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Defining Military Experiments

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PREFACE

This paper was prepared by the Institute for Defense Analyses (IDA) for the Joint Staff's Wargaming, Simulation and Assessment Directorate (J-8) under the task order Joint Battle Center Experimentation and Assessment. The study was conducted in response to the task objective "to assist the [Joint Battle Center] JBC in the design and execution of experiments which explore and evaluate new warfighting concepts and supporting C4ISR technology."

The purpose of this paper is to advance and fuel the debate on the meaning of *joint experimentation*. Experimentation supports the process of innovation, a process that can lead to evolutionary or revolutionary change. Our goal here is to provide a point of departure that includes a useful framework, a lexicon, and definitions for the joint experimentation community. Most of the work is oriented towards the idea of the *military experiment* and is equally suited to Service or Joint applications. The material in this document is an extract of a much larger body of work conducted for the same sponsor.

Our J-8 sponsor, Mr. Vincent P. Roske, Jr., has graciously provided the support and latitude to pursue this topic for the larger community. Mr. William "Andy" Rumbaugh of the Joint Battle Center read early drafts and provided thoughtful comments and encouragement.

Several research staff members within IDA took the time to review the many drafts and provide useful guidance in the development of the work. They are Major General Larry D. Budge, USA (ret.); Dr. William J. Hurley; Dr. Richard J. Ivanetich; Lieutenant General Peter Kind, USA (ret.); Colonel Steve McNamara, USAF; Colonel Tom O'Leary, USMC; Colonel Mike Starry, USA (ret.); Lieutenant General Paul K. Van Riper, USMC (ret.); and Mr. Phillip J. Walsh.

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EXECUTIVE SUMMARY

The Department of Defense has recently embarked on a mission to *experiment* with new warfighting concepts and capabilities. It appears that the experiment practiced in college physics labs is serving as the *de facto* model for the military experiment. However, the hypothesis-testing science experiment has little applicability to military experimentation. Three alternative experimental forms better suited to military experimentation are offered in this paper: (1) the field research method, (2) applied research and exploratory development, and (3) applied social research. (Figure ES-1 depicts an overview.)

The *field research method* is employed in the discovery phase of scientific inquiry to determine how a phenomenon works and to generate plausible explanations for why it works. Field research is often conducted in an iterative collect-interpret-collect fashion. Heuristics are questions that guide the investigation and evolve at each iteration.

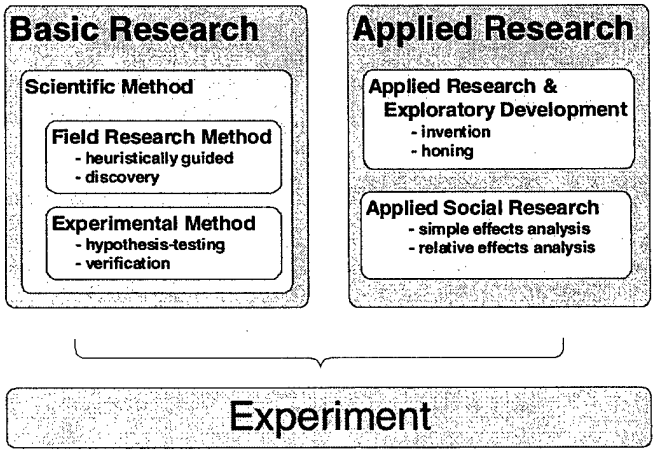

Figure ES-1. Overview

In contrast, inventors and engineers practice *applied research and exploratory development* that culminates in a prototype product. Practitioners often apply theory and intuition through a trial-and-error procedure that terminates when a performance goal is reached.

Social scientists practice *applied social research* to inform public policy makers. One of the important functions of applied social research is the measurement of a program's effectiveness, called simple effects measurement. Another function, relative effects measurement, compares the effectiveness of several programs.

All of these research methods employ experiments. A fourth experimental approach mentioned in this paper, the hypothesis-testing experiment, is the least applicable to military experiments. In contrast, the field research method supports the discovery phase of military experimentation necessary to achieve grand innovations. Applied research and exploratory development is appropriate for inventing a solution. Applied social research is most applicable to guide resource allocation decisions.

The word *experiment* has several meanings. To each community, its own definition is correct. However, the definitions are *correct* only because they are *useful* to that community. The military community should borrow and adapt those definitions that produce the desired results of military experimentation. The following simple definition is offered.

> **military experimentation,** *n.* The process of exploring innovative methods of operation, especially to assess their feasibility, evaluate their utility, or determine their limits.

Having a working definition is useful, but not as important as understanding that military experimentation is a learning process built on discovery and invention far more than it is a hypothesis-testing process that verifies theoretical cause-and-effect relationships.

The word *joint* is used in a variety of contexts. The meaning derived from each context is legitimate, but the variety of meanings makes it difficult—perhaps impossible—to determine exactly what "joint experimentation" might be. Some examples of common usage follow.

- **Joint**: The Joint Staff, unified combatant commands, subordinate unified commands, joint task force headquarters.
- **Joint**: The strategic and operational responsibilities of joint commands.
- **Joint**: Multiple Service or all Service, i.e., a committee of Service representatives with no one in charge.
- **Joint**: An issue of interest to more than one Service, e.g., infantry weapons (or tactics) to the Army and Marine Corps, or strike fighters (or tactics) to the Air Force, Navy, and Marine Corps.
- **Joint**: Service interoperability, e.g., interoperability of Army and Marine Corps ground communications or of Air Force and naval aircraft communications.

Based on statements made by senior leadership within the executive and legislative branches, the following definition is offered for *joint experimentation.*

> **joint experimentation,** *n.* Military experimentation conducted to (a) develop a Service-specific military capability for employment by the Joint Force Commander, (b) develop a military capability without regard to current roles-and-missions boundaries, or (c) to allocate resources across Service programs.

WHAT DOES "MILITARY EXPERIMENTATION" REALLY MEAN?

The Department of Defense recently established *experimentation* as a new military mission.[1] What does *experimentation* mean in a military sense? What does a proper military experiment most resemble, and what are its elements?

The physical, social, and life sciences each use words like *experiment* and *hypothesis* differently. Each community of scientists considers its own definitions *correct* because these same definitions are *useful* for their purposes. Military experimenters should borrow, adapt, and develop definitions that best support their purposes. This paper examines various approaches in search of meanings that are useful for the purposes of peacetime military experimentation.

Scientists involved in the pursuit of new knowledge employ the methods of scientific inquiry. The earliest phases of scientific inquiry are about exploration and discovery and often result in plausible theories; the latter phases are about testing and verifying those theories. The field research method of scientific inquiry employs the *heuristically guided discovery experiment* and the experimental research method is based on the *hypothesis-testing verification experiment.*

Inventors and engineers, rather than pursuing new knowledge, apply available knowledge to develop products for patent or for market. They often apply a trial-and-error procedure in a *goal seeking invention experiment.* Social scientists and policy analysts use a fourth type of experiment, the *performance measuring experiment,* to monitor existing program performance and predict new program performance to inform resource allocation decisions.

THE PURPOSES OF MILITARY EXPERIMENTATION

Calls to transform the United States military come from congressional leaders, senior Defense officials, the Joint Chiefs of Staff, and the academic community. Many believe we are witnessing a "revolution in military affairs" similar to that which occurred between World Wars I and II, and call for experimentation as a means to foster innovation. But a strategy for pursuing a revolution in military affairs, like any strategy, must subordinate means to ends. Neither innovation nor experimentation is the end we are pursuing.

The end to be continuously maintained is a military instrument in the hands of national leaders—an instrument that is suited to the pursuit of our national interests, superior in military effectiveness to our adversaries, and sustainable in peace and war. Evolutionary and revolutionary improvements in effectiveness and efficiency can both contribute to this end; however, some assert that revolutionary change is necessary or at least desirable. The

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[1] Department of Defense News Release 252-98, *U.S. Atlantic Command Designated Executive Agent for Joint Warfighting Experimentation,* May 21, 1998.

end, therefore, is a transformed military instrument containing at least some elements that represent a grand departure from current capabilities. But the end is elusive, continually pursued, and never reached.

Pursuing this end poses a host of difficult questions. What will be the future threats to our national interests? What will be our national security strategy? How will we organize for and conduct military operations? What new military capabilities should we develop? Which current capabilities should we embrace and which will we abandon? How should we allocate scarce resources among a seemingly endless array of competing alternatives? The process underwriting the transformation strategy is, then, one of acquiring the knowledge necessary to answer these questions. *A fundamental purpose of military experimentation is the acquisition of knowledge to guide decisions about an uncertain future.*

Every experiment should be designed to produce information that eventually informs a decision. But different decisions require different information. What information should be generated and gathered? While data collection plans are dictated by each specific experiment, certain useful generalizations can be made, depending on the type of experiment and its purpose. Figure 1 suggests several objects of experimentation.

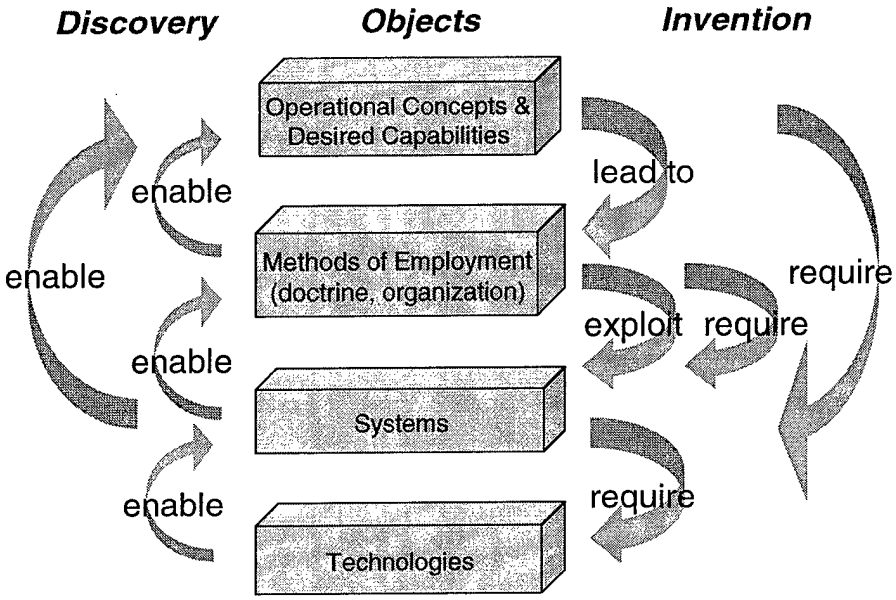

Figure 1. Experimentation Supports Both Discovery and Invention

Volumes have been written recently on military innovation, particularly in the period preceding World War II.[2] In this body of literature, it is commonly asserted that during times of relative peace, methods of employment (strategies, doctrines, tactics, techniques, procedures, and organizational arrangements) do not keep pace with technological advances. The inability of either side to fully exploit technological advances in World War I, for example, is offered as one explanation for the sluggish and costly stalemate that ensued. In World War II, both sides incorporated the significant technological advances of the interwar period, and then forced a dramatic acceleration as new methods of employment were attempted and rapidly adopted, adapted, or discarded in response to combat outcomes.

Actual combat is the most demanding and unforgiving laboratory for military experimentation with tools and techniques. There is survival for those who succeed and crushing defeat for those who fail. An important goal of military experimentation in peacetime, then, must be to develop employment methods that keep pace with and fully exploit the ever-changing tools of war. The results may vary according to the magnitude of the departure from past practices: the so-called revolutionary and evolutionary innovations. The role played by the military experiment varies considerably, depending on the magnitude of innovation attempted.

The fundamental value of a military experiment is that it provides the opportunity to observe military phenomena empirically—to learn by doing without the attendant costs of war. Military experimentation is therefore a process of exploration and discovery. Any experiment ought to permit the observation of military phenomena to support the higher purpose of keeping tactics, techniques, and procedures abreast of technological advances—exploiting technology through methods of employment.

RESEARCH METHODS

It is useful to make a distinction between *basic research* and *applied research.* Basic research is undertaken in pursuit of knowledge for the sake of the knowledge itself. Scientists employ the methods of scientific inquiry to develop a body of knowledge or theory. Applied research, on the other hand, applies knowledge to a problem of practical significance, perhaps developing new knowledge along the way. This form of research is commonly practiced by inventors, engineers, and public policy analysts, albeit differently. The social scientist typically is concerned with understanding social problems and informing public policy. In contrast, elements of the private sector employ applied research in the early stages of bringing a product to market.

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[2] See, for example, *Military Innovation in the Interwar Period*, W. Murray and A.R. Millett, eds., (New York, NY: Cambridge University Press, 1996).

The Methods of Basic Research and Scientific Inquiry

An initial finding in the research leading to this paper is that the scientific experiment as taught in undergraduate physics and chemistry is being taken by many as the model for military experimentation. Much of what is written about military experimentation includes discussion of hypothesis formulation and testing, control of independent variables, and trials of sufficient numbers to provide statistical significance and inference. We believe this type of scientific experiment has little applicability or utility to those conducting military experiments, or to the decision makers who must act on their outcomes.

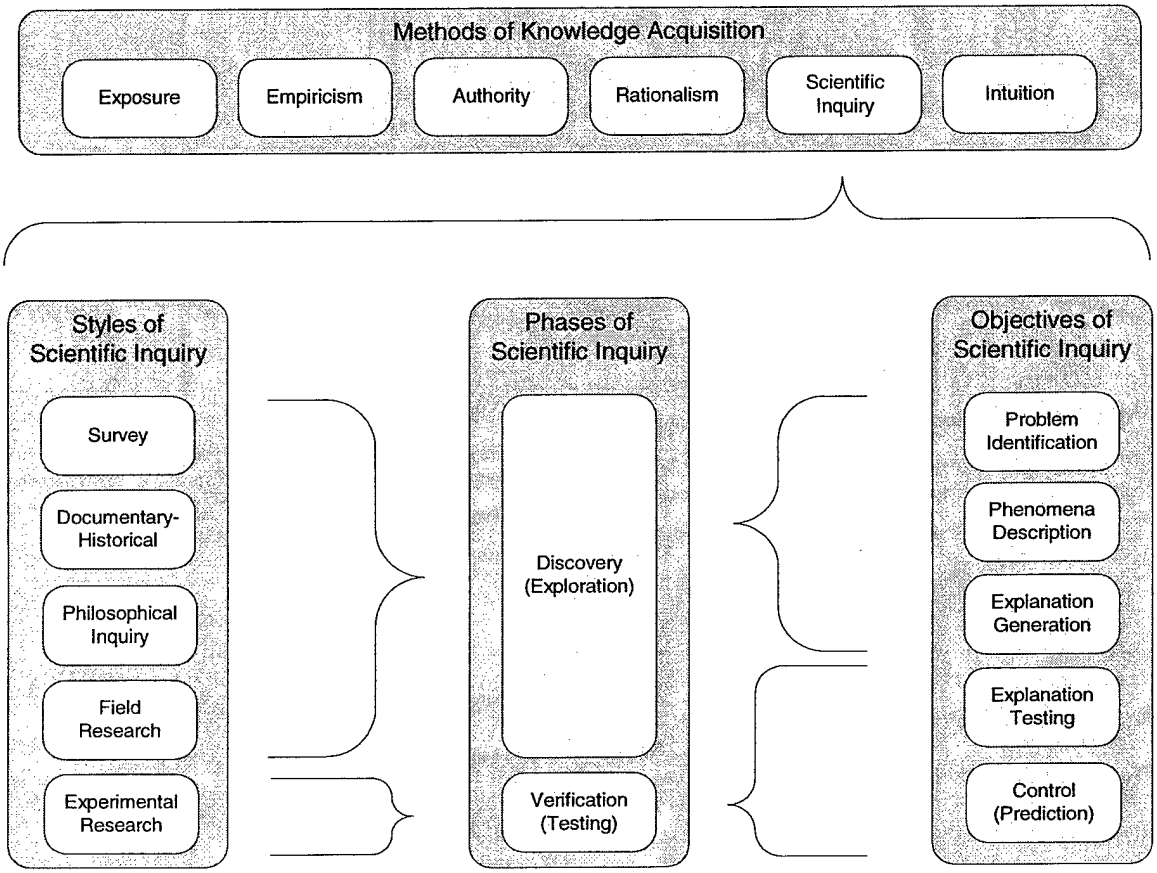

Figure 2. Knowledge Acquisition and Scientific Inquiry[3]

Figure 2 above depicts scientific inquiry as but one of the methods of knowledge acquisition. Scientific inquiry has two phases—discovery and verification—with the preponderance of effort devoted to the first. The lower half of the figure adequately describes the methods of basic research.

[3] Adapted from *Experimental Methodology*, 7th ed. by L.B. Christensen (Boston: Allyn and Bacon, 1997).

The discovery phase of scientific inquiry has three aims. The first is to identify a problem worth solving. Problems abound, but identifying problems that are worth solving *and* amenable to solution by scientific methods eliminates many candidates from consideration. The second aim is to describe phenomena accurately. A good description portrays some phenomenon as it is observed, identifies the variables at work in the phenomenon, and identifies the degree to which each variable participates. The third aim is to develop one or more plausible explanations of *why* the phenomenon occurs, i.e., what *causes* it.

The objectives of the verification phase are different from the discovery phase. Alternative explanations are tested using scientific methods to confirm causality, test theory, and establish predictability. Successful explanations, or theories, allow the scientist to predict an outcome based on the values of independent variables—to accurately anticipate an event prior to its actual occurrence. Control, in this context, refers to the ability to control outcomes (dependent variables) by specific interventions (manipulation of independent variables), and implies the ability to generalize from the experiments.

In addition to a number of objectives, there are several styles of scientific inquiry. The hypothesis-testing scientific experiment is part of the *experimental research method* and is used to support the verification phase. Thus, a focus on the hypothesis-testing experiment excludes most methods of knowledge acquisition, the discovery phase so critical to scientific inquiry, most objectives of scientific inquiry, and most styles of research. We believe this exclusion, which is implicit in many current military experimentation documents, is unintentional and counterproductive.

The *field research method* is far better suited to the discovery phase than the experimental research method with its hypothesis-testing experiments. In field research as practiced in the social sciences, the scientist poses one or more questions for which he or she has no confident answers, and a case study (with embedded experiment) is proposed that might provide answers. The experiment might be based on already-recorded empirical data, such as training data or analysis of actual military conflicts. It may be based on the results of simulation, an experiment embedded in real-world operations, or a field experiment might be designed specifically to generate the data. In any case, the experiment is designed to provide answers to specific questions. A good experiment might generate more questions than it answers, and likely will require that a new case study be designed to answer the new questions posed. These constantly evolving questions are called *heuristics,* and this approach to the acquisition of knowledge is called *heuristically guided investigation.*

This formulation—experimentation as a heuristically guided investigation to support discovery—is at odds with the apparent definition provided by the hypothesis-testing experiment employed to verify theories as part of the process of scientific inquiry.

The Methods of Applied Research and Exploratory Development

Scientists conducting basic research are not the only community that experiments. Engineers and inventors also experiment but use a different procedure. While scientists

tend to pursue new knowledge through basic research, inventors and engineers pursue solutions to practical problems through applied research, often based on trial and error. From this distinction, one might correctly conclude that some military experiments would be more like those of engineers than of scientists.

Applied research and exploratory development do in fact offer useful analogies for military experimentation. Those involved in applied research and exploratory development employ an iterative trial-and-error procedure that terminates when the performance goal is achieved. To prove a concept, applied research may conclude with the exploratory development of a prototype product. Bringing a new military capability into being bears considerable resemblance to bringing an innovative product to market. Clearly, this type of experimentation has military application.

The Methods of Applied Social Research

Another type of decision that requires the acquisition of knowledge is concerned with allocating scarce resources among competing programs. Decision makers need experiments formulated to provide the necessary information. Experiments could be designed to measure the *potential* utility of proposed capabilities or the *actual* utility of newly developed capabilities. Social scientists are well practiced in this type of experiment in their attempts to inform government actions.

Public policy is implemented through a variety of programs. Negative symptoms tend to focus public debate, and policy objectives are formulated to counter or reverse symptoms. Based on theoretical cause-and-effect relationships, interventions are proposed to achieve policy objectives. Programs are funded that implement the interventions. Empirical evidence is collected from ongoing programs.

Table 1. Applied Social Research Questions[4]

Type	Examples
descriptive	What methods are being used to treat drug addiction? What percentage of addicts receives treatment?
normative	Are treatment programs performing adequately? How well managed are treatment programs?
correlative	Is there a correlation between arrest and treatment? What is the relationship between treatment and subsequent arrest?
simple effects	Does participation in a treatment program lower recidivism?
relative effects	Which type of treatment is most effective in lowering recidivism?

[4] Derived from *Applied Research Designs: A Practical Guide*, T.E. Hedrick et al. (Thousand Oaks, CA: SAGE Publications, Inc., 1993).

Applied social research questions tend to be *descriptive*, *normative*, *correlative*, or *effects* related. Table 1 above provides examples of the kinds of questions addressed by social scientists. Examples are taken from the domain of national drug policy. Capping this set of questions is "What is the best mix of programs?" Collectively, these questions are quite similar to the questions that drive military force structure analysis.

Summary of Research Methods

In short, there are several communities whose methods offer analogies for military experiments (see Table 2 below). Basic research methods used in the pursuit of knowledge include both heuristically guided discovery and hypothesis-testing verification. Inventors and engineers use applied research and exploratory development to address practical problems, employing a goal-seeking, trial-and-error procedure. And social scientists use applied social research methods in measuring the effects (intended or unintended) of government interventions (planned or implemented).

Table 2. Broad Categories of Experimental Forms

Driving Principle	Dominant Procedure	Purpose
heuristic guiding	exploration/investigation	discovery
hypothesis-testing	multiple, controlled trials	verification
goal seeking	trial and error/honing	invention
effects measuring	operational evaluation	resource allocation

ADAPTING EXPERIMENTS TO MILITARY PURPOSES

The previous section surveyed the experimental methods of non-military communities for useful analogies. This section adapts and applies those analogies to the purposes of military experimentation. Three broad categories are considered: measuring the effects of proposed or newly fielded capabilities, improving current practices, and innovating in grand fashion.

Measuring Effects

There is no shortage of ideas, but which ideas offer the greatest payoff? Fiscal realities dictate that not all meritorious proposals will be pursued. The surest and most accurate way to evaluate a capability's *actual* effectiveness would be to build the systems required to implement it, try them, and then decide whether to put the systems into production and fielding. For any but the simplest systems, this approach is prohibitively expensive in terms of both time and money. A more affordable but less accurate approach is to build a model (in the loosest sense) of the necessary systems and capability, measure the capability's

potential effectiveness, and then decide whether to invest in the research and development necessary to field the supporting systems and the desired capability.

These two approaches require different tools. Measuring effects in the field can only be conducted with real equipment and forces; the demand here is for instrumented ranges and at least production-representative systems. Measuring actual effects is most closely approximated by traditional operational test and evaluation. Measuring potential effects employs wargames, analytic models, human-in-the-loop simulations, and field exercises using real equipment and surrogates. All of the supporting tools have limitations—but all have a contribution to make.

Experiments conducted as field exercises, particularly large ones, are not repeatable in the rigorous sense and, in any case, are too costly to repeat. They appear to enjoy greater credibility than computer simulations but less credibility than empirical evidence derived from actual warfare. Computer simulations allow the large numbers of trials necessary to generalize, but suffer from lower credibility. The results of computer simulations are rarely referred to as empirical evidence. Some combination of these tools—capitalizing on the strengths of each while offsetting their respective weaknesses—is probably the best approach.

The purpose of this type of experimentation is to measure performance. The emphasis is on determining performance measures—designing an experiment that generates the necessary data, and collecting and interpreting the data—and not on testing hypotheses derived from an underlying theory of the phenomenon.

Improving Performance and Overcoming Deficiencies

All current military capabilities can be improved, but some deficiencies are more glaring than others. Poor performance in combat or in training may point out a deficiency; or a new weapon or information system dropped into current organizations and doctrine may introduce an opportunity to improve performance. If a capability already performs close to its desired goal, then we are "honing." Honing takes place naturally as part of daily operations and training. If a capability is far from its desired goal, then we are engaged more in an invention process. The distinction is the degree of freedom applied to varying the independent variables.

For this type of military experiment, methods of employment serve as independent variables and explicit performance measures serve as the dependent variables. A trial-and-error procedure is applied until a specified goal is reached. The experiment design must state *measurable goals* and provide a data collection plan accordingly; stating a *hypothesis* serves no purpose.

Reducing fratricide in close operations is a good example. We already know how to conduct coordinated air-ground operations in the close fight, but experiments might be conducted that vary tactics, techniques, and procedures (independent variables) and measure the effects on fratricide, lethality, and survivability (dependent variables).

Innovating in Grand Fashion

Grand innovations represent a significant departure from previous practice. With grand innovation, one thing we can state unequivocally is that *we don't know what we don't know.* An essential purpose of experimentation is to provide the opportunity to observe military phenomena, to learn something about that which we don't know, and to generate questions. We may have a difficult time identifying the questions for the initial experiment in a heuristically guided investigation. Thus, the first experiment might be conducted to generate an initial round of questions. Other experiments might follow that answer those questions and generate new ones. *Heuristics* are needed, not hypotheses.

At some point, the heuristically guided investigation gives way to an invention process and heuristics give way to measurable goals. The invention process is goal seeking. Only after a capability is "invented" should it be subjected to evaluation. The evaluation phase is most analogous to the effects-measuring experiment of applied social research. Once implemented and fielded, the process of improving capabilities takes over. Grand innovation requires the entire spectrum of experimentation types described in this paper.

Even after a new grand capability is demonstrated, it cannot simply be handed over to operational commands, nor can operational commands immediately begin to *train to standards* with the new capability. They must have the opportunity to learn how and when to employ the capability and to learn its limits.

The scholarly examination presented in *America's First Battles, 1776–1965*,[5] leads quickly to the conclusion that "more glaring than poorly trained troops as a first-battle problem is the weakness of command-and-control." The authors go on to attribute this weakness to "inadequate preparation of commanders and staffs for the real world of combat." Military trainers have taken these admonitions to heart and have structured training programs to provide commanders and staffs with "first battle" experience in peacetime and in a benign environment. Training is the correct method for teaching leaders and organizations how to employ proven methods, but training is inadequate to the task of developing and learning how to employ methods unproven in combat. Experimentation must be the precursor to training.

In wartime, technological advances accelerate as more resources are allocated to research and development, and exploitation methods are hastily developed and honed in combat. Necessity is truly the mother of invention. Peacetime military experimentation must take the place of wartime experience; otherwise, first battles will provide the learning environment at unacceptably high cost.

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[5] *America's First Battles, 1776-1965,* C.E. Heller and W.A. Stofft, eds., (Lawrence, Kansas: University Press of Kansas, 1986).

WHAT'S DIFFERENT ABOUT JOINT EXPERIMENTATION?

The discussion so far is equally applicable to experimentation within a single Service as it is to joint experimentation. It is the purpose to which the results of experiments are put that distinguish joint from Service experimentation. Joint experiments are conducted for one or more of the following three purposes.

- Developing Service-specific military capability for employment by the Joint Force Commander.
- Developing military capability without regard to current roles-and-missions boundaries.
- Allocating resources across Service programs.

It is difficult to imagine designing a single experiment that could achieve all these purposes simultaneously. More to the point, various decision makers within the joint experimentation community have significantly different objectives in mind. All these decision makers have legitimate information needs, and it is unlikely that they will all be equally satisfied by a single experiment or even a single type of experiment.

Depending on the magnitude of departure from current practice, developing military capability will be adequately supported by the methods supporting grand innovation or capability improvement. Given that the Services hold the purse, who will develop military capability independent of current Service roles-and-missions boundaries?

Institutionally, a single Service may be able to decide how to allocate resources across its own programs—that is, to pick winners and losers—by conducting evaluative experiments. Deciding how to allocate resources among the Services is another matter. The Services that must pay for the experiment do so at the risk of losing a favored program. Who will manage, fund, and evaluate cross-Service experimentation?

In addition, the word *joint* is used in a variety of contexts. The meaning derived from each context is legitimate, but the variety of meanings makes it difficult—perhaps impossible—to determine exactly what "joint experimentation" might be. Some examples of common usage are listed below and depicted in Figure 3.

- **Joint**: The Joint Staff, unified combatant commands, subordinate unified commands, joint task force headquarters.
- **Joint**: The strategic and operational responsibilities of joint commands.
- **Joint**: Multiple Service or all Service, i.e., a committee of Service representatives with no one in charge.
- **Joint**: An issue of interest to more than one Service, e.g., infantry weapons (or tactics) to the Army and Marine Corps, or strike fighters (or tactics) to the Air Force, Navy, and Marine Corps.
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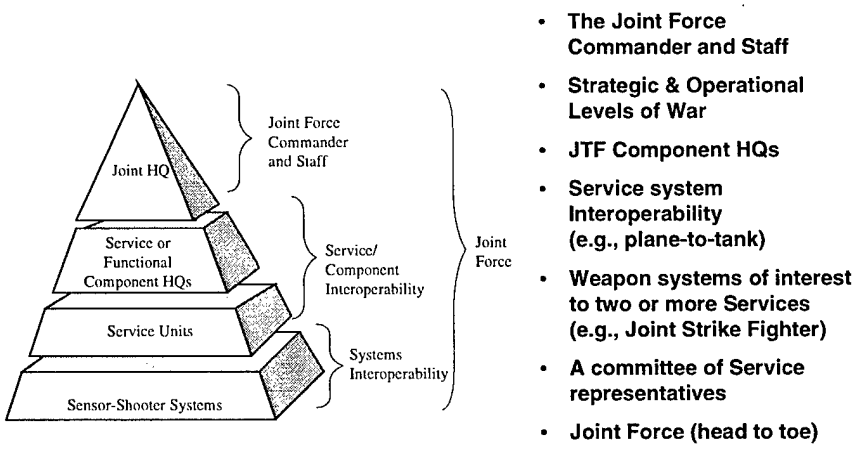

Figure 3. The Many Meanings of Joint

No amount of analysis will determine which of these definitions should apply when we talk of joint experimentation. However, senior decision makers in the legislative and executive branches must come to an understanding of what *joint* means in *joint experimentation*. In all likelihood, no single definition will suffice. Appropriate definitions of joint experimentation, as suggested by the above taxonomy, should be determined case by case. As objects of experimentation, methods of employment should be strongly favored over systems.

CONCLUSION

In summary, the word *experiment* means many things to many people. To each community that conducts experiments, its own definitions are correct. However, these definitions are *correct* only because they are *useful* to that community. The military community need not select one definition. Rather, it should borrow, adapt, and develop definitions and frameworks that produce the desired results of military experimentation. The following simple definition is offered.

> **military experimentation,** *n.* The process of exploring innovative methods of operation, especially to assess their feasibility, evaluate their utility, or determine their limits.

Of course the actual definition is not as useful as understanding that military experimentation is a learning process—one which supports discovery and invention as shown in Figure 1—far more than it is a hypothesis-testing process that verifies theoretical cause-and-effect relationships.

Grand innovation is best supported by two phases of experimentation. The first requires experiments that support discovery and exploration that culminate in greater insight and in at least one promising solution approach. The second phase requires experiments that support invention that possibly produce a prototype capability. By contrast, improving

existing military capability requires experiments that support invention and honing of performance. Resource allocation decisions may be required to field innovative capabilities, and those decisions may be properly supported by experiments measuring simple and relative effects.

Based on statements made by senior leadership within the executive and legislative branches, the following definition is offered for *joint experimentation.*

> **joint experimentation,** *n.* Military experimentation conducted to (a) develop a Service-specific military capability for employment by the Joint Force Commander, (b) develop a military capability without regard to current roles-and-missions boundaries, or (c) to allocate resources across Service programs.

Military and joint experimentation are important topics discussed at the highest levels of government, yet it is not at all clear that participants in the discussion are talking about the same things. Agreement on the meaning of these important terms is a necessary step in maintaining the current momentum across the spectrum of government decision makers.

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13. ABSTRACT (Maximum 200 words)

DoD recently established experimentation as a new military mission. Experimentation supports innovation, transformation, and the revolution in military affairs. However, experimentation, in a military context, is not adequately defined. DoD documents, congressional speeches, and scholarly literature on the topic have been examined for meaning and intent. Scientific texts on both basic and applied research have been examined for more general and formal definitions. Four models for military experiments are presented: (1) the hypothesis-testing laboratory experiment practiced by physical scientists, (2) heuristically guided experimentation from the field research method practiced by behavioral, social, and life scientists, (3) the goal-seeking experiment practiced by engineers and inventors that results in prototypes or patents, and (4) the performance-measuring experiment as conducted by social scientists and policy analysts. Of the four, the hypothesis-testing experiment appears to be serving as the *de facto* model for military experimentation, yet it has the least utility in fostering innovation and a revolution in military affairs.

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