

An Approach to Joint Warfare Analysis

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The concept of “jointness” is not new in military operations, but its importance has increased dramatically over the past 15 years. Historically, the Army, Navy, Air Force, and Marine Corps have worked toward common goals to enhance overall military capability to meet expected national security challenges. Today, a primary goal of jointness is to leverage individual service capabilities and unique strengths to reduce requirements for multiple, possibly redundant, military acquisition programs. Increased overall warfighting capability is still essential to meet new threats, but providing that capability in the post–Cold War era using fewer budget resources is also necessary. This article describes an approach to Joint warfare analysis that is providing decision makers with the information needed to evaluate alternative approaches to meeting future Joint warfighting needs. (Keywords: Analysis, Simulation, Wargaming.)

INTRODUCTION

Joint warfare is a term that gained prominence in the late 1980s after Congress passed the Goldwater–Nichols Act of 1986. The act reorganized DoD, placing more authority with the Secretary of Defense, the Chairman of the Joint Chiefs of Staff, and the theater Commanders. A principal goal was to bring all U.S. military service forces together under theater Commanders to ensure unified application of the full range of military power to meet national objectives, regardless of the services involved. The decline in the DoD budget throughout the 1990s gave additional impetus to Joint planning and operations. The Joint Requirements Oversight Council, supported by Joint warfighting capabilities assessments, has been strengthened to ensure that the requirements of the theater Commanders are better linked with the DoD system acquisition and engineering process.¹

Joint warfare analysis is an essential part of the military planning process that helps decision makers determine the most cost-effective way to provide Joint force capabilities that support the military’s warfighting concept for 2010 and enables appropriate use of those capabilities. It is the assessment of military systems, concepts, and architectures forming or supporting a Joint force package performing one or more missions under a Joint command structure. Therefore, Joint warfare analysis is

... more than the simple addition of two service models or analyses. . . . The primary differences lie in the characteristics of joint warfighting (particularly command, control, communications and intelligence), the level and types of analyses, and the creators and users of joint analysis.²

It is independent of the sponsoring agency or service, is applicable across the full spectrum of conflict—from

peacetime operations to major war, and relates to any level of analysis—from an engineering-level system analysis to a campaign-level analysis.

This article describes an approach to Joint warfare analysis being used at APL. We first show how its functions in a particular time frame (i.e., past, present, future, and far future) preclude a single, simplistic approach. We then identify tools and techniques from operations research and systems analysis that have special utility in Joint warfare analysis, provide an overview of the process used at APL, and conclude with a short discussion of the future of Joint warfare analysis.

USES OF JOINT WARFARE ANALYSIS

Joint warfare conjures up the image of a joint force performing an operation under a designated Joint Force Commander, such as occurred in Operation Desert Storm in 1991 or the 1999 war in Kosovo, Yugoslavia. Joint warfare analysis, however, must encompass the full spectrum of activities that require support by analysis, and these vary with time as shown in Table 1 and as discussed in the following paragraphs.

We cannot change the past, but we can learn from it. Analyzing past events and identifying the issues, lessons, and insights can lead to a better understanding of the present and future through historical operations analysis and benchmarking for future exercises and force assessments.

Analysis to enhance the readiness and capabilities of today's operational forces, based around the world performing varied missions, is an important part of Joint warfare analysis. Unless occupied by a particular mission, these forces are constantly engaged in training exercises to enhance readiness, capabilities, tactics, techniques and procedures, and doctrine. Education and training depend heavily on analysis to develop hypothetical situations for students and trainees. Planned

exercises are executed throughout the year, many with forces from other nations. Some exercises are one-time events, performed for specific objectives. Others are annual events, with their objectives evolving over time. Joint warfare analysis is used to support exercise planning, real-time and post-exercise force assessment, extrapolation of force capabilities, and alternative force evaluations. A Commander-in-Chief's staff continually develops and refines contingency plans for the theater using insights from such analyses.

Analysts planning for 10 years in the future will be major users of warfare analysis as evidenced by the many activities that analysis supports, e.g., DoD budget development and the services' 6-year acquisition plans. Analysis support is needed for requirements development; force structure determination; concept of operations development; system acquisition decisions; planning, programming, and budgeting systems; resource allocation; system development trade-offs; and experimentation. Of particular interest today is Joint experimentation to evaluate innovative warfare concepts and technologies. Joint warfare analysis is an essential component of planning the experiment and analyzing the results. All of these activities require a significant amount of analysis to support the systems engineering process that helps shape future military forces.

The far future includes activities that support broad concept development and technology investment for a period of 10–25 years. Analysis at this level often becomes more subjective and qualitative, based on forecasting and professional military judgment. The challenge for Joint warfare analysis is to provide credible assessments of the military utility of new, innovative concepts and technology.

It becomes obvious that the analyses required for activities having different time frames are quite varied. Therefore, using only one analysis process is not appropriate. Many different processes are required to fully

Table 1. Functions of Joint warfare analysis by time frame.

Past	Present	Near future	Far future
Historical analysis	Doctrine development	System requirements	Technology requirements
Benchmarking	TTP ^a development	Force structure	Advanced concepts
	Operations planning	Concepts of operation	
	Exercise support	System acquisition	
	Training	PPBS ^b support	
	Education	System development	
	Test and evaluation	Experiments	
	Contingency planning	Technology development	

^aTTP = tactics, techniques, and procedures.

^bPPBS = planning, programming, and budgeting systems.

support the various activities. The key is determining which kinds of analyses should be used (and when) in an overall Joint warfare analysis process for a particular problem. There are, however, two broad categories of Joint warfare analysis: one type supports the system acquisition process and the other operational planning and execution.

ELEMENTS OF JOINT WARFARE ANALYSIS

Systems analysis employs several basic elements: problem definition, operational context and identification of alternatives, analysis methods and tools, and evaluation of possible solutions.³ Figure 1 illustrates how these elements pertain to a Joint warfare analysis problem.

Joint warfare analysis applies analytic techniques from operations research and other disciplines. These techniques include quantitative methods, such as exercise of mathematical models and computer simulations, as well as more judgment-based qualitative methods, such as wargames and decision support techniques. However, the complexity of the issues involved and the number of relevant factors that must be addressed appropriately require highly skilled analysts. With the known shortcomings of even the best models, the analysis that helps support major budgetary decisions and plan real-world operations would be suspect if not for analyst expertise. Analysts determine the context, account for everything the model cannot represent, understand the information provided by the models, and communicate that information to senior decision

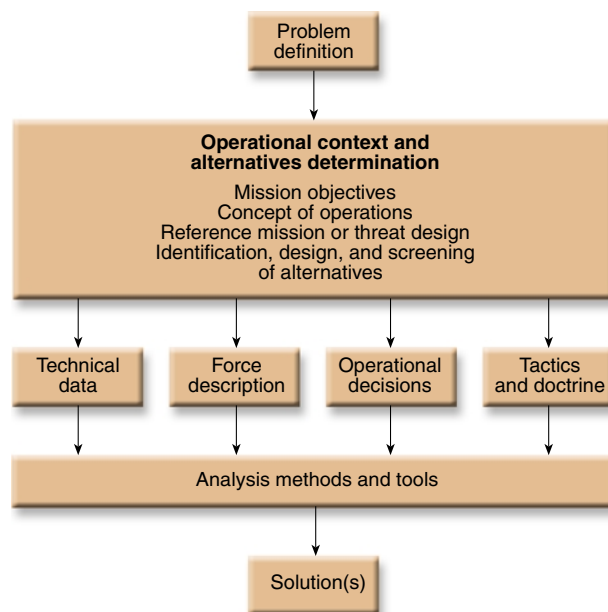


Figure 1. Joint warfare analysis elements.

makers. Some of the most important analyses have been based on the professional judgment of analysts.²

APL JOINT WARFARE ANALYSIS PROCESS

Figure 2 depicts the Joint warfare analysis methodology used at APL for near- and far-future time frames. Users, operational planners, mission area specialists, and Joint warfighters all contribute to the process. However, this activity typically occurs in discrete events because circumstances often prevent all these people from participating full time in the analysis.

Beginning with the appropriate formulation of the problem, the user provides basic information and guidance for the analysis, especially the underlying assumptions of the geopolitical environment from which an overall operational context is developed. Operational planning for how the problem is represented within the context is then performed. This is most often a subjective analysis aimed at gaining insights into operational decisions that will be modeled in the subsequent analysis steps. The contributions of operational planners from the services and Joint staffs are especially valuable to ensure realism and accuracy in this part of the analysis.

An important tool used for operational planning is the Warfare Analysis Laboratory (WAL) Exercise (WALEX), typically held at the APL WAL. (Nolen in this issue describes the WAL and the WALEX process.) Bringing together the sponsor (usually from a single service), Joint operations planners, analysts and engineers, and users (Joint warfighters—those military personnel with current or recent operational experience) leads to invaluable insight into operational decision making.

With these participants, one or more facilitators guide the group through one or more operational contexts, leading discussions and decision making at selected events. This process is fully interactive with the audience and is supported by advanced computer technology. Having representatives from all pertinent services and the Joint staff encourages the understanding and exploration of different perspectives. Thus, potential service biases can be discovered and altered to present a balanced operational plan. Under the auspices of a skilled analyst and facilitator, a genuinely Joint plan of operations emerges from this activity.

The truly distinctive characteristic of Joint warfare analysis is the way that it must bring the perspective of an individual service system and personnel into an integrated and balanced whole with comparable perspectives from the other services. This is accomplished using an appropriate set of analysis tools and techniques and a common operational context.

From the planning activity, multiple operational scenarios are developed that require further detailed

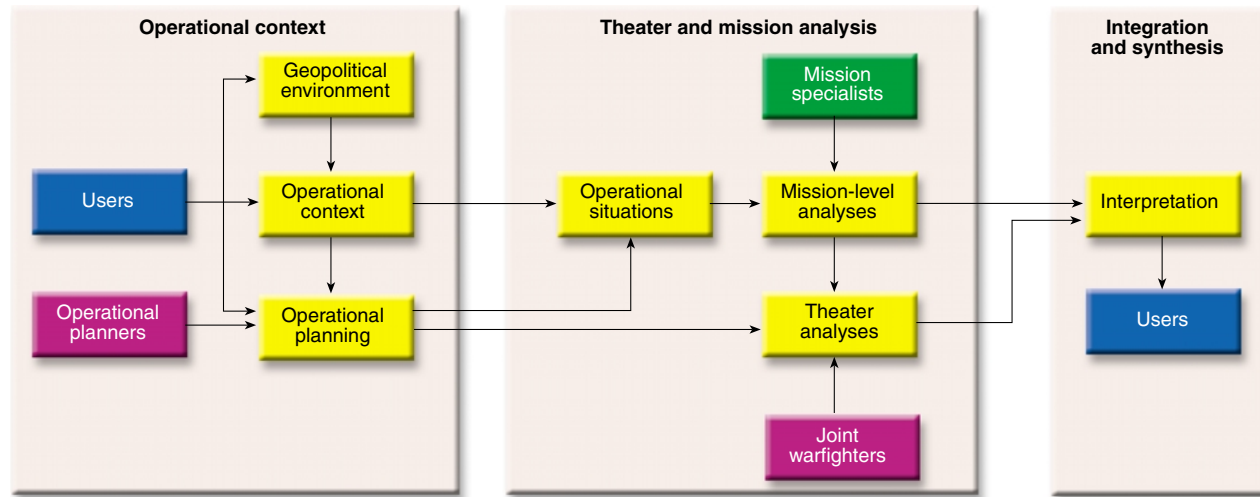


Figure 2. APL Joint warfare analysis process. The yellow boxes indicate activities led by the Joint warfare analyst. Other boxes represent operational personnel and point to analysis elements in which they play a major role.

mission analysis. Mission-area specialists, both military and civilian (including government and industry engineers), assist in this part of the analysis. Theater-wide analysis from the perspective of a Joint Force Commander is also performed, perhaps in parallel to the mission analysis. Joint warfighters, as well as service-specific warfighters, are involved during this step. Finally, the integration and synthesis of all analytical results occur. At this stage, results are interpreted and the alternatives are presented to the sponsor. The WALEX process can be exploited to provide multiple perspectives on the results of the quantitative analyses at the various levels.

CHALLENGES

Using this general process, Joint warfare analysts have many challenges, not the least of which is the interaction of diverse teams of people responsible for specific activities. Keeping the study sponsor abreast of progress can also be difficult, and typically occurs at periodic status briefings. Finally, keeping the entire team up to date with study plans, assumptions, decisions, and results is a challenge that consumes much of the lead analyst's time and energy.

The Joint warfare analysis process often involves theater-level analysis, which includes many aspects that have not been traditionally represented rigorously in DoD analysis activities. A major challenge involves representing the impact of command, control, communications, and intelligence (C³I) on the force effectiveness of system architectures. Most current analytical tools do not represent C³I at a level that allows evaluation of alternative concepts or architectures; the analytical relationship of C³I performance and military force effectiveness is not yet fully understood. Therefore,

empirical evidence based on recent operational experience is typically employed to represent this relationship in the analysis. Until advanced tools become available, Joint warfare analysts must rely on the operational experience of their teams and participants and skillfully convert subjective assessment into quantitative inputs. This situation is exacerbated by DoD's current emphasis on injecting advanced information technology into the development of future C³I, weapons systems, warfighting concepts, and doctrine.

The APL process mitigates some of the challenges by involving active-duty military officers who provide operational experience and realism, planning functions, and portrayal of the real-world warfighting process with subjective discussion. Additionally, integrating mission-level results into theater-level analysis ensures the proper representation of systems and their effectiveness in the broader Joint warfare context. This process uses state-of-the-art mission and theater modeling capabilities and has been successfully applied in major studies such as the cost and operational effectiveness analysis of the 21st Century Destroyer (DD 21).

THE FUTURE

Advances in several areas are changing the possibilities for the future Joint warfare analysis process:

1. Individual analysis methods and tools are advancing and becoming more sophisticated. Advanced mathematical techniques are becoming automated, facilitating their extensive use in analysis. The more effective implementation of mathematically based decision support tools is becoming available.
2. Advances in information technology are continuing to improve our analysis abilities. Joint warfare analysis

- may in fact become less complex in the future with more innovative, collaborative technology in the analysis tool kit. Network technology, software advances, collaboration techniques, video conferencing, etc., are transforming how analysis can take place. Physical entities increasingly can be represented in virtual space and shared across vast distances by multiple users.
3. Analysis will integrate horizontally across warfare mission areas to consider concurrent, multimission operations. Vertical integration of system- to mission- to theater-level analysis will occur, replacing today's discrete, sequential steps. Parallel processing and distributed interoperable simulation techniques will allow for simultaneous analysis at all levels based on tactical and operational situations.
 4. Visualization will continue to be enhanced as three-dimensional rendering of scenarios and simulation results improve. Sharing three-dimensional representations over wide-area networks and interacting with them in real time will allow analysts and users to apply "what-if" situations more extensively.
 5. Analysis documentation will change as more reports are written on compact disks and disseminated electronically. Some reports will become Web-based and interactive, where readers will be able to alter a subset of input parameters and understand the sensitivity of results to various assumptions. Interactivity and collaboration are the keys to the future of Joint warfare analysis.
 6. The quality of the analysis will improve as advanced methods and tools are applied to the complex problems associated with planning and executing Joint warfare in the future.

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