e.g., trained analysts, adequate tools, needed data bases). Similarly, the Joint Staff offices charged with performing the JWCAs have comparable limitations. Additional resources may be needed to ameliorate these deficiencies.
- PPBS. The key products in the PPBS (e.g., POMs, POM issue books, budgetary submissions) have historically been configured to focus on Cold War issues. Thus, they are structured to highlight resources allocations for conventional and nuclear-capable operations. Conversely, they are not usefully configured to identify and assess the adequacy of allocations in the areas of greatest interest today. In addition, to focus deliberations, the review process has historically established high resource thresholds for selecting those issues that are to be reviewed by senior defense management. Since C^2 and IW issues may not involve extensive allocations of resources, they may be subject to "out of court" settlements. These observations suggest the need to reevaluate the structuring of PPBS products and the criteria by which issues are identified and resolved.
- Voids in IW knowledge. Since IW is in its infancy, it is not surprising that there is currently a lack of broadly recognized analytic techniques and MoMs that can be used to assess IW issues. This suggests the need for intensive action by the analysis community to redress these shortfalls.
- "Stovepiped" institutions. The Working Group believes that the nature of the JWCA issues is such that it will require broad, multi-disciplinary teams to address them successfully. This is currently at variance with the tendency to approach these problems from narrow, discipline-oriented perspectives. Consideration should be given to forming appropriate Integrated Process Teams, drawing upon the full set of disciplines needed to address the issues.
- Role of Congress. It is important to recognize that the PPBS does not end with the submission of a budget to Congress. The extended JROC process

will be successful only if Congress authorizes and appropriates resources consistent with the recommendations of the JWCA process. This suggests that efforts should be made to communicate a coherent mission perspective to the appropriate Congressional staffs so that they do not make fragmentary changes in a vacuum. Since authority for national security issues is so diffused among a multitude of Congressional committees, it will require a concerted, organized strategy for communicating the vision and following up on specif ic issues.

Integration and Coordination

The Working Group observed that the decomposition of the JWCA process into the current nine mission areas does not readily lend itself to easy synthesis of the individual results into a coherent total picture. That is due to the fact that the overlap and interdependencies among the nine mission areas is so strong that they can not be meaningfully analyzed in isolation and then synthesized.

To facilitate integration and coordination, consideration should be given to expanding and adapting the J-6 mission oriented framework to the total JWCA process. Once the current mission oriented framework is modernized and expanded (e.g., to treat IW explicitly), its structure could provide a useful template for selecting a new set of consistent mission areas. The mission-oriented framework would facilitate the integration of the results of individual analyses and provide a unified mechanism for displaying the relative "health" of the individual mission areas, consistent with broad strategic goals and objectives.

In particular, the Working Group observed that there is a special relationship among the current JWCA mission areas of C^2 & IW, ISR, and Strike. It is recommended that those three missions areas work together as an integrated team to address critical "sen-sor–to–shooter" issues. This implies formulating and implementing an end-to-end target engagement perspective for those issues and employing common data, scenarios, and assumptions when addressing more in-depth, mission side–issues.

Finally, the Working group noted that the existing JWCA mission areas can be divided into military fighting activities (e.g., strike, ground maneuver, IW) and support activities (e.g., C^2, readiness, strategic mobility). In the near term, integration and coordination would be enhanced by creating Integrated Process Teams for each military fighting activity, comprised of representatives from each of the support activities. This arrangement would make it more likely that major cross-cutting issues would be identified and addressed in the context of the military fighting activities.

Selected Recommendations

Overall, the nature of the problem for C^2& IW demands the use of a variety of tools across the full spectrum of tool techniques. This requires a strategic approach to the selection, adaptation, and orchestration of tools (and ancillary material such as MoMs and data) that reflects the key characteristics of the PPBS (e.g., what product is needed, in what form, with what lead time). [Note: the generation of such a strategic approach is

discussed below].

In the near term, the J-6 and J-33 face a daunting task, with very limited time and resources available. In view of those constraints, the Working group recommends that the Joint Staff emphasize expert elicitation approaches. There are a variety o f expert elicitation techniques available that have the advantage of being broadly applicable to a variety of sensitive issues and requiring limited resources and limited time to use. For example, a trained facilitator, using recent developments in groupware (e.g., shared decision support tools), can help a group of domain experts identify the critical actions that the Joint Staff might wish to highlight in the Defense Planning Guidance and perform initial rank order assessments of POM issue alternatives. Specific steps should be taken to enhance the credibility of these results (e.g., extensive use of sensitivity excursions to establish the robustness of any conclusions). In addition, adaptations of more focused expert elicitation tools could prove of value, particularly in the area of IW. As an example, RAND has used "The Day After ..." methodology to illuminate issues associated with the problems of nuclear proliferation. Using a variation of this technique it should be possible to identify and illuminate many of the key policy issues associated with IW.

As another near-term activity, efforts should be undertaken to tap C^2 and IW lessons learned from crises/conflicts more effectively. These lessons learned should be pursued from multiple perspectives: Blue (as recorded in JULLS, JAARS, and Service repositories) and from other national points of view (e.g., Russian, Chinese, and Iranian papers on the lessons that they have learned from recent conflicts like Desert Shield/Desert Storm). The latter perspective will be of specific value to the IW community.

Finally, the Joint Staff should take advantage of recent studies that MORS members have performed in key C^2 issue areas using constructive M&S. It is notable that recent winners of MORS' prizes have used constructive M&S creatively to shed light on many of the Joint Staff's C^2 issues of interest (e.g., combat identification (ref. 6), space launch operations (ref. 7)). Second, it is conceivable that the Joint Staff may be able to gain access to some of those constructive M&S tools to extend those results. It should be noted, however, that even when a useful constructive M&S tool exists, it is often time consuming to assemble the needed data and to exercise the tool properly. The complexity of these tools is such that they generally call for a well trained analyst to apply them properly.

In the mid-term (e.g., next one or two years), consideration should be given to expanding and adapting the J-6 mission oriented framework to the total JWCA process. In addition, there is adequate time available for the Joint Staff to take advantage of an orchestrated family of tools to deal with a few, high priority, continuing issues. These families of tools can fall within two classes: within a tool class (e.g., constructive M&S) and across tool classes (e.g., constructive - virtual - live M&S). In the former category, the Working Group identified several mission areas where interesting sets of tools are emerging that have the potential to illuminate key C^2 issues (e.g., Air Force ESC MASC to evaluate air C^2 issues, Aerospace Corporation's tools to assess space launch options). In the latter category, organizations

like JADO/JEZ are working with a mix of tools to analyze air C^2 issues. Because of the extensive time and resources needed in these activities (e.g., to assemble needed data and exercise the tool), it is recommended that the Joint Staff task those organizations with the appropriate skills and tools to perform the analyses of interest. Even in these cases, the Joint Staff has to be fully versed on the capabilities and limitations of the tools in question in order to be an effective consumer of the product. Thus, it is recommended that well trained analysts should be assigned throughout the Joint Staff.

At one point in the discussion, the Working Group addressed the issue about the desirability of a "standard" tool to address key issues. After extensive discussion it was concluded that a spectrum of tools is needed to reflect alternative points of view and to stimulate constructive debate (particularly in nascent areas like IW). One of the panelists observed that "... any thought of common tools, models and databases could be very destructive of the quality of analysis and the value of results. Different people running different analyses using a variety of tools is a fundamental ingredient of good operations analysis." Thus it is recommended that a standard, common tool should **not** be sought by the Joint Staff.

Over the longer term, the Working Group had several additional recommendations:

- An Organization to Address Basic IW Issues. It was noted that there was a need to develop an "intellectual reservoir" upon which to base future IW activities. If such an "intellectual reservoir" is to be created it will require a continuing, highly capable, multidisciplinary team (e.g., political scientists, computer scientists, anthropologists, operations analysts) with access to all relevant information. As one potential organizational model, one might consider the Phase One Engineering Team (POET), which draws on personnel from FFRDCs and not-for-profits to support analyses of ballistic missile defense issues.
- New Tools. Although there are promising tools available and emerging to support C^2 assessments, the picture is much bleaker for IW. In order to ameliorate that shortfall, an initiative should be undertaken drawing on the experiences of RAND's Strategy Assessment System. It is recommended that emphasis should be given to the problem of modeling the thought processes of potential adversaries. At the outset, this effort should not be computerized. In addition, the modeling activities of social scientists (e.g., economists, sociologists) and societal scientists (e.g., transportation engineers) should be explored to see if they can be adapted to the needs of IW analysts. These activities would be appropriate tasks for the proposed IW organization.
- Deriving Lessons Learned. As noted above, it is important that we enhance our ability to derive lessons learned from actual crises/ combat from multiple perspectives. To support this activity in the longer term, we should improve our preparations for such efforts (e.g., decide what data we want to collect, how we will collect it, and how we will process it). Again, the

proposed IW organization could play a pivotal role in this effort.

- Understanding Human Behavior. Human behavior, particularly decision making, is central to many of the issues associated with C^2 and IW. The Joint Staff should encourage R&D efforts to enhance our understanding of human behavior and our ability to model it.
- JWCA MOP. At present, there is considerable confusion about what constitutes an acceptable JWCA product. It would prove useful to codify the process and its desired products in a JCS MOP to provide guidance to the community.
- PPBS Overhaul. In the near term, the JWCA must conform to the characteristics of the PPBS (e.g., nature and timing of products). In the long term, the JWCA might be the catalyst to recast the PPBS so that it provides the necessary visibility into the most critical problems that the national defense community will face over the next decade (rather than the problems that it used to face in the preceding three decades).

Challenge: Proper Use of Tools

A recent cartoon depicted an irate customer, with hands bandaged, returning a hammer at a complaint desk and saying "this hammer keeks hitting two inches to the left!" That cartoon serves to highlight several important issues. It is also critical that the user be properly versed on its capabilities and proper use. This cartoon suggests that if those conditions are not met, the tool can do more damage than good. This also argues for the recommendation that thought should be given to assigning analysts to the J-6 and J-33 staffs to support the JWCA process.

The Joint Staff Dilemma

Prior to this workshop, some of the members of the Joint Staff indicated interest in understanding how to perform "rigorous" analyses in support of the JWCA. It is perhaps fitting to close this report by suggesting that the nature of the problem is such that it will probably not be feasible to develop "rigorous", elegant solutions. However, by drawing on the best that the analytic community has to offer, in terms of methodologies, tools, and data, it may be possible to develop insights that can lead to more enlightened allocations of resources across the national security environment.

7. *Intelligence, Surveillance and Reconnaissance*

Eugene P. Visco, FS

Current Definition and Content

Battlespace knowledge is central to future joint warfighting capability. Intelligence, surveillance and reconnaissance (ISR) that provide seamless real time knowledge of the battlespace is the key to leveraging our warfighting capability. The ISR Joint Warfighting Capability Assessment (JWCA) team has been charged with assessing the intelligence, surveillance and reconnaissance capabilities and architectures needed to support joint warfighters in the near term and the future. The ISR JWCA team is currently using the Korean major regional contingency scenarios for 1995 and 2005 as the vehicles to examine ISR requirements, capabilities and gaps.

Overview of the ISR Working Group Identified Focus and Goal

At the outset of its efforts, the MORS working group established a target of identifying a set of analytic tools, techniques, processes, and models that might be used by the ISR JWCA team in its future deliberations and analyses might be used by the ISR JWCA team in its future deliberations and analyses. Future was carefully defined as post- February 1995, although any suggestions that might assist the team in achieving its objectives for February 1995 would be gratefully accepted. Candidate processes and models would also have to meet the characteristics of simplicity, economy and transparency before they could be considered for recommendation to the ISR JWCA team.

Process of the ISR Working Group

The first step taken by the group was the disaggregation of the functions of intelligence, surveillance and reconnaissance. Procedurally, the members of the group were polled, one-by-one, to present a single concept, idea, activity, or principle that served to disaggregate ISR. Examples drawn from the list of more than 30 "ideas" tabulated are:

- Battle damage assessment
- Fusion
- Cuing weapons

The full list is appended to this report. No attempt was made to criticize or question the contributions; questions related to clarity were the only ones permitted. As can be seen, there are many inconsistencies and incongruities among the topics on the list. No attempt was made to constrain the working group members in making their contributions. The list is organized to combine entries that seem to have some commonality, without attempting to define the specific nature of that commonality. There was insufficient working group time to discuss reaggregation of the topics; there was a modest view that efforts at reaggregation (requiring a taxonomy, perhaps suggested by the disaggregated items themselves) would result in valuable insights about the relationships among the components of ISR.

That first step of disaggregation served an additional purpose; it helped organize the working group itself--that is, helped focus the disparate members on an operational perspective of ISR. That was achieved by each person viewing the list of components from his/her perspective and experiences; thus, each

person developed his/her own understanding of ISR.

The second step was to move to the identification of measures of effectiveness. The working group chose sample topics from the list of disaggregated topics and collectively produced measures that would indicate disaggregated topics and collectively produced measures that would indicate the extent to which each of those topics would serve the higher order objective of ISR as a battlefield function. The group quickly determined that "measures of effectiveness" took on different meanings related to the level of analysis. Thus, the phrase **measures of performance** is reserved for the lowest level of analysis (sometimes specified as the system level) which is also the highest level of resolution, alternatively referred to as the lowest level of aggregation (that is, the level at which the military systems under examination are not further disaggregated--the atomic level, so to speak). The phrase **measures of effectiveness** is reserved for the next higher level of analysis (a lower level of resolution and a higher level of aggregation) and is related to systems integrated into some level of military force--deliberately not specified at this point in the working group's analysis. In any event, the second level is the first wherein systems are combined and where synergism begins to become important. The final phrase, **measures of force effectiveness**, is assigned to a higher level of military force, perhaps considered as a combined arms or joint force level which is also the highest level of analysis (the lowest level of resolution, alternatively referred to as the highest level of aggregation). [We acknowledge and credit earlier work of MORS and others for establishing the hierarchy of measures used here.]

For each sample component the working group defined measures of performance, measures of effectiveness, and measures of force effectiveness. The first sample worked was battle damage assessment (BDA). The **measures of performance** for systems that contribute to BDA are:

- Probability that the target is correctly assessed (consideration of Type I and Type II errors)
- Timeliness of reports
- Operational cost [Note: cost is not a measure of performance, but rather a dimension that must be considered; perhaps affordability is a better notion, with some systems being "more affordable" than others.]

The **measures of effectiveness** are:

- Number of strikes required for success
- Unnecessary strikes avoided
- Enemy losses confirmed

The **measures of force effectiveness** are:

- Objectives (political, force, terrain, and time) achieved
- Excess force used (unnecessary, wasted)
- Casualties
- Remaining forces

The working group quickly assessed additional disaggregated topics. The results suggested the following hypotheses (to be further tested by the ISR JWCA team):

- **measures of performance** are specific to individual systems
- **measures of effectiveness** for integrated systems may have commonality at the same levels of aggregation, that is, there may be many common measures

- **measures of force effectiveness** are force level specific but are the same for all equivalent force levels, regardless of systems and integrations

If these hypotheses are validated, then the common measures of force effectiveness will become the standard measures for ISR systems. However, the working group also pointed up the fact, observed by others examining the same issues, that the lower order measures (**performance**) are the most reliable but narrowly applicable to the problem at hand. The next level (**effectiveness**) are less reliable but more applicable. And, finally, the highest order measures (**force effectiveness**) are the least reliable at present yet most applicable (perhaps necessary is a better word than applicable). This perversity has been referred to by a working group member as a dilemma between reliability and applicability. There is no short term solution; present analytical tools provide only imperfect solutions.

ISR Assessment Tools

The final step of the working group was to identify specific tools, techniques and sources that may assist the ISR JWCA team in its further deliberations. The list of contributions follow:

- Multi-attribute decision making (a process of selecting the best among a set of alternatives, each of which has varying levels of achievement of the attributes on which the decision is to be based)
- Multi-objectives optimization (a process intellectually similar to the above but which deals with designing the best alternative to meet many objectives)
- METRIC (a constructive model; currently used in support of JS Dominant Battlefield Awareness study)
- Future Theater Level Model (sensor piece prototype available)
- Mission Effectiveness Model (a DIA model)
- Functional models (e.g., CASTFOREM at TRAC, Ft Leavenworth)
- Expert panels
- Functional decomposition
- Space systems analysis capabilities at Colorado Springs (Space Command) (e.g., BMDO battle management C4I test bed)
- Traditional war games to define requirements, organizations, concepts of operation, and doctrine
- Decision analysis processes

As a consequence of the workshop and working group sessions, preliminary contacts have been made to access some of the tools in the above list. In addition, further ongoing work relating ISR information to combat outcomes (**measures of performance** related to **measures of force effectiveness**) have been identified at the US Military Academy and at the Defence Research Agency, Ministry of Defence, United Kingdom. Steps were taken subsequent to the working group deliberations to access the on-going work to determine immediate and longer term applicability to the ISR JWCA team's needs.

The general observation introduced at the end of the **Process of the ISR Working Group** section serves to close this report: concentrated effort must be expended now to find and refine the appropriate (efficient and

effective) analytic tools to determine the relationships between ISR **performance** and **force effectiveness**.

Annex A

Disaggregated Intelligence, Surveillance and Reconnaissance Functions, Tasks, Elements

Provide information for efficient, effective resource allocation
Pre-battle awareness
Battlefield awareness/situation awareness
What I have to know (about opponents' capabilities)
Locating maneuver avoidance areas
Opponents' plans and intentions Environmental information integration
Opponents'/allies'/CNN behavior patterns
C4I synoptic view of the battlefield

Electronic warfare (defensive/offensive)

Targeting (target selection/target identification)
Target status
Non-cooperative targets
Facilitate "smart searches"
Cuing weapons
Common, accurate, precise aim points (grid points)

Battle damage assessment
Reduction of fratricide
Develop historical battle diaries (lessons learned)

Fusion
Survivability of ISR
Timely to specific decisions
Access (awareness/dissemination)
Dissemination to right level with right fidelity and quantity (tailored to requirements)
Failure analysis
Foci: operations other than war; crises; war
"Just in time" intelligence

CONOPS framework

ISR not integrated
Indication & Warning (to feed others)
Collection is by Sources; Output is by Topics

Annex B

Examples of Hierarchy of Measures
(operational cost included at all levels)

Battle damage assessment

Measures of performance
- Probability that target state is correctly assessed (Type I & II errors)
- Timeliness of report

Measures of effectiveness
- Number of strikes required
- Strikes averted
- Enemy losses confirmed
- Lost opportunities

Measures of force effectiveness
- Objectives achieved (political, terrain, force, time)
- Forces remaining
- Casualties
- Excess (unnecessary) force used

Cuing weapons

Measures of performance
- Probability of target detection (as a function of area coverage)
- Target location & velocity accuracy
- Timeliness
- Timeliness
- Rate
- Probability of correct identification (Type I & II errors)

Measures of effectiveness
- Ratio: detections to launches
- Ratio: kills to launches
- Lost opportunities

Measures of force effectiveness
- Objectives achieved (political, terrain, force, time)
- Forces remaining
- Casualties
- Excess (unnecessary) force used

8. *Overseas Presence*

Colonel Edward A. Smyth, USMC

The Overseas Presence Working Group consisted of 23 members from a variety of backgrounds, including government, industry, and academia. The Group was chaired by Colonel E A. Smyth, Director, Studies and Analysis Division, Marine Corps Combat Development Command, Quantico, Virginia. The co-chair was Colonel Stan Romes, Strategy Division, Office of the Director for Strategic Plans and Policy (J-5), the Joint Staff. Throughout the conference, there was a free exchange of ideas and spirited debate on a number of overseas presence issues.

The focus and goal of the working Group initially centered on three areas. The first was to validate the Joint Requirements Oversight Council (JROC) definition of overseas presence; specifically, evaluating the trade-off between forward deployment versus CONUS-based forces. Second, the transition from the current to the future assessment process. And, third, the development of measures of effectiveness (MOEs), both qualitative parameters and quantitative metrics, for determining the efficacy of overseas presence.

The Group spent considerable time in evaluating the current definition of overseas presence, as defined by the J-5. This definition can be broadly stated as the "totality of United States instruments of power deployed overseas (both permanently and temporarily) along with the requisite infrastructure and sustainment capabilities". Within this framework, the purpose of overseas presence can be defined as: (1) to reassure and support friends and allies (partnership); (2) to deter would-be aggressors (prevention); (3) to influence events in ways favorable to the United States (engagement and enlargement); and finally, to provide an initial crisis response capability (security and warfighting). Based on this definition, overseas presence can be further evaluated as a function of the sum of military to military relations, training, exercises, operations tempo, and other factors. After considerable debate on the objective, purpose, and factors of overseas presence, the consensus of the Group was that the current definition used by the J-5 was reasonable and adequate.

Having validated the current definition, the working Group turned its attention to the current process used by J-5 to evaluate overseas presence. This is a hierarchical process which is structured as follows.

- National Security Objectives
  - Regional Military Objectives
    - Overseas Presence Priorities
      - Regional CINC Warfighting Requirements
        - Military to Military Issues
        - Peace Operations
        - Regional Contingency Capabilities

This process is a well-structured "strategy to task" process, which reflects the J-5 focus on the tasks of military to military issues, peace operations, and regional contingency capabilities. The consensus of the Group was

that the current process was basically sound, but very narrow in scope. To expand on the overseas presence JWCA, the Group recommended a broader focus in the following areas:

a. Emphasize the CINCs' role in overseas presence versus simply the warfighting requirements. This emphasis would broaden the scope of the process to accurately reflect the broad definition currently in use.

b. Clarify operational steps and rules of aggregation. This can be accomplished by the use of various techniques and tools, such as panels, Delphi techniques, and simulations.

c. In a slightly different vein, different methods can be used to evaluate the various objectives of regional presence. For example, qualitative tools can be used to determine the capability of overseas presence to influence and/or deter potential aggressors. Quantitative methods can be used for more easily defined objectives such as initial crisis response.

d. Give higher priority to presence/ power projection trade-offs for initial crisis response. If affordability is an issue, the JROC must evaluate the cost of forward stationing versus forward deployment. In the current process, this is simply not addressed.

e. Finally, any discussion of this JROC requires an evaluation of the impact of force structure changes on the CINC's ability to provide the forward basing leg of overseas presence.

In order to evaluate the process, measures of effectiveness were developed to address three of the four objectives stated in the current JROC definition. The effectiveness of partnership (reassuring and supporting friends and allies) can be measured through an evaluation of: (1) burden sharing, e.g., participation in regional peacekeeping; (2) equipment/systems Interoperability or foreign military sales; (3) enhanced access to host nation airfields and ports; (4) increased trade and investment founded on a militarily secure trading partner; and (5) contacts and interaction with host nations.

In the area of engagement and enlargement (influence events in ways favorable to the U.S.), two measures could be utilized to evaluate this objective. First, an analysis of favorable or unfavorable trends in U.S. relations with a foreign nation over time. Second, an evaluation of crises averted by the presence of U.S. forces in the area.

Measures of effectiveness for the security/warfighting (provide an initial crisis response capability) objective can be developed using more traditional measures. For example, a "win the war" measure utilizing simulation/wargame analysis; and theater/ campaign measures such as Force Exchange Ratios, Forward Edge of the Battle Area movement, and force closure rates.

Developing measures of effectiveness for the fourth objective, prevention (deter potential aggressor), proved elusive. The essence of this objective is evaluating the "war that didn't occur". Such an objective does not lend itself to traditional measures of effectiveness.

Having ratified the current definition, evaluated the current process and recommended changes to that process, and

finally, developed MOEs to evaluate overseas presence, the working Group focused on three potential impediments to implementation of our recommendations.

a. The members of the working Group believe there is a reluctance to cost the essential elements of overseas presence. This perceived reluctance centers on the linkage between a declining force structure, and the ability to maintain current overseas commitments.

b. There are also institutional constraints which impede the process. First, the CINCs focus on near-term warfighting requirements, and not the potential long-term benefits of enhanced overseas presence. Second, Washington (Pentagon, Administration, Congress) owns the Planning, Programming, and Budgeting System (PPBS), which is not responsive to the needs of the CINCs, who have limited direct input (CINC Integrated Priority Lists) to the process. Finally, the services fund the cost of overseas presence, providing little incentive for the CINCs to evaluate cost trade-offs.

c. It is difficult to measure the effectiveness of various elements of presence. For example, the value of port visits, bilateral training exercises, employment of dental teams, host nation construction projects, etc., are extremely difficult to measure.

Finally, the Group addressed the significant challenge of integrating and coordinating the efforts across the entire spectrum of the Joint Warfighting Capabilities Assessment (JWCA) processes. First, and foremost, in a successful integration, the Chairman and members of the JROC need to play a significant role in the ultimate integration of these processes. Second, JWCA working Group chairmen from this conference can provide effective coordination at the working level to establish programmatic and issue-related trade-offs. This approach ensures a broad integration effort in conjunction with, yet independent of the Joint Staff. Third, standards for measuring effectiveness and costs will provide a common basis for evaluating the JWCA processes. In line with establishing standards, a uniform methodology should be developed to ensure proper coordination and exchange of information among the JWCA working Groups.

In summary, the issues and potential solutions addressed in this conference provide a solid basis for a continuing effort to refine and integrate the JWCA processes.

9. *Joint Readiness*

William A. Brinkley

Introduction

The Military Operations Research Society (MORS) Workshop for the Joint Requirements Oversight Committee (JROC) examined the process and methodologies applicable to conducting the Joint Warfighting Capabilities Assessment (JWCA) by the nine Joint Staff assessment Groups strike; Ground Maneuver; Strategic Mobility and Its Protection; Air Superiority; Deter/Counter Proliferation of Weapons of Mass Destruction; Command and Control and Information Warfare; Intelligence, Surveillance, and Reconnaissance; Overseas Presence; and Joint Readiness. Work Group 9 was responsible for examining the "Joint Readiness" JWCA assessment process and recommending possible methodological approaches to conducting the assessment in a more structured and credible manner. A list of Work Group 9 participants is at the Annex.

Statement of the Problem

The basic problem for the Joint Readiness JWCA is that of definition of "joint readiness" and the identification of how and where threat assessment fits within the total JWCA process. It is clear that no precise, agreed-to definition exists between the Joint Staff, the Commanders-in-Chief (CINCs), and the Services. The best definition seems to be "the ability of a unified commander to execute an assigned mission with the forces available." This would imply a near-term, rather than far-term, assessment focus.

Secondly, it is clear that a formal internal Joint Staff process for conducting the 9 individual JWCA assessments and integrating those assessments into a total assessment for the Vice Chairman and Chairman, Joint Chiefs of Staff (VCJCS and CJCS, respectively) has not existed.

Discussion

The ultimate "customer" for the integrated JWCA assessments is the CJCS. If the J-3 is the responsible J-staff directorate for the Joint Readiness JWCA, the output or product - the "joint readiness assessment" - should be the mechanism for providing OSD and the Services with the CINCs' perspective of how well they can execute the operations plans (OPLAN) or contingency plans (CONPLAN) for which they are responsible. Incorporated with the other 8 JWCA's, the joint assessment can be used by the JROC to help in determining if new start programs or major modifications to existing programs supporting one or more of the individual JWCA elements is required now, can be deferred, or is not needed in the POM period.

The CJCS can also use the joint assessment product to form the basis for his annual report to OSD and the Services on what the CINCs' need to able to execute their assigned missions.

In assessing joint readiness, there appears to be at least four levels of assessment that should be considered by the Joint Staff in developing "Joint Readiness" inputs for the CJCS and JROC. Figure 1 presents the four levels of possible assessment and how they

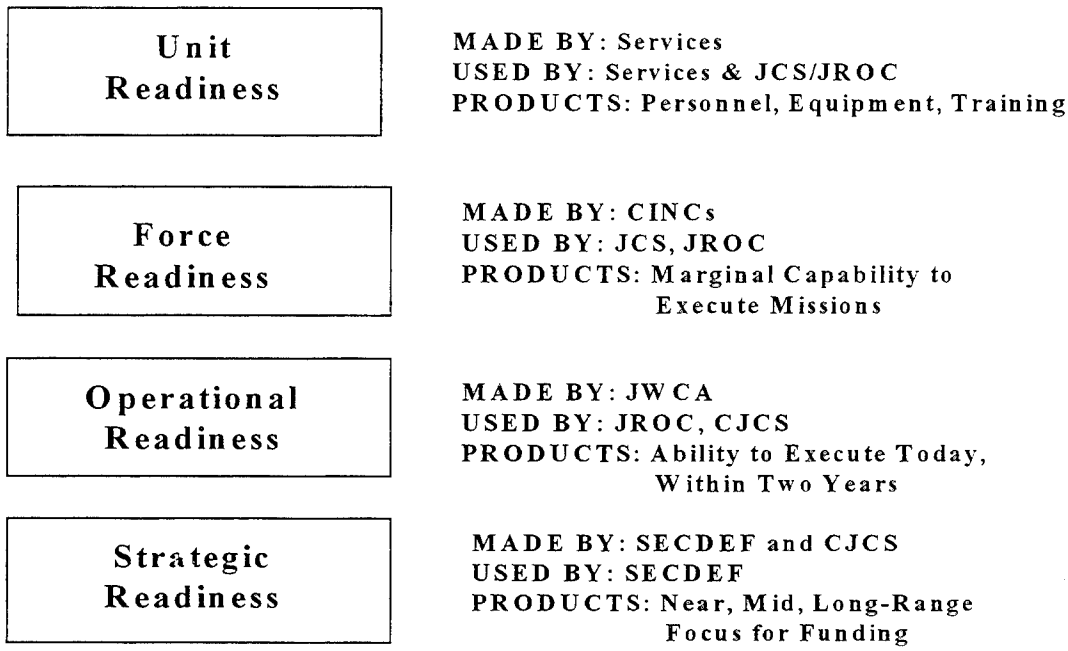

Figure 7. Readiness Assessment: Who and For What?

might be used by the JROC, VCJCS and CJCS.

The first level is that of individual service assessments of the capabilities of units that are or could be assigned to support a CINC in execution of an OPLAN or CONPLAN. Because each service has a reporting process that provides unit readiness relative to manning, equipping and training of specific active and reserve units, data bases exist which are routinely updated (generally monthly) to provide the service's unit readiness assessments within the joint readiness assessment process. It is also recognized that every service unit can be assigned to multiple-CINC force lists for accomplishing OPLANs or CONPLANs.

A second level of assessment is that made by the CINCs themselves. Based on the total number of OPLANs and CONPLANs they are responsible to execute, the force lists of specific units that they could be provided, and their ability to integrate units into a operationally effective joint force, the CINCs must routinely provide the Joint Readiness JWCA with assessments of their ability to execute one or all of their assigned missions. This joint readiness assessment by the CINC can be more clearly expressed as a "force readiness" assessment directly linked to each of the OPLANs and CONPLANs which have

potential for execution.

The third level of assessment is that of the JCS JWCA Joint Readiness working Group. During the Work Shop, the JWCA sponsor stated that he was tasked to provide a near-term (today) and mid-term (within two years) joint readiness assessment that accounted for service unit assessments and CINC force readiness assessments. The Joint Readiness JWCA working Group must also incorporate JCS perspectives for conducting joint operations which may not be readily apparent or available to the CINCs. Three areas that seems to require additional information to conduct the Joint Readiness assessment by the Joint Staff were personnel, training, and logistics. Because the JS J3 is the responsible staff element to prepare this JWCA assessment, it appears that this assessment is really one of joint "operational" readiness - "What can we do today, in the near term and in the next two years if we have to increase or reallocate our commitment to joint operations?" Thus, the assessments of the Joint Readiness JWCA should provide the VCJCS the impacts of additional or new missions which must be executed or are expected to be executed in the near future. The question then becomes, "Given the CINC forces allocated and deployed today, what will be the impact of executing OPLANs or CONPLANs or new contingencies now and over the next two years?"

The fourth level of joint readiness assessments should be at the global level and be based on joint agreement between the SECDEF and CJCS as to what immediate and long term Department of Defense fixes are needed to support the strategic policies of the United States. The CJCS's inputs to the SECDEF should provide the "warfighters" or CINCs' assessments of what they need now and what longer term capabilities would enhance their capabilities to carry out their OPLANs and CONPLANs if told to execute. This "global joint readiness assessment" must incorporate the political and fiscal realities and national strategy into the near, mid and long term planning and programing process.

As discussed above, the process for evaluating joint readiness is built up from the traditional Service measures of unit readiness combined with an assessment of the impacts of resource constraints and multiple contingency operations. The effects on above and below the line forces and the relationship on depletion or diversion of assets are integral to a valid assessment that can be the basis of an institutionalized joint readiness system. Primary discussion issues on the process centered around the relations among unit and joint aspects and the equivalency between readiness and preparedness. Within this process structure, the idea of joint enablers that move readiness from the unit/service realm to the total mission perspective was discussed. Many such aspects, or enablers, were identified with extensive debate overlift, C2, joint training, pre-positioned assets, communication, intelligence and surveillance. Generally speaking, the concerns were over control of activities that are usually beyond the purview of a single Service or serve as a customer client relationship between Services in a joint environment.

Observations

Joint readiness assessment is based on judgment about how to proceed in a situation filled with uncertainties and constraints. Although a quantitative solution is desired,

logical solutions obtained from reasoning based on experience and sound operations research principles are required to define a basic methodology that can be conducted analytically. From discussions in the Group, the methodology in Figure 2 was developed. This methodology allows a CINC specific contingency scenario to be decomposed into the functions that must be performed and the forces required to achieve the mission. Since current strategic status is accounted for, the impacts on existing, ongoing actions can be quantified. In this manner, the ability of the present force structure to take on "one more job" can be addressed in a continuous, rolling manner. The product of this assessment methodology is to identify near term shortfalls that can be passed back into the other eight JWCA processes for inclusion in the long term procurement evaluation.

Issues that received the most attention included the ability to functionally decompose the entire mission area, the focus between global situation success and the ability of diverse Service units to work together within a CINC OPLAN, the requirement to continually evaluate multiple possible contingencies and the affordability problem. An unresolved problem at this juncture is whether the methodology should be used as a means to directly impact the overall acquisition and PPBES process. It was generally agreed that an associated risk assessment is needed to look at influences on the POM cycle that would arise from interim shifting of dollars, reduced mission capability or schedule stretches.

Discussions relative to performance measures centered around the need to "do what" and how to measure joint aspects of mission achievement. How fast, how soon, how long were points of contention during the forum. Measures for force projection, sustainment, training status, resource allocation priorities, functional control, time dependent capability and commit decision impacts were all deemed important. The readiness measures of merit were based on the need to

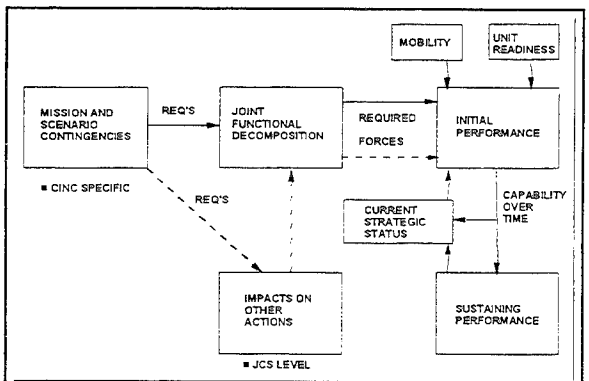

Figure 8. An Assessment Approach for Multiple Contingencies

- Win
- Do it quickly
- Minimize casualties.

From this perspective, the bases to identify measures of performance are allied to

- Scenario specific needs to meet a defined mission
- Identification of deficiencies in overall capability
- Reduced force capability arising from diversion of assets to a new task
- Assessment of redundancies from a joint view
- Ability to provide shortfall data to the budget and acquisition process.

Quantitative measures are required for

- Unit readiness (probably in existence)

	Strategic Priority	Executing?	Forces Required	Force Available?	CINC's Assessment	JCS's Assessment
CINC A						
OPLAN 1	1	No	List	Yes	No	No (Tng)
OPLAN 2	3	No	List	No	Yes	No(Lift)
.						
.						
.						
OPLAN n						
CONPLAN 1	2	Yes				
CONPLAN 2						
.						
.						
.						
CONPLAN m						
CINC B						
OPLAN 1	4	Yes				
OPLAN 2						
.						
.						
.						
OPLAN x						
CONPLAN 1						
CONPLAN 2	5	No	List	Yes	Yes	Yes
.						
.						
.						
CONPLAN z						

Figure 9. A Joint "Operational Readiness Decision Matrix

- Force functional readiness/ preparedness
- Joint status
- Relative cross CINC impacts
- Success of joint enablers.

Utilizing this overall process would permit the development of a joint operational readiness decision matrix that the Chairman and Vice Chairman could use to assess the entire spectrum of possible scenarios and situations that could occur in the near term. Break points in total, joint capability would be visible as each new task is added incrementally to the complete set of potential operations. An example is shown in Figure 3.

Near Term Recommendations

- Specify that the purpose of the JWCA 9 Joint Readiness assessment is to provide near term operational assessments of the U.S. ability to meet new, expanded or additional missions defined by the administration or defined through OPLANs and CONPLANs.
- Use Process Analysis techniques to establish how the Joint Readiness assessment will be made and what information is required and available to support the assessment process.
- Determine the ability of the CINCs' staffs to routinely provide quantitative and qualitative assessments of the

CINCs' ability to respond to additional missions.

- Determine what qualitative and quantitative information can be provided by the J1, J4, and J7 staffs to further assess the capabilities of the joint forces to respond to additional missions.
- Given the required and available information, construct a decision matrix similar to that in the figure above using "Consumer Report" or RED, YELLOW, or GREEN qualitative presentation techniques.

Long Term Recommendations

- Determine shortfalls in current CINC staff assessment capability and develop an approach to obtain necessary data and conduct rolling evaluations of CINC level operational readiness.
- Identify additional information required from J1, J4, J7 and other J-staffs to expedite complete joint capability assessment and include in the Joint Readiness Assessment process.
- Automate and fully populate a decision support matrix (Figure 3) for use by the VJCS.
- Develop an approach and process to insert this near term resource allocation focus into the more long term approaches of the other JWCA Groups to impact the overall acquisition process.

Conclusion

If the Vice Chairman agrees that the focus for the Joint Readiness Joint Warfighting Capability Assessment is near term then the problem reduces to a resource allocation assessment Given the forces available today to support CINC missions, the level of unit (service) and joint training, the availability and adequacy of joint operational enablers, and the deployment and sustainment capabilities required and available, what risks will the US. take by committing to and executing new, modified or additional operational missions ranging from OOTW through 2 major regional conflicts?

Based on the work Group discussion, it appears that the Joint Readiness JWCA should retain a short term focus providing the Chairman and Vice Chairman, JCS, almost real-time, day-to-day assessments of the ability of the CINCs, supported by the Services, to execute expended, new, or additional OPLANs and CONPLANs beyond those to which DOD is already committed. The Joint Readiness JWCA assessment should be able to provide a reasonably accurate assessment across the total force of our ability conduct "one more mission" today, tomorrow or within the near term (less than two years). This JWCA should not be expected to provide information or assessments that would impact on the PPBES system. The figure below presents a perspective of how the JCS should view the relationship between Joint Readiness JWCA and the other 8 JWCAs. The integration of the near term (JWCA 9) and the long term (JWCAs 1-8) assessment into a total force assessment is based on judgment as well as quantitative measures.

If the VCJCS's intent is to impact the PPBES with an integrated JWCA assessment of global joint readiness, the working Group identified a process to assess joint readiness based on the agreed to definition and address

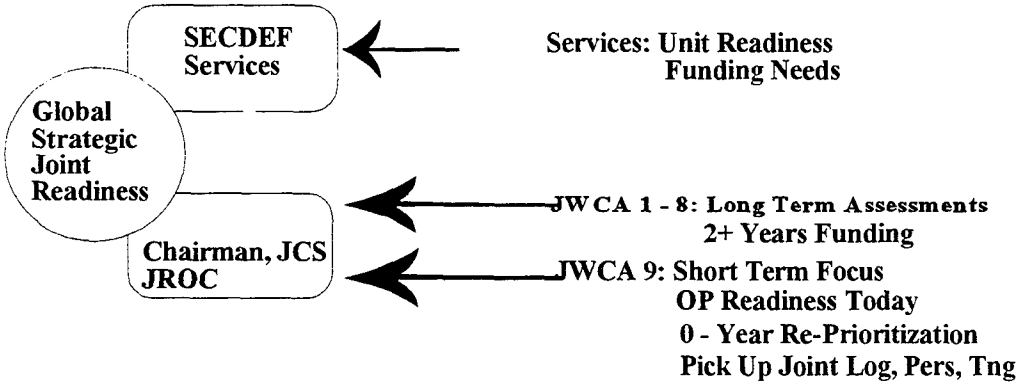

Figure 10. Process of Integration

ed an analytic methodology to measure joint readiness capability in a multiple scenario environment. Generic measures of merit were identified with the recognition that individual scenarios would be the driving parameter of interest in the analysis process. With tools currently available, the Group believes that a reasonable assessment could be made of joint readiness in a two MRC or an MRC / OOTW environment that would permit comparison of potential measures of performance and further develop those most appropriate for the application to successs in the joint world, implications on the acquisition process and the capability of US forces to function in a multi-conflict scenario in a dollar constrained situation.

10. *Integration*

Dr. William G. Lese, Jr

Working Group 10 was led by Dr. William Lese, Deputy Director of OSD(PA&E) for Theater Assessments and Planning. His co-chairs were Jack Burton of SPAC and Dr. Jerry Kotchka of McDonnell Douglas.

The task of Working Group 10 was to determine how the fields of operations research and management science could be applied to help integrate the products of the nine Joint Warfighting Capability Assessment areas. To accomplish this task, WG10 organized its activities around three goals: first, understand the JWCA process as it is currently conducted; second, suggest changes to the process itself which would facilitate integration; and third, suggest specific tools and methodologies which would be useful in integrating JWCA results. The following discussion will first describe the current process, followed by a discussion of some recommended revisions. Opportunities for integration and analytic support will then be proposed, including some considerations for application. Finally, the discussion will conclude with a set of near and far term recommendations.

In working on the first goal, to understand the current structure of the JWCA process, it became apparent to the working Group that a general process had been described, but that operating details had not been established. Though it may have been quite apparent to insiders when the process started, how it developed, and when results were to be reported out, it was not apparent to outsiders. The greatest implication of this for working Group 10 was a lack of structure around which to build an analytic support process for integration. Nevertheless, after

Step	Current Process	Proposed Process
0	Identify issues to be addressed by each JWCA	Also identify need to assess each JWCA in total
1a	JWCAs report periodically to JROC	JWCAs also review and evaluate analytic approach and models
1b		IAD integradres results via tools to support JROC
1c		Review trade-offs, resource allocations, etc
2	Take 9 JWCAs to JROC for integration	Same, except product is CPR
3	JROC takes draft COA to CinCs	Same
4	Obtain Chairman's approval	Same
5	Provide CPA to SECDEF to influence budget	Provide CPR to SECDEF to influence DPG

Figure 11. JWCA Process Evaluation

much discussion, the Group agreed on the following description of the current process:

Step 0: Start. Establish the work Groups and identify the issues to be addressed by each JWCA. These could take the form of either directed or self-initiated issues. Since the JWCAs are intended to be standing Groups constantly reviewing issues, this may be more a formality to start the reporting process.

Step 1: JWCAs periodically report results to the JROC. This allows each JWCA to keep on track, keeps the JROC principles informed of current issues and progress , and it allows emerging cross-cutting issues to be identified.

Step 2: At some point in time, the JWCAs report their "final" product. Integration into the Chairman's Program Assessment (CPA) is accomplished after the fact by the JROC, with J-8 (Integration and Assessment Division) facilitating.

Step 3: The JROC takes the CPA to the CinCs for review and negotiation, with the intent to achieve a consensus for the CPA and note any dissenting positions.

Step 4: The resulting CPA is submitted for the Chairman's approval, and

Step 5: The CPA is provided to the Secretary of Defense to influence the budget.

With this definition of the current process as a baseline, the Group was able to tackle its second goal, to suggest revisions which would aid the integration The working Group devised the following modifications to the JWCA process, which retains the same basic steps as in the current process. Two major changes are made: first, the process is timed to focus on the Chairman's Program Review (CPR) so that it affects planning and programming early, and second, analytic preparations and integration steps are added into the process. It may be redundant to say, but we emphasize that integration is itself integrated throughout the revised process. That process follows.

Step 0: Start. As in the current process, establish the work Groups and identify the issues to be addressed by each JWCA. In the revised process, all JWCAs would be reviewed to see which ones require a top-to-bottom assessment.

Step 1: JWCAs still periodically report results to the JROC. Two additional elements would be included in JWCA responsibility:

a) Each JWCA would review and evaluate analytic approaches and models to support its efforts.

b) J-8 Integration and Assessment Division would integrate results (generate via step 1a) of the various JWCAs using appropriate tools and methods, to support the JROC deliberations.

Step 2: At a specified point in time, the JWCAs report their "final" product. J-8 IAD accomplishes the integration of

results using tools previously determined, the results are presented to the JROC for final negotiation, integration, and incorporation into the *Chairman's Program Review* (CPR).

Step 3: The JROC takes the CPR to the CinCs for review and negotiation. However, IAD takes the lead in illuminating the underlying analytics and integration methods for the decision makers.

Step 4: The resulting CPR is submitted for the Chairman's approval, and

Step 5: The CPA is provided to the Secretary of Defense to influence the programming process..

In step 2, integration in the current process is accomplished after the fact, essentially through the efforts of the JROC with the assistance of J-8 Integration and Assessment Division (IAD). It is, understandably, unclear exactly how this would be accomplished. However, the revised process employs the integrating tools and methods developed in step 1 to organize the JWCA outputs for the JROC's consideration. IAD would ensure that the JROC understands the type of analytics, any operational settings, and assumptions and limitations used in the integrating analytics.

The strengths and weaknesses of the current process are reasonably obvious. It does focus on and involve the JROC directly in the decision process, and it has a built-in vehicle for compromise and consensus. Its major weakness is that the process has no evident underpinnings of analytic process, either within each JWCA, or in support of the integration process. On the other hand, the revised JWCA process retains intimate involvement with the JROC, and ultimately depends on the senior decision makers for integrated *decisions*, but provides greater opportunity for generating integrated *information* for the decision makers. It emphasizes early involvement of analysts within and across the JWCAs to learn the issues and to find or develop appropriate methods of evaluation and integration. The general concept of timing the process to focus on the CPR simply allows a greater opportunity to *guide* the programming process rather than *reacting* to it. The weakness of the revised process is simply that, while it is believed to be sound and executable, it is untested.

In pursuing its third goal to suggest analytic approaches to integration, the working Group debated several approaches and tools, from which it assembled a set of observations and considerations for the JWCA process. A first important consideration is that integration amounts to a constrained resource allocation problem — prioritizing alternatives in the

CATEGORY	***Current Process***	***Proposed Process***
Strengths	***Total involvement of JROC***	***Total involvement of JROC***
	Vehicle for compromise and consensus	***Vehicle for compromise and consensus***
Weaknesses	***No analytical underpinnings***	***Not tested***

Figure 12. JWCA Process Evaluation Comparison

absence of resource constraints is a trivial exercise. Therefore, any meaningful integration methodology must incorporate costs of alternative programs, budget (resource) limitations, and assessments of impact on operational utility and/or effectiveness. Moreover, useful analytic methods must facilitate integration across diverse scenarios and missions to be generally useful. Finally, such methods must allow assessment of risks of pursuing or not pursuing each alternative, and must provide understandable information to allow negotiation and joint consensus building. Given the scope and diversity of the JWCAs themselves, this is a very demanding set of considerations. Though no single model or process is viewed as sufficient, several opportunities exist to reduce the dimensionality of the current integration problem.

A generalized campaign analysis approach is suggested, where "campaign" is expanded to include traditional warfighting and operations other than war. The goal is to determine a single, or, at most, a few high level Measures Of Effectiveness for the joint force. This will facilitate tradeoffs within and between the alternatives of various JWCAs, and reduce the burden of the ultimate integration process. Standardizing to DPG planning scenarios whenever reasonable will provide a consistent environment for such analysis. Using approved joint doctrine and concepts of operations will also improve consistency of the analysis, but must be carefully considered since the effectiveness of some alternatives will hinge on successful modification of current doctrine.

Two additional considerations are suggested. First, integration must recognize the time-sensitive nature of threats and force capabilities. Therefore, the working Group believes that the evaluation of effectiveness must be carried out at multiple points in time, using appropriate DIA-approved threats for various time frames. Finally, the high level measures chosen must correspond as closely as possible to CinC-driven campaign objectives to provide an objective medium for evaluation of success and risk associated with any alternative.

Among the tools considered by the working Group which contribute to meeting the preceding considerations are the following:

- Use of current campaign models to generate effectiveness. Though these models are not useful for analysis in all JWCAs, they do allow direct, or at least parametric, analysis crossing several JWCAs.
- Use of mathematical programming techniques. This is a useful medium for combining cost, budget, and effectiveness (or utility), and examples of successful defense applications are growing. Actual utility usually depends on combat modeling or some other medium to estimate effectiveness, but useful formulations are available to accommodate some of the non-linearities inherent in these problems.
- Use of decision theory methods. Integration of disparate JWCAs may ulti-mately depend on estimating relative "utility" of alternatives. Decision theory provides methods for establishing such values. One such method, called the Force Value Calculator, was successfully employed

- **Analytic support methodology criteria**
  - **Incorporates effectiveness, cost and Budgets**
  - **Facilitates integration across scenarios, missions, etc.**
  - **Permits risk assessment and joint consensus**
- **Generalized Campaign Analysis approach**
  - **Employs high level MOEs**
  - **Evaluates force effectiveness**
  - **Permits trade-offs across JWCA alternatives**
- **Terms of reference using DPG scenarios**
  - **DIA approved threat for appropriate time frames**
  - **Concept of operations and doctrine**
- **High-level measures of effectiveness**
  - **Assess CinC-driven campaign objectives**
  - **Permit trade-offs with acceptable risk**

Figure 13. Methodology Considerations

by the Joint Staff in 1991 to evaluate alternatives while building the "Base Force."

Having developed potential process revisions and methodology opportunities, working Group 10 gathered the following conclusions. To support the need to do something useful now while looking toward improvements in the future, recommendations are broken into near and long term.

Near Term:

It is evident that there is no "overall" analytical methodology which will substitute for the 4-star integrators. Nor is there a single overall methodology to support the 4-star integrators. Therefore, we must focus on construction of a set of models tailored to the burning issues, which must be identified as soon as possible.

We recognize that Cold War era models may be limited. However, combining current models using a *system of systems* approach will permit evaluation of both the dominant battlefield awareness and vision of the battlefield with future weapons. JCS should lead this effort with OSD, CinCs, and Services in support.

The analytic involvement posed by the revised process should be led by J-8 IAD. Since the level of effort is large, IAD should be augmented by an Analytic Support Working Group drawing on CinC, OSD, and Service capabilities. This team would perform the duties suggested in steps 1 and 2 of the process, and be involved early and throughout the process. Since this is expected to be an institutional process, manning IAD sufficiently to support the process in the future would be beneficial, and allow the Analytic support Group to be funded and empowered to develop tools for the future.

Because the Nimble Dancer wargaming efforts are already drawing together an analytic working Group, these Group is a

logical starting points for both models, data, and integration support.

One specific approach with near term potential to assist in integrating JWCAs is a decision theory tool called the Force Value Calculator. This tool was developed and used by J-8 to answer base force questions. BG Hicks has already had LTCOL Roy Rice, one of the originators, present information on the design and past use of the tool. It seems to had potential in this current process.

Long Term:

Current JWCAs focus on warfighting and operational capabilities, but this does not cover the full budget. "Infrastructure" must be factored explicitly or parametrically into the overall analysis but it can affect or be affected by the JWCA process, and may well be an area of primary CinC concern.

Finally, decision theory offers potential not frequently applied to military analysis. This problem should be posed to researchers to allow time for basic research to develop approaches to the thorny issues.

- **NEAR TERM**
  - **Build on current methodologies available from Services, Joint Staff, OSD, CinCs and others**
  - **Augment IAD with Analytic Support Working Group drawing on Devices, OSD, CinC capabilities**
  - **Build on current Nimble Dancer wargame process**
  - **Build on Joint Staff Force Calculator model**
- **LONG TERM**
  - **Expand JWCA scope to address full set of resources issues: warfighting, OOTW, personnel, infrastructure**
  - **Pursue, evaluate and apply decision science theory**

Figure 14. Recommendations

Part III

SYNTHESIS GROUP

Christine A. Fossett and Brian D. Engler

Introduction

Each member of the Synthesis Group observed one of the ten working groups on behalf of MORS. They were tasked to look for common themes, concerns, and omissions; and to identify opportunities for MORS to continue efforts in this area.

Overall, the Synthesis Group was impressed with the working groups' preparation, discussions and resulting insights. The members, representing diverse organizations and professional disciplines, shared varying perspectives and approaches. They put aside their parochial views and engaged in open and constructive dialog about the current status of and issues related to assessing joint warfighting capabilities.

The following summarizes the Synthesis Group observations and describes challenges and opportunities for the JROC and MORS.

Joint Warfighting Capability Assessment (JWCA) Definitions, Content, Foci and Goals

The JWCAs provide an innovative approach to determining operational requirements for the evolving national security paradigm. Each working group was challenged to provide the Joint Requirements Oversight Council (JROC) with ideas about how best to apply this new thinking, started with an attempt to clarify the definition of its assigned JWCA. The Synthesis Group noted that the degree of difficulty involved in transitioning from the traditional "vertical stovepipes," which supported the old paradigm, varied among the working groups. It was not simple or easy for any working group, but for some working groups it was particularly complex and difficult.

Existingt definitions for a few JWCAs were described as narrowly focused whereas others were considered very broad. Some JWCAs interfaced with a few others whereas others overlapped with many or all others. One working group, in particular, noted that many of their important military requirements were contained within the purview of other JWCAs.

The working groups tended to scope the JWCAs narrowly, which is natural when there is pressure to accomplish work under tight time constraints. In the future, however, the JROC should guard against turning JWCAs into horizontal stovepipes to replace the traditional vertical stovepipes. One approach is to focus explicitly on the areas where the JWCAs interact with the objective of "seamless" integration. To accomplish this, JWCA interactions and interdependencies should be identified early. Efforts to coordinate and integrate should be sustained throughout the process--before, during and after assessments--not left for the Integration Group to work at the end.

JWCA Measures of Effectiveness (MOEs)

Efforts to define the scope of the JWCAs continued as the working groups focused on determining appropriate measures of effectiveness. The working group members drew upon their experiences with past and current studies as they defined requirements germane to their JWCAs. Several working groups were comfortable with using selected, traditional measures. Other working groups, however, recognized that past MOEs did not neatly map onto their newly defined JWCA, especially within the changing national security paradigm and attempted to define new measures. This innovative thinkins is good and should be encouraged.

Unfortunately, MOEs appeared to be developed for JWCAs with little or no regard for how they meshed with MOEs for other JWCAs, especially for those with which there was anticipated interaction. Cross drivers that might facilitate integration were occasionally discussed, but not systematically identified.

Furthermore, when considering "What MOEs?", a common exclamation was "MOEs for what?" MOEs for what goals--for what type and level of operations and for what time period? There was no disagreement that requirements should anticipate future needs, but several working groups voiced concerns that there was no commonly accepted vision statement regarding the future. Working groups discussed a number of concepts needing greater specificity before MOEs can be developed, including success, robustness (i.e., how substantial or how strong?), risk of failure, and vulnerabilities at the seams. Working groups also opined about Operations Other Than War MOEs, but with no definitive resolution.

Questions also were raised about the possible need for broader JROC MOEs in addition to JWCA MOEs. For MOEs to be useful, they need to be commonly agreed upon and relevant to the question being addressed. Can and should certain JROC MOEs be standardized? Can agreement be reached about a set of common JROC MOEs? Are there MOEs that can or should be rolled up to present an aggregated perspective about required capability? If JROC MOEs are defined, will they lose their usefulness for the individual JWCAs?

The working groups had little or no discussion of costs and affordability analyses. Among the challenges that remain in addressing these issues, two areas appeared critical. First, a common framework should be developed to permit a comparative analysis across systems and JWCAs. Second, a method of determining how "cost" plays in the analyses is also needed. To what extent should capability be maximized subject to budget constraints and should cost be minimized subject to capability constraints?

JWCA Processes

The JWCA processes are in early and varied stages of development. The working groups identified several strategies and approaches that might be helpful as the JWCA processes evolve. Baseline assessments or meta-analyses can be useful for establishing a starting point--the current state of knowledge, and identifying gaps in our knowledge and limitations in prior analyses. With this information, a JWCA team would be in a better position to decide on the directions for future assessments.

The JWCAs also will need data from a

variety of sources. Constructive models and simulations will continue to provide important information. Advanced distributed simulations may be useful for experiments to test assumptions. Also operational tests and training can provide insights. Routine review of after-action reports and lessons-learned data bases could also be useful. The JWCAs should develop standard questions and methods of inquiry for systematic and periodic searches of these valuable information sources.

Internally, the tradeoff analyses within and among JWCAs will be critical to overall JROC decisions. Processes should be developed for integrating JWCAs--defining how assumptions and MOEs critical to but outside the JWCA are handed-off to other appropriate JWCAs.

Overall, the integration and streamlining of the JWCA processes should be focused on the use of the end results. If one of the primary goals is to influence the Defense Planning Guidance, the JWCAs should identify the types of information considered in those deliberations and design the JWCA processes to produce those types of results. With that and other spheres of desired influence in mind, specific action items can be defined to ensure that the processes are analytically based and useful.

Operators, managers, and analysts will bring important, but different perspectives and skills to these JWCA processes. Dedicated analytical support, especially when involved early, can be a key resource for providing a corporate memory; tapping and assessing information generated by other analysts; identifying issues and framing questions; proposing useful tools and ensuring they are appropriately applied; presenting results and explaining assumptions and limitations; and planning a portfolio of analyses including long term assessments and short term responses to immediate questions.

Transitional Impediments

Problems related to the credibility of models and simulations were raised in all working groups and each recommended more attention to verification, validation, and accreditation. These efforts are important and should be undertaken to enhance credibility. Analysts and users, however, often differ in their confidence in model and simulation results. At times the analyst may be cautious about a model's or simulation's capabilities, yet the user may over extend or misuse the results. At other times, the analyst may be very comfortable with the models' capabilities and results in answer to a specific question, but the user may have no confidence in the model and not use its results at all.

A related problem is the lack of agreement within the analytic community. Different analytic communities have developed models and simulations using available data and assumptions most appropriate for addressing the questions in their specific areas of concern. Agreement between analytic communities about data and assumptions appropriate in a joint context or for joint analyses is lacking. Furthermore, there are differing interpretations of joint doctrine.

Another challenge is to use appropriate tools usefully. Models and simulations used for combat analyses are only one set of tools for generating information for JROC deliberations. While they are important, emphasis on analysis is more important. The decisions facing the JROC will require a broader array of tools. Decision and policy

analysis may become more important for integrating the results from the individual JWCAs. In this context, a mix of quantitative and qualitative methods is needed. The JROC and JWCA teams should keep in mind the distinction between analysis (examination/study) and assessment (judgment).

JROC Success and Future MORS Efforts

Overall, the workshop working groups provided constructive dialog and interaction among various disciplines. The workshop succeeded in providing the military operations research community with a greater appreciation for the JWCA processes and the challenges they face. Likewise, JROC and JWCA team members involved in this workshop seemed to emerge with an appreciation of what the military operations research community, and MORS in particular, can bring to the JWCA process. Many concerns surfaced as well as some specific, hopefully useful, ideas for future action. No one, simple solution was expected and it did not emerge.

With their increased awareness of the JWCA efforts, the military operations research community should continue to explore relevant and practical methods to be used in the JWCA processes. The Synthesis Group recommends that MORS undertake several initiatives to continue exposing analysts to and seeking their help with JROC challenges. First, MORS should map the JWCAs onto the existing MORS Working Group structure and suggest that Working Group Chairs dedicate a session to continued JWCA discussion at the annual symposium.

Also joint issues and analyses should be stressed in MORS publications. Specifically, the authors of sections of the *Military OR Analysts Handbook* should emphasize joint aspects of the models, algorithms and data sources contained therein. This should include describing the appropriateness of the models, algorithms, and data for joint analyses, and providing examples of use in a joint arena.

MORS also should consider establishing a Senior Advisory Group to advise on conducting follow-on special meetings to address specific topics and/or establishing a new permanent working group to focus on joint analytic issues.

APPENDIX A

GLOSSARY

2MRC	Two Major Regional Contingencies
ACOM	Atlantic Command
ADS	Advanced Distributed Simulations
BDA	Battle (Bomb) Damage Assessment
C^2	Command and Control
C^2/IW	Command and Control and Information Warfare
C^3I	Command, Control, Communications and Intelligence
C^4	Command, Control, Communications and Computers
CINC	Commander-in-Chief
CJCS	Chairman of the Joint Chiefs of Staff
COEA	Cost and Operational Effectiveness Analysis
CONOPLAN	Contingency Operations Plan
CONOPS	Contingency Operations
COTS	Commercial-Off-The-Shelf
CONUS	Contental United States
CPA	Chairman's Program Assessment
CPR	Chairman's Program Review
DIA	Defense Intelligence Agency
DoD	Department of Defense
DMSO	Defense Modeling and Simulation Office
DPG	Defense Planning Guidance
FLOT	Front Line of Own Troops
FSTA	Futures to Strategies to Tasks to Acquisition
ISR	Intelligence, Surveillance and Reconnaissance
J1	Director for Manpower and Personnel
J2	Director for JCS Support, DIA
J3	Director for Operations
J4	Director for Logistics
J5	Director for Strategic Plans and Policy
J6	Director for Command, Control, Communications and Computers
J7	Director for Operational Plans and Interoperability
J8	Director for Force Structure, Resourcees and Assessment
JAST	Joint Aircraft ??
JMA	Joint ??
JMNA	Joint Military Net Assessment
JROC	Joint Requirements Oversight Council
JS	Joint Staff
JSIMS	Joint Simulation System

JWCA	Joint Warfare Capabilities Assessment (Area)
JWFC	Joint War Fighting Center
JWID	Joint Warfare Interoperability Demonstration
MOE	Measure of Effectiveness
MOFE	Measure of Force Effectiveness
MOP	Measure of Performance
NSIA	National Security Industrial Association
OOTW	Operations Other Than War
OPLAN	Operations Plan
OSD	Office of the Secretary of Defense
POM	Program Objective Memorandum
POM98	Program Objective Memorandum Fiscal Year 1998
PPBES	Planning, Programming, Budgeting and Execution System
PPBS	Planning, Programming and Budgeting System
R&D	Research and Development
S&A	???
SPAC	Systems Planning and Analysis Corporation
TBMD	Theater Ballistic Missile Defense
VCJCS	Vice Chairman of the Joint Chiefs of Staff
VV&A	Verification, Validation and Accreditation
VV&C	Verification, Validation and Certification

APPENDIX B

Terms of Reference

WORKSHOP

THE JOINT REQUIREMENTS OVERSIGHT COUNCIL PROCESS

1. Background

The Goldwater-Nichols Department of Defense Reorganization Act of 1986 legislates that the Chairman of the Joint Chiefs of Staff is responsible for performing net assessments to determine the joint warfighting capabilities of the armed forces of the United States. It also requires the Chairman to advise the Secretary of Defense on the extent to which program recommendations and budget proposals conform with the priorities established in strategic plans and combatant command requirements; and submit alternative recommendations and proposals to achieve greater conformance with these priorities. Furthermore, the chairman assesses military requirements for defense acquisition programs, develops doctrine for the joint employment of forces, and recommends roles, missions, or function changes to achieve maximum effectiveness of the armed forces. The Joint Requirements Oversight Council has emerged as a key forum in which senior military leaders support the Chairman in undertaking these responsibilities.

The JROC is becoming a central platform for discussing and proposing solutions to the issues that are embodied in the concept of military requirements. Expanding the JROC's function requires major changes in staffing and analytic support for JROC deliberations. The Joint Staff has established nine joint warfighting capability assessment areas (JWCA's) and an assessment integration function for focusing the new JROC process, charged separate Joint Staff offices with coordinating the assessment in each of the capability areas, and invited participation from a wide range of agencies and analysis organizations. The assessment process now integrates key war fighting areas across traditional stovepipes in order to gain insights, foster innovation, and support the intellectual synergism that contributes to conceptual breakthroughs. The JWCA's are: strike; ground maneuver; strategic lift and its protection; air superiority; deterrence and counter-proliferation of weapons of mass destruction; command, control and information warfare; reconnaissance, surveillance and intelligence; overseas presence; and joint readiness.

Developing and articulating a corporate military perspective at the top levels of the nation's military leadership is the fastest and surest way of bringing about the changes the new era demands. The Military Operations Research Society's role as a catalyst for the military operations research community makes it the appropriate organization to examine the new process and to elicit contributions to enhance and improve it.

2 Objective

The objective of the JROC Process workshop is to provide an opportunity for the military analysis community and the Joint Staff to come together to explore the philosophy, policies, processes, and methods of evaluation and analysis useful to the JROC activities. The workshop will:

- Educate military operations research analysts and decision makers about the purpose, organization and functions of the Joint Requirements Oversight Council process,
- Identify military OR review, analyses, methods, and products that may support the expanded JROC process; and
- Provide insights on the JROC process for widespread dissemination

3 Approach

An unclassified workshop will carry out the objective through two complementary means

The first half day of the workshop will consist of a plenary session during which the Vice Chairman of the Joint Chiefs of Staff will address the full membership of the workshop on his expectations of the JROC process and for the workshop. Following the Vice Chairman, the Joint Staff Director for Force Structure, Resources, and Assessment will brief the workshop participants on the current JWCA integration methodology. The final part of the plenary session will consist of briefings from the assessment proponents for each of the JWCAs

The afternoon of the first day and the morning of the second day will be devoted to parallel working Group sessions, with one working Group assigned to each of the nine JWCAs and a tenth working Group dealing with the concern of integrating the output from the nine JWCAs to form a coherent assessment for the Chairman to report to the Secretary of Defense. Each working Group will be chaired by a senior military OR analyst; and each Group will be supported by knowledgeable representatives of the assessment of the relevant mission capability areas. The working Group sessions will include informal presentations (necessarily brief), discussions, identification of issues, and analysis and assessment approaches to the issues raised

Each working Group will develop observations, conclusions and analysis and assessment methodology recommendations appropriate to its specific topics and JWCA. In addition, each Group will be invited to identify findings and observations relevant to the overall workshop theme. Summary presentations will be made to the entire workshop Group in a plenary session set for late morning of the second day. Thus all participants can share the insights gained by each of the working Groups. The final plenary session will also focus on areas of consensus from the overall workshop and identify topics needing further examination

Throughout the working Group deliberations, an eleventh Group of selected senior military analysts will be invited to circulate among the working Groups to help cross-pollinate ideas and provide additional insights. Each working Group will be charged with maintaining a record of its deliberations, a summary of each Group's deliberations will be included in the

proceedings of the workshop. The results of the working Groups and the final plenary session will be the subject of a briefing by the workshop General Chairman and others to be presented to the Vice Chairman and the workshop proponents during a half-day session, to take place about 15 days after the workshop. All workshop participants will be invited to this briefing.

4. Membership

Participation in the workshop will be by carefully structured invitation. The purpose is to provide a climate that maximizes the flourishing and nurturing of innovation and creative approaches. The plan is to have the participants reflect a wide community of interests, insights and capabilities. To that end, each working Group will consist of a mixed Group of not more than 20 (16 preferred) members, reflecting in approximately equal proportions: military operational research analysts; functional area specialists; non-DoD government (e.g., from Departments of State, Energy) relevant experts; and exogenous disciplines. Among the exogenous other disciplines to be considered are those traditionally outside the mainstream of modern military analysis, perhaps representative of the earlier concept of the mixed team (e.g., military historians, lawyers with experience in nuclear disarmament and arms control, economists with appreciation for long acquisition cycles). The working Group chairs will identify memberships for their Groups in conjunction with the workshop organizing committee. Membership in the working Groups will be managed to avoid establishing Groups where many of the participants have already structured ties to one another and have already "solved the problem."

5. Product

A briefing which will include the findings, observations, conclusions, and recommendations from each of the working Groups and the overall workshop will be developed. This briefing will be presented to the Vice Chairman, the workshop proponents, and the workshop participants about 15 days after the workshop. Proceedings will follow, consisting of summaries of each working Group and the briefing material. The results of the workshop will be the subject of a general session at the 63rd Military Operations Research Society Symposium, June 1995. An article for the *PHALANX* will also be prepared at the earliest opportunity following the workshop.

6. Proponents

At this writing, proponents of the workshop include the MORS Sponsors from the Office of the Secretary of Defense, the Joint Staff, the Army, the Navy, the Marine Corps, and the Air Force.

7. Organizing Committee

General Chair: Vincent Roske
Technical Chair: James C. Cooke
Deputy Chair: Fred E. Hartman
MORS Advisor: Dr. Jacqueline R. Henningsen

Administration: Richard I. Wiles and Natalie S. Addison

8. Administrative

Name: *The Joint Requirements Oversight Council Process*
Dates: 17-18 October 1994
Location: Sheraton National Hotel, Arlington, VA
Fee: $150 for Federal Government; $300 for all others
Attendance: Approximately 200, by invitation
Classification: Unclassified

APPENDIX C

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