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UNIT TRAINING IN THE GULF WAR

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PREFACE

This paper was prepared for the Office of the Under Secretary of Defense (Personnel and Readiness) under a task entitled "Impact of Training Resources on Force Readiness." The objective of this effort was to develop information on the training and performance of Service and Joint units prior to and during the Gulf War that can be used to provide guidance for planning Service and Joint training for combat. Technical cognizance for this task was assigned to John J. Walsh, OUSD (P&R).

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Much of the information presented in this paper is based on interviews conducted with many individuals who participated in the Gulf War and provided records about that conflict. We acknowledge, with appreciation and respect, the assistance provided. The names of those who helped us are cited in Appendix A, and we apologize to any who may have been overlooked. Lee Ann Miller contributed substantial skill and patience throughout the development of this paper.

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SUMMARY

A. SCOPE

The purpose of this study was to determine what link can be made between the training of American units before and during Desert Shield, and the actual performance of those units in the Gulf War. We addressed three questions:

- What does the evidence show about training for the Gulf War?
- What does the evidence show about a link between training and performance in training?
- What does the evidence show about a link between training and performance in combat?

We looked for data on the types and amounts of training U.S. units accomplished before and during Desert Shield, on the performance that those units demonstrated during training, and on their actual performance in combat. We looked for these data because we believe that if we know how much and what kinds of training led to our dramatic victory, we will be better able to decide what type of training works and why, and, therefore, how to allocate resources for training in the future. We believe that this kind of understanding will put us in a stronger position to assess the readiness of existing forces and to budget more realistically for tomorrow's readiness.

This paper describes our efforts and the data we assembled. Our efforts on the Army, Navy, and Air Force were extensive but less so on the Marine Corps. We offer conclusions and make recommendations for the collection of data in the future, both in peace and war.

B. FINDINGS

1. The Services produce voluminous records on training accomplishments.

Military units produce training plans and maintain data on training accomplishments. Army units produce training plans and track individual training, individual and crew weapons qualification scores, and unit training assessments. Navy units produce

records of OPTEMPO (Operating Tempo), of training events accomplished, and of certification scores. Air Force units retain data on numbers and types of training sorties flown by individuals and units.

2. Data on performance during training are not saved and assembled centrally; conversely, the available data have limited value for training assessment.

The Army assesses performance in the course of training individuals and units. If we could retrieve the data that Army units produce in assessing unit performance, and on the types and amounts of training of those units' members, we might be able to assess the effects of training on performance, and thus on the state of training readiness. However, our review of Army records from the Gulf War period revealed that such data were not saved.

The Navy keeps track of training accomplishments and assesses the performance of individuals and units. Recent improvements in data keeping should make information on assessment available in the future.

Although the Air Force assesses performance in the course of training individuals and units, most of the data that are saved describe only the number and types of training events and sorties, but not the results of the training. Thus, despite assembling an enormous database on pre-war operations and training, we found little data that could be used to analyze the performance of individuals, or to assess unit performance in light of unit training.

We found extensive information in the form of "grades" given by the Air Force for unit performance in operational readiness exercises and inspections prior to August 1990. Unfortunately, these data are often incomplete and would not, in any event, permit us to examine the effects of different amounts and types of training on performance in combat exercises. Nor is it possible to relate these grades to the training and/or prior experience of the individuals who comprise a unit.

3. U.S. forces trained well at the individual and tactical levels.

In the course of our research, we interviewed many members of all the Services. Over and over again, their accounts provide strong and credible evidence that U.S. units trained in an extensive and conscientious manner, particularly at the individual and tactical

levels (i.e., Army battalions, Air Force squadrons, and Navy ships and squadrons and below).

4. U.S. forces performed remarkably well in combat.

During every phase of the war, U.S. forces performed remarkably well. A stunning feature of their performance in this war is the extent to which potential human mistakes did not occur. For example, in the course of thousands of sorties flown by the air arms of all the Services and of our allies, and the myriad aerial interactions needed to refuel in the air and assemble to conduct raids on the enemy, the absence of mid-air collisions is notable.

5. Apart from believable anecdotal evidence, we have little data on combat performance at the tactical level.

We did not find the data needed to relate prior training to combat performance. We have no data with which to compare the performance of different units during combat training. We did not find the nugget needed to confirm our goal to "Train as you fight and fight as you train." We were able to collect a limited amount of data on Navy air strikes on bridges and on Air Force air strikes on targets by F-117s with precision guided bombs. These data, which are still incomplete, may allow us to examine the link between training and combat performance in these two specific cases.

6. Even if we had good data on training, we would not be able to relate training to combat performance.

We need to devise procedures that will ensure that all of the Services produce, save, and assemble data on performance in combat. We need also to take steps so that we can then relate that combat experience to the training of the units that took part.

7. U.S. forces did not systematically train high level component and joint staffs.

We were unable to find any useful data on the training of high level component and joint staffs. Our interviews suggest that high level component and joint staffs developed and revised many battle plans but did little training on how they might conduct those missions against an opposing force. It appears that what joint, high-level staff training was conducted did not force the Services to resolve such inter-service issues as the Fire Support

Coordination Line and the Air Tasking Order or the weaknesses in staff performance that contributed to the escape of the Iraqi forces.

8. Pre-deployment and post-deployment training was ad hoc.

All Services conducted both pre-deployment and post-deployment training although there were few plans for such training. We believe that both the pre-deployment and the post-deployment training were helpful in increasing the combat capability of U.S. forces but might have been better and more efficient had pre-war plans included provisions for this training.

B. CONCLUSION

The DoD did not retain and assemble the data needed to permit systematic examination of the effect of combat training on combat performance. The absence of such data limits the ability of the DoD to use the pre-war and wartime experience of the Gulf War to improve our methods of training and to determine the efficient allocation of resources to future training. Analysts cannot use that experience for insights into:

- More accurately assessing the readiness of today's forces, or
- More efficiently budgeting for tomorrow's forces.

C. RECOMMENDATION

The Services and CINCs should collect, retain, and use accomplishment and performance data in all forms of operations—training, war, and operations other than war

The Services and CINCs should collect, retain, and interpret data on the accomplishments and performance of Service and Joint units and organizations in all forms of operations—training, war, and operations other than war. A common format should be used to collect such data. It appears reasonable and feasible to use the structure of the Universal Joint Task List as the format for organizing the data. Using this format, accomplishment and performance data would generally be referenced to the tasks that were conducted; performance data would include both objective measures, such as scores on gunnery, and subjective measures, such as assessments of the degree to which a task was performed to standard and the commander's assessment of performance quality. Collecting these data will enable the Services and CINCs to determine the effectiveness of various

types and amounts of training on performance in peace, in war, in operations other than war, and to assist in the allocation of resources to training to assure readiness.

Although the Services and CINCs already collect much of this training data, they need to ensure that such data are accessible for review and interpretation and to detect trends in readiness. They should establish procedures and practices for collecting and retaining data on training accomplishments and performance during the pre-deployment phase for a war or operations other than war (e.g., the training conducted prior to and during Operation Desert Shield, as well as prior to deploying to Somalia and Haiti).

The Services and CINCs should also establish procedures and practices for collecting and retaining accomplishment and performance data in war and operations other than war. Such operational data are essential if a link is to be made between training and operations. Proposed changes might include the following:

- Collect the data as part of the lessons learned system. Ensure that the data needs and collection practices are established in advance and that the responsible commanders are committed to collect the necessary data. A system for objectively evaluating performance in a consistent fashion will have to be developed.
- Take advantage of advances in computer and communications technology to collect as much data as possible with embedded systems that can automatically collect and transmit the data.

Since this recommendation applies to all Services and CINCs, a working group should be established with representation by all concerned to encourage compatibility of database structures and the exchange of information relevant to Joint activities.

NOTE

After this paper was completed, the U.S. General Accounting Office issued a report[1] with the following findings:

> The Marine Corps, the Air Force, and the Navy have not established effective procedures to ensure that all significant information from training exercises and operations is submitted to their lessons learned programs. As a result, these programs are missing important information that could be useful to others (p. 3).
>
> Despite lessons learned programs in the military services and the Joint Staff, units repeat many of the same mistakes during major training exercises and operations. Some of these mistakes could result in serious consequences, including friendly fire incidents and ineffective delivery of bombs and missiles on target. As a result, the services and the Joint Staff cannot be assured that significant problems are being addressed or that resources are being used to solve the most serious ones.
>
> The programs have not achieved effective results for different reasons.
>
> - The Marine Corps, the Air Force, and the Navy do not include all significant information from training exercises and operations in their lessons learned programs.
> - The Joint Staff and all of the services, except the Army, do not routinely analyze lessons learned information to identify trends in performance weaknesses.
> - The Air Force does not ensure that lessons learned information receives the widest possible distribution.
> - The Air Force, the Navy, and the Marine Corps do not ensure that lessons learned information is being used to its fullest potential.
> - The services and the regional commanders in chief have not implemented adequate remedial action processes to follow up and validate that problems have been corrected (p. 2).

[1] U.S. General Accounting Office. *Military Training: Potential to Use Lessons Learned to Avoid Past Mistakes is Largely Untapped*, Report to the Chairman, Subcommittee on Military Personnel, Committee on National Secretary, House of Representatives. GAO/NSIAD-95-152, Washington, DC, August 1995, p. 2-3.

I. INTRODUCTION

A. BACKGROUND

In January and February 1991 the United States and its allies achieved a historic victory against the forces of Iraq that had seized the nation of Kuwait and were holding its people and resources hostage. The war itself and the reasons for its successful conclusion have been the subject of many subsequent reviews. Many people argue that the Revolution in Military Technology was the principal cause of our victory. Others argue that it was mainly the fighting qualities of American men and women and their generals that led to the victory. Still others argue that Iraqi incompetence was the major factor. None of these reviews directly addresses the impact of either individual or unit (collective) training on the victory. In this study we attempted to determine if a link can be made between the training American units received and exercises conducted prior to the war and the performance of those units during the war. We tried to answer three questions:

- What does the evidence permit us to say about training for the Gulf War?
- What does the evidence permit us to say about the link between training and performance in training?
- What does it permit us to say about the link between training and performance in combat?

We based our research on the hypothesis that the linkage between training and performance can be described as an input-process-output model. In this model the trainees, the trainers, and the training resources comprise the inputs. The process is simply the ways in which the inputs are used to train individuals and units. The output (i.e., the product) can be measured in several ways. Most often it is measured, or at least described, in terms of types of training accomplished and by amounts of training accomplished. A more useful measure of output would be in terms of performance in training—in an exercise, for example—or performance in actual combat or other type of military operation.

To that end we have attempted to collect data (1) on the types and amounts of training US. units actually accomplished during the pre-Desert Shield period of 1990 and during Desert Shield before the war and (2) on the quality of performance those units

demonstrated in training and their actual performance in combat. We sought to collect these data because we believe that if we know how much and what kinds of training led to our dramatic victory, we will be better able to allocate resources to training. We also believe that this kind of understanding will put us in a stronger position to assess the readiness of existing forces and to budget for tomorrow's readiness expenditures.

B. CHRONOLOGY OF KEY EVENTS

To provide a frame of reference for the training that took place both before and after the crisis developed in the Gulf, we offer the following chronology of key events.

July 1990[1] Saddam Hussein publicly threatens war with Kuwait and the United Arab Emirates for exceeding OPEC production quotas and driving down the price of oil. In its annual Global War Game, the Naval War College includes an attack by Iraq on Kuwait and Saudi Arabia. USCENTCOM issues a warning concerning Iraqi intentions and conducts a command-post exercise of its draft operational war plan.

2 August 1990 Three Republican Guard Divisions cross the border and converge on Kuwait City. President Bush freezes Iraqi assets and bans imports from Iraq. The UN demands the unconditional withdrawal of Iraqi forces. The United States orders the Independence Carrier Battle Group to deploy to the North Arabian Sea and two KC-10s to Diego Garcia.

3 August 1990 President Bush declares a National Emergency.

6 August 1990 The UN calls for restoration of Kuwaiti sovereignty and an embargo on Iraq.

7 August 1990 President Bush orders deployment of U.S. forces to Saudi Arabia; Operation Desert Shield starts the next day.

August–November 1990 U.S. forces build up.

8 November 1990 President Bush orders an additional 150,000 air, sea and ground troops to the Persian Gulf.

29 November 1990 The UN Security Council votes to use force against Iraq unless it withdraws unconditionally from Kuwait and releases all foreign nationals by 15 January 1990.

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1 This chronology is based on information presented in GWAPS, 1993, Volume V, Part II.

12 January 1991 Congress grants President Bush the authority to go to war against Iraq.

16 January 1991 (Greenwich Mean Time, 17 January in local Saudi time) Desert Storm starts as coalition forces strike targets in Iraq.

24 February 1991 The coalition begins the invasion of Kuwait and Iraq.

28 February 1991 The cease fire goes into effect after 100 hours of ground combat. The crisis lasted 205 days; hostilities lasted 43 days and the ground war lasted 4 days. Some of the Iraqi forces escaped destruction.

II. METHODS

A. ARMY

We searched Gulf War records of the Army for information related to training conducted at home stations and in Saudi Arabia prior to the start of the ground war. We also searched for records of unit performance both in training and in combat. We hoped to find extensive quantitative information on individual and unit training, and on performance in training. We hoped also to find some systematic evaluations of unit performance in training and in combat.

We began our research by going to the Combined Arms Center (CAC) at Fort Leavenworth, Kansas, and discussing our project with the experts at the Center for Army Lessons Learned (CALL) and the office of the CAC Historian. Both of these organizations had collected large amounts of information from the Gulf War. CALL had been responsible during the war for keeping track of lessons learned and had written the major study of lessons learned from the war.[1]

During our first visit to Fort Leavenworth, in October 1993, we discovered that the Army study of lessons learned focused on the seven Army Battlefield Operating Systems,[2] but neither training nor performance per se are among them. As a result, this report and the data base that supported it had virtually nothing to say about either training or performance. It quickly became apparent that the CALL had not been directed to collect data on training or on performance and, accordingly, had not collected any data on our subjects of interest.

Next, we visited the office of the CAC Historian, who was responsible for collecting all the unit records from the Gulf War and placing them into an electronic database, the Army Historical Archive System (AHAS), so they could be made available to the entire defense community. At the time, most of these data had been catalogued, but none had been placed in the AHAS. The data were accessible only by searching through

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[1] This study effort was commanded by MG Thomas Tate, and the study is sometimes known as the Tate Report. It was never distributed outside the Army.

[2] Army Battlefield Operating Systems are command and control, maneuver, fire support, air defense, intelligence, logistics, mobility and countermobility.

the written indexes and reviewing the hard copies of the documents. On several visits we reviewed all the Gulf War documents in the collection. (See References.) Although we discovered some information on unit training, we found virtually no useful training data and no performance data. After further discussions with Army experts, we concluded that we were not likely to find the data we needed in existing collections and we began a systematic search to find people who had been in the war and who might be able to give us additional data.

During this phase of the study, we interviewed people who had been involved in training Army forces for the war; the individuals with whom we conducted our major interviews are listed in Appendix A. These interviews proved to be the most productive source of information on Army training. From them, we learned first hand what training many units had conducted both in their home station and in Saudi Arabia before the war. Unfortunately, the descriptive data we obtained was insufficiently detailed to provide an objective basis for systematic analysis. None of our interviewees was able to provide comparable performance data.

We also visited several units to determine if they had additional training records from the Gulf War period, but our search was unsuccessful. Units apparently did not retain these records when they returned from the war. Our final research effort was to review as many reports and books on the Gulf War as we could find. Although many of these books described Army training in general terms and Army performance in heroic terms, none of these sources provided the kind of data on either training or performance that we were searching for.

B. NAVY

The most comprehensive analysis of Desert Storm operations and pre-war training we found was a study by the Center for Naval Analyses (Perla, 1991; Brown, Gibson and Marcus, 1991). We used CNA data on Carrier Battle Group (CVBG) training prior to and during Desert Shield. These data describe the "training workups" of the six CVBGs that participated in Desert Storm, and explain which training events were shortened (or "compressed"), and which were canceled altogether. It provides information on which CVBGs operated with the same escorts they had worked with in training, and which were assigned different escorts. From the Navy Sea Logistics Center, we also collected and analyzed flying hour data for the CVBG air wings for the 5 months prior to the commencement of Desert Storm strike operations.

We obtained information from CNA on the wartime operations of the CVBGs that participated in the war. The performance-related data included bomb damage assessments for Navy airstrikes on bridges (3 percent of total Navy airstrikes) (Brobst, et al., 1994), Status of Resources and Training System (SORTS) reports, and Mission Capable Rates for the CVBG air wings.

C. AIR FORCE

The Air Force collected a great deal of data on pre-Desert Shield training, pre-war Desert Shield training and operations, and Desert Storm operations, but these records rarely contained performance information, let alone data that would enable us to link training to performance. We collected records on Air Force training from numerous sources: the statistical appendices to the Gulf War Air Power Survey (GWAPS) and the Wing Histories for a sample of eight Air Force deployed wings. This search included physical reviews of individual and unit files and interviews with Air Force historians and others at the Pentagon, and at Langley, Bolling, and Maxwell AFBs.

The *Gulf War Air Power Survey* (1983) summarizes all activities of all deployed units during Desert Shield and operational activities during Desert Storm, *combined* for all deployed units. It does not present any training or operations data for specific units (either wings or squadrons), or statistics on the types and amounts of unit training conducted during Desert Shield. Statistics on unit training were extracted from wing histories, documents supporting the wing histories, and from personal interviews. The extracted data on training and operations fall principally into two categories:

Process: training events accomplished, operating tempo, sorties, bombs dropped

Output: unit readiness, performance effectiveness, evaluations, and indicators such as hits and misses and bomb damage assessments.

Most of our data concern the training process, although we found some evaluations on the degree of success of selected training exercises and some aspects of unit readiness. There is significant information on the performance of F-117A aircraft in bombing ground targets. The F-117 "hit or miss" data are not reported in this paper but will be the focus of future analysis.

D. JOINT

We also searched for records of joint training at every level from the tactical/ technical to the operational and strategic. For example, when looking for data on service

training, we also looked for data on training that individual units might have had with units from another service. We also looked for data on service and joint training at higher command levels and at the CENTCOM level.

For example, Air Force data in GWAPS and wing histories indicate that joint training occurred with Navy and Marine Corps air units and with allied units or with ground forces on a range of aviation tasks. Navy data reveal Navy aircraft training with Air Force fighter and tanker aircraft. The GWAPS and the wing histories also contain data on close air support training although the information provided often does not specify whether this training was with Army forces or with Air Force ground-based forward air controllers. Numerous interviews with Army ground commanders and helicopter unit commanders revealed little joint Army/Air Force training in close air support.

At higher command levels, Service and joint headquarters did little, if any, specific training for combat operations. These headquarters were consumed with the deployment to Saudi Arabia, with supporting the fighting units, and with planning for the war.

III. ARMY DATA ON TRAINING

A. INTRODUCTION

This chapter describes the results of our search for data on Army training prior to Desert Storm and on the Army's performance in the war. First, it summarizes key propositions that emerged from the soldier interviews we conducted and from our survey of written materials about Army experience. Second, it provides an account of the Battle of 73 Easting, of the reconstruction of that battle using SIMNET (Simulator Networking), and of training in the 2nd Armored Cavalry Regiment (ACR). In Appendix A we list the interviews we conducted. The references we reviewed are listed at the end of the paper.

B. KEY FINDINGS

The bold-faced statements below reflect judgments based primarily on our interviews with the individuals listed in Appendix A and on published sources. Following each statement, we make some relevant observations.

1. The Army trained very well at the tactical level.

We discussed pre-war training with a wide range of Army officers and other observers. Their accounts provide abundant evidence that Army units trained in a thorough and professional manner at the individual level, and at the level of tactical units (e.g., brigades and smaller units).

2. The Army did not systematically retain and assemble data on unit performance in training in the period immediately prior to the Gulf War.

We visited the Center for Army Lessons Learned (CALL) at Fort Leavenworth in an attempt to find documents containing data on training prior to Desert Storm. That search proved substantially fruitless.

In the course of our detailed investigation of training in the 2nd Armored Cavalry Regiment, we obtained some documents depicting small unit performance, e.g., Squadron-by-Squadron scores on tank and Bradley gunnery. We are certain that a wide range of

other Army units produced such documentation of training and performance-in-training as a matter of course prior to (and since!) the Desert War. However, we found no evidence that such information is collected in ways that would make it possible to:

- Compare the performance of like units, or
- Assess changes in one unit's performance over time, or
- Estimate the effect of training on performance.

Nor did we find any evidence that these data are saved for more than short periods by originating units, or forwarded to other organizations for centralized storage and easy access by staff or analysts working for the Army.

3. We have no systematic data on unit performance in the Gulf War.

Individuals have impressions and anecdotal accounts of how their units performed in combat and how this performance compares with that of other units. But the Army as a whole has not systematically gathered such data. Nor has the Army as a whole attempted to interpret how various types and amounts of training did (or did not) contribute to combat effectiveness. Nor, as far as we can tell, have units within it. Similarly, the Army has no set of "objective" indicators of wartime performance that could be used to guide future training and thereby enhance future readiness.

4. The Army performed well at the tactical level, across the board.

Few interviewees complained about unit performance in combat. In conjunction with our spectacular victory and few casualties, it is hard to argue that performance was anything short of superb.

5. Many unit leaders believe that personnel stability was critical to their unit's degree of proficiency.

Several interviewees cited personnel stability as an important factor in their success.

6. Apart from planning, the Army did not (much) train higher-level staffs.

Planning is important and serves to train staffs in the planning function. However, planning does not train staffs to carry out their other functions. For that purpose, you need to run the staff against an opposing staff and critique its performance on a reasonable variety of exercises, and this did not happen. The Battle Command Training Program

(BCTP) staff deployed to the Desert, but were never used to run high-level training exercises.

C. TRAINING, PERFORMANCE, AND THE BATTLE OF 73 EASTING

1. A Brief Account of the Battle[1]

The Battle of 73 Easting is a case study in which we can examine both training and performance in combat.

All day on February 26, 1991, the third day of the 4-day ground war against Iraq, the 2nd Armored Cavalry Regiment led the VII Corps, which was moving eastwards in the "left hook" plan of attack. Its most important mission was to "discover the main outline of the Republican Guard's main line defense so that the two following armored divisions could aim directly toward it."[2] The Regiment's Commanding Officer, Colonel Don Holder, USA, controlled his squadrons' movements by reference to north-south lines, 1 kilometer apart, called "Eastings." The 75 Easting was roughly 35 miles east of Kuwait's border.[3] Holder knew that the Tawalkana Division of the Republican Guard lay somewhere in the vicinity of the 70 Easting, but not exactly where. That afternoon, an increasingly bad sandstorm (or Shamal) grounded his helicopters. Visibility varied between 200 and 1,400 meters. The regiment could see further ahead with its thermal sights; the Iraqis did not have thermal sights or even knowledge of the presence and direction of attack of the VII Corps.

The 2nd Squadron of the 2nd ACR was the northernmost, forming COL Holder's left flank. Ghost Troop, led by Captain Joseph F. Sartiano, USA, was on the left;

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1 Detailed accounts of the battle include: (1) a history written by Colonel Michael D. Krause, USA, and published by the U.S. Army Center for Military History (Krause, 1991); (2) detailed data on the battle compiled by Illusion Engineering, Inc., for the Defense Advanced Research Project Agency (Crooks, Colburn, et al., 1992; 73 Easting Re-creation, Validation and Verification, 1992; Project 73 Easting, 1991), and a video tape (The Reconstruction of the Battle of 73 Easting, 1992); and (3) a symposium on 73 Easting (Orlansky and Thorpe, 1992). This material has also been used by three groups to verify the Janus combat simulation model [Christenson and Zirkle, 1992; Dryer, 1991; and Wacher, Jackson et al. (no date)].

Other accounts of the Battle of 73 Easting appear in *Crusade: The Untold Story of the Persian Gulf War*, by Rick Atkinson (Houghton Mifflin Company, Boston, 1993), in *Certain Victory: The U.S. Army in the Gulf War*, by Robert Scales and a team of Army historians (Office of the Chief of Staff, U.S. Army, 1993), and in *The Generals' War*, by Michael R. Gordon and Bernard E. Trainor, Little, Brown and Co., Boston, 1994.

2 *Certain Victory*, p. 223.

3 *Certain Victory*, map p. 288.

Eagle, led by Captain H.R. McMaster, USA, was in the middle; and Iron, led by Captain Daniel B. Miller, USA, was on the right. VII Corps had established the 70 Easting as the regiment's limit of advance.[4]

At 1618 on the afternoon of February 26, Eagle Troop's lead tanks cleared a low rise. At least eight Iraqi T-72 tanks were to its direct front, visible only through Eagle's thermal sights. McMaster immediately ordered his troop to open fire and to continue its advance. Within 4 minutes, Eagle's attack destroyed all of the T-72s and several BMP armored fighting vehicles. A second line of T-72s lay about 1 mile ahead. Eagle continued its attack and destroyed those tanks too. Eagle halted at 1640 and formed a defense. The Army would credit it with destroying 28 tanks, 16 personnel carriers, and 39 trucks. Although the Iraqis had stood and fought, Eagle suffered no losses.

At roughly the same time, Iron Troop saw other enemy tanks ahead and also attacked immediately. It destroyed the tanks of the initial Iraqi line, and moved on to destroy the armor in the second Iraqi echelon. During the action, Killer Troop to the south mistakenly identified an Iron Bradley as an Iraqi vehicle, and launched a TOW against it. The TOW hit and wounded the crew, but all survived.

Ghost troop heard of Eagle's battle to its south before it made contact with the enemy. When it spotted Iraqi vehicles, which had turned off their engines to present a smaller thermal signature, it opened fire but did not continue to advance. Instead, it remained at the 73 Easting, moving up and down, and continued to fire. The Iraqis launched a counterattack at 1740, only to be destroyed by Ghost's direct fire weapons, augmented by artillery and mortar fire. One Iraqi shot hit a Bradley and killed its gunner.

Ghost Troop's battle lasted about 4 hours. When it finished, the 2nd ACR had destroyed one Brigade of the Tawalkana Division, part of the Iraqi 12th Armored Division, and about 200 vehicles.

2. Reconstructing 73 Easting for SIMNET

The Army's senior leadership quickly recognized that the 73 Easting Battle was a classic armor engagement. At the same time, Col Jack Thorpe, USAF, Program Manager of the ARPA-Army SIMNET (Simulator Networking) Program, realized that the SIMNET system could be used to develop a precise record of the battle in a way that would provide

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[4] *Crusade*, pp. 442 and 444.

an opportunity to review visually what had happened as well as a way to examine, on an as-if basis, what might have happened if different weather, sensors or weapons were involved in that battle. Victor Reis, Director of ARPA, agreed to fund the project. Thorpe and General Paul F. Gorman, USA (Ret.), visited General Gordon Sullivan, USA, then Vice Chief of Staff of the Army, and immediately received his cooperation and support. Planning for the effort started quickly, and a team left for Southwest Asia in April 1991, while the 2nd ACR was still in the battle area. The team was led by Colonel Michael Krause, USA, Deputy Chief of Military History. Other members of the team had extensive experience with SIMNET, cavalry doctrine, battle area terrain analysis, and/or previous duty in the 2nd ACR.

SIMNET is a sophisticated training system. It consists of a network that links hundreds of simulators of tanks, ground support vehicles, aircraft and control centers and permits manned, two-sided combat engagements to take place in real time, much as might occur on an instrumented range, such as the National Training Center or Hohenfels. Every action, turret rotation, turret elevation, tank movement, and weapon fire is recorded automatically (15 data points per second) so that all of the actions of all vehicles can be replayed and observed from any point of view, such as from a particular tank or from the ground or in the air.

Although the purpose of the 73 Easting project was to produce a detailed record that could be observed in a grand simulation, it is obvious that neither the 2nd ACR, the Iraqi opposition, nor the battle area had been instrumented to provide the data needed for a historical reconstruction. Nor had the terrain where the battle occurred been reduced to a digital version on which simulated tanks could maneuver. All of this had to be developed to a degree of precision not required by a written description of the events of a battle.

The in-country team, therefore, had to collect information in sufficient detail to reconstruct a SIMNET-like record of a battle. The product may look as if it were a motion picture, but this appearance is misleading. A motion picture records a particular set of actions, but can replay them only from the viewpoint of each camera. SIMNET also records a particular set of actions. As in a motion picture, these actions and the environment cannot be changed. However, on any replay, the SIMNET observer is free to move and observe from any position of interest—i.e., on the ground, in the air, or in any vehicle—without changing the actions of any vehicle as captured in the digital record.

In effect, the Army-ARPA team had to develop a moment-by-moment record of what each tank did, how it moved, when it shot at what enemy tank, and what each shot

did. This is an exaggeration of what was actually achieved because, although the record was reasonably complete, there were gaps that could not be resolved. Participants remembered key events but not the intermediate steps between them. In most cases, it was reasonable to assume that specific tanks moved from known position "A" to known position "B" and to use an animation technique to accomplish the required movement.

The raw data, reduced later to a scenario showing position, time, movement and shots for each tank, were collected on the spot. This data-collection effort was accomplished by

- Flying in helicopters over the terrain and taking photos,
- Recording (via GPS) the precise location of killed enemy tanks still in the desert,
- Noting the damage suffered by Iraqi targets, and
- Analyzing the pattern of vehicle tracks in the sand and of TOW wires to targets.

The SIMNET data team interviewed soldiers who participated in the battle as well as their officers at every level of command. The team collected after-action reviews, Engineer Survey Data, various maps and data records, and some tape recordings of actual radio communications during the battle.

The first version of the SIMNET video tape reconstruction was reviewed and discussed by about 10 members of the 2nd ACR over a period of 3 days at the Institute for Defense Analyses and modified to incorporate corrections. It is no exaggeration to say that the precision and technology required to produce a SIMNET-based record makes 73 Easting the most minute, and probably most accurate, historical record ever produced of a real battle.

3. Training in the 2nd ACR

If we accept the finding that the 2nd ACR achieved a spectacular victory at 73 Easting, we wish next to address how its training prior to the battle contributed to that performance. Leadership, quality of personnel and weapons, concept of operations, nature of the enemy, and plain good luck are significant contributors to such a victory. Here,

however, we will focus primarily on training. Nor do we imply that, given the opportunity afforded to the 2nd ACR, other troops would not have produced about the same result.[5]

Preparation of Eagle Troop for meeting the enemy at 73 Easting started when Captain McMaster took command of Eagle Troop in Germany in February 1990, long before the Iraqi invasion of Kuwait. McMaster judged the troop to be below required battle standards and set a personal goal of making it the best cavalry troop in the Army. (Although we believe that McMaster did an unusually effective job in training Eagle Troop, a retired Army Colonel tells us that, when Captains take command, they frequently report that they have to improve their unit's training.)

McMaster's strategy was to take training seriously, always to train with his men, and to provide feedback on the spot. He sought to make everyone believe that high levels of proficiency are needed to succeed in battle. With the concurrence of his superior officers, McMaster replaced a small number of personnel who, for whatever reason, did not or could not respond to the new training regime. (This sign that he would act to improve performance actually helped build morale and mutual respect in the troop.)

McMaster developed a comprehensive, long-range training plan and followed it meticulously. McMaster used the METL (the Army's Mission Essential Task List) as the basis for his unit training plan at all levels, i.e., troop, platoon, crew and individual; he followed the Army paradigm for imposing successive levels of difficulty in the tasks to be learned (i.e., crawl, walk, run). Eagle troop trained for prescribed individual and tank crew tasks at its home station and in the field near the former inter-German border. McMaster and his officers conducted many terrain and chalk-board talks with the troop's non-commissioned officers, mainly on offensive operations. (Later, offense turned out to be the key feature of the 73 Easting battle.) A fleet of HMMWVs (High Mobility Multi-Purpose Wheeled Vehicles) was used at the border as command posts in battle drills, consistent with Army guidance.[6]

McMaster spent 2 weeks on squadron operations with emphasis on having the troops know what to do without orders. This was also a feature of what happened at

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[5] The information reported here is based both on the available documentation and on a series of recent interviews, by phone and in person, with key individuals who participated in the battle. Most of our information centers on the performance of Eagle Troop, led by Captain H.R. McMaster, USA. We sought detailed training records of Eagle Troop during the Desert Shield period and found that such records were not available.

[6] See FM 100-25, *Training the Force*.

73 Easting. The troop performed well in field maneuvers and battle engagements at CMTC Hohenfels, which served as a prelude for home station gunnery training. (Incidentally, special attention was given to regular reporting of UCOFT [Unit Conduct of Fire Trainer] scores and making sure that MILES [Multiple Integrated Laser Engagement System] worked correctly before using it to estimate gunnery scores in field engagements.) The troop met all gunnery standards in its exercises.

An unusual aspect of Eagle Troop's training was that there were few constraints on the ammunition and fuel it needed to exercise; in effect, Eagle took advantage of supplies that were not used by other troops. In addition, Eagle Troop trained to a superior performance level with little soldier turnover. During September and October, even though the troop was not scheduled for deployment to Saudi Arabia, foresight mandated additional training. When the deployment alert was issued in early November, the Troop also benefited by retaining trained personnel scheduled to rotate.

After the alert, the troop began more intensive desert warfare training in Germany. The troop used borrowed equipment because its own equipment was then being shipped to Saudi Arabia. The vehicles showed up the day after the troops arrived early in December. The vehicles were maintained and painted before leaving the port for the area of operations. By the time the air war started, Eagle troop had completed 5 weeks of crew, platoon, and maneuver exercises in the desert, and had practiced the exact plan for its entire operation. The soldiers built and busted berms, walked through battle drills followed by After-Action Reviews, and then did it all over again.

McMaster's training sought to instill confidence in the superior capability of the troop's equipment and its command and control, compared to that of their enemy. Owing to the confidence that the men had in their own capability and in each other, they trusted their colleagues. McMaster wanted to use this confidence as a way to encourage his troops to go on the offensive when attacked and thereby to overcome natural fear and hesitation. He succeeded: when ordered to stop in the actual battle, the men of Eagle Troop wanted to continue to attack the enemy.

McMaster told us that once the battle started, there was no way he could tell his men what to do. Each tank crew did the right thing because the men knew what to do and trusted those on their flanks to do their jobs. Detailed reconstruction confirms that this is what actually happened.

4. What Can We Learn from This Case Study?

The assembled evidence argues that:

- Eagle Troop trained very well, and
- Eagle Troop fought very well.

Even though these findings are clearly warranted, we could not find the data needed to establish what kinds of training contributed to success and what kinds were less relevant.

IV. NAVY DATA ON TRAINING

This chapter describes three aspects of the training of the Navy Carrier Battle Groups (CVBGs) that participated in Desert Shield and Desert Storm operations:

- The standard Navy training cycle for CVBGs,
- Pre-deployment and Desert Shield training for the six Carrier Battle Groups that participated in Desert Storm, and
- How future research might assess the effect of pre-war CVBG training on wartime outcomes.[1,2]

Pre-deployment and Desert Shield training varied across battle groups. Three CVBGs deployed to Southwest Asia (SWA) during Desert Shield while three CVBGs arrived only days before the war began. Each CVBG was in a different stage of its inter-deployment training cycle at the beginning of Desert Shield. Accordingly, when the war started we would expect each to be at a different level of training readiness, which could affect their performance in combat.

A. THE TYPICAL CARRIER BATTLE GROUP INTER-DEPLOYMENT TRAINING CYCLE

The Navy training and readiness system is based on an 18-month period between deployments. Training during this period will be described separately for surface and air units of a CVBG.

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1 Fairly extensive data are available for CVBG training accomplishments prior to and during Desert Shield. The Center for Naval Analyses collected and analyzed most of these data. (See Brown, Gibson, and Marcus, 1991). We obtained data on overland tactical air (TACAIR) strike operations from Brobst, Sauter, Mach, Shepko, and Allen (1992), and from Shepko, Brobst, Axup, Hayes, and Newett (1992). In addition, we obtained data on Navy, Marine, and British TACAIR units' performance in strikes against bridges from Brobst, *et al.* (1994). Finally, we obtained daily and career flight hour data from the Naval Sea Logistics Center (NSLC) and the Navy Safety Center.

2 For a detailed account of Navy accomplishments and lessons learned from the war, see Perla (1991) and the 12 volumes of the CNA Desert Storm reconstruction study.

1. CVBG Training

Ideally, a CVBG just coming off deployment and returning to CONUS "Stands down" for a 1-month leave period during which the Navy reassigns some personnel and sends other to schools. Then, the CVBG moves into a rebuilding phase which its ships and squadrons will accomplish in three phases: Basic, Intermediate, and Advanced training. Completion of the key training events shown in Table IV-1 can serve as a measure of CVBG readiness.

Table IV-1. Key CVBG Pre-Deployment Training Events

Training Event	Type of Unit (Ship/CVW/CVBG)	Training Phase
Refresher Training (RFT)	Ships	Basic
Operational Propulsion Plant Exam(OPPE)/Operational Reactor Safeguard Exam (ORSE)	Ships	End Basic (Escorts)/Advanced (CV)
Fleet Fighter ACM/Strike Exercise (FFARP/SFARP)	CVW(fighter/attack)	End of Basic
Missile Tactical Certification	Ships	Intermediate (ITA)
CVW Fallon Detachment	CVW	Intermediate
Strike Leader Attack Training Syllabus (SLATS)	CVBG	Intermediate
Intermediate training phase COMPTUEX/ITA	CVBG	End of Intermediate
Advanced training phase FLEETEX	CVBG	End of Advanced

For the carrier and escorts, the basic training phase comprises roughly 34 steaming days and includes a series of prescribed training events, exercises, and certifications. During this time, the air wing trains from shore bases and conducts shipboard flight operations only for the purpose of carrier landing qualifications or for training the ship's company.

The intermediate training phase also requires about 34 steaming days. During this time, all or part of the air wing embarks when the ship is at sea, and the Navy seeks to integrate the ship/air wing team into a single tactical unit. This phase culminates in an

exercise called the Intermediate Training Assessment (ITA). Upon successful completion of the ITA, the CVBG enters the advanced phase.

During Advanced Training, the Navy seeks to integrate the carrier (CV), carrier air wing (CVW), and the CVs escorts and assigned submarines into a cohesive unit. This phase ends with a FLEETEX intended to test readiness for deployment. The FLEETEX is an intensive, around-the-clock exercise designed to test all elements of the battle group in their Primary Mission Areas. To the extent possible, the Navy tailors each FLEETEX to the expected deployment scenario.[3]

2. Surface Unit Training

As surface units move through each of the three phases, they must qualify in certain required exercises and certifications. The Basic and Intermediate phases each begin with a Command Assessment of Training (CART I and CART II) made by the ship Commanding Officer (CO) with the assistance of the Afloat Training Group (ATG). Afloat Training Group detachments are of three types—Combat Systems (CSTG); Fleet (FTG) with cognizance over aviation, seamanship, damage control, and navigation; and Engineering (ETG). The primary mission of the ATG is to assist the ship CO, but when tasked to do so, it also responds to higher command in an evaluative role. The ATG also validates Status of Resources and Training System (SORTS) C-ratings for ships during the inter-deployment training cycle.

The ATG provides personnel for four Tailored Ship Training Availabilities (TSTAs). These begin in port where the ATG assesses training requirements (including schoolhouse quotas), and trains the ship's training teams. During TSTA III, the ATG comes aboard only if requested by the CO. The final TSTA generally takes place at sea where the ATG or Type Commander observes required exercises, such as Composite Task Unit Exercises (COMPTUEX), MISSILEX, Naval Gunfire Support (NGFS), and Anti-Air Warfare (AAW) and Anti-Submarine Warfare (ASW) Exercises (ASWEX). Such exercises may be conducted in conjunction with Refresher Training (RFT).

During RFT, conducted under the direction of ATG, the ship's crew must demonstrate proficiency and knowledge of safety and operational procedures in such tasks as

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[3] The FLEETEX has been replaced by what is now called a Joint Task Force Exercise (JTFEX). The JTFEX has been expanded to include units of all services and is conducted under the auspices of USACOM as a Joint Tier II exercise. The then current terminology—FLEETEX—will be used here.

underway replenishment, emergency flight deck operations, man overboard, damage control, and navigation.

In addition to required exercises, surface ships must achieve certification in certain operations and engineering areas. For example, all air-capable ships must demonstrate the capability to safely conduct air operations. Missile ships must also be certified. These certifications cover operations, emergency procedures, safety, and equipment functionality and material condition. Engineering departments must pass an Operational Propulsion Plant Examination (OPPE) or Operational Reactor Safeguard Exam (ORSE).

3. Air Wing Training

Air wing inter-deployment training parallels that of the surface units. Squadron air crews qualify in certain competitive exercises (COMPEXs) in each primary mission area and participate in individual squadron and air wing exercises. Squadrons equipped for air-to-air combat (i.e., those equipped with either F-14s or F/A-18s) take part in 2-week Air Combat Maneuvering (ACM) exercises called Fleet Fighter ACM Readiness Program (FFARP) or Strike Fighter Advanced Readiness Program (SFARP) for the F–14s or F/A–18s, respectively. The Navy conducts these exercises on instrumented ranges, against dedicated aggressor/instructor forces when possible. The SFARP also includes an air-to-ground phase.[4]

In addition, CVBGs typically send Air Wing detachments to "Strike University" in Fallon, Nevada, where they conduct coordinated strike operations. The Fallon range is fully instrumented and capable of supporting air wing training in a simulated hostile electronic countermeasures (ECM) environment; many consider Fallon experience the best air wing combat training the Navy has to offer. In many cases, an aircrew's first experience operating as a coordinated force with all elements of the air wing occurs there. While at Fallon, strike leaders and planners also attend the Strike Leader Attack Training Syllabus (SLATS) course.[5] The SLATS course consists of classroom sessions where

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4 This discussion applies to the period before Desert Storm. The aggressor squadrons are being decommissioned as part of the post-Cold War budget reductions. Reserve or active squadrons from other air wings take the role of the Red force when an aggressor squadron is not available. The FFARP has been discontinued and F-14 squadrons now have an SFARP which includes air-to-ground attack and lasts for 3–4 weeks.

5 The SLATS course is attended by strike leaders—CO, Executive Officer (XO), and most department heads—from all fighter/attack squadrons and by CO/XO from all squadrons plus ship/staff officers responsible for strike planning. In addition, all cruise missile capable ships send representatives to the course.

strike leaders/planners study the finer points of planning and executing coordinated strike operations.

B. THE TRAINING EXPERIENCE OF THE "DESERT STORM SIX"

Six CVBGs participated in Operation Desert Storm.[6] Two CVBGs—built around the carriers *Saratoga* and *Kennedy*—deployed to Southwest Asia (SWA) just after Saddam's invasion and stayed in the region through the end of the war. The *Midway* arrived in mid-October. Three other carriers arrived in the SWA region just before Desert Storm began. Rates of deployment are shown in Table IV-2.

Table IV-2. Deployment to SWA, Length of Inter-deployment Period, Expected Deployment, and FLEETEX Dates for Desert Storm CVs

Carrier	Deployment Date	Months Since Last Deployment	Expected to Deploy	FLEETEX
Saratoga	7 Aug. 90	32	Aug. 90	6/7–6/25
Kennedy	22 Aug. 90	18	b	8/17–8/21
Midway	15 Oct. 90	N/A [a]	Sep. 90	
Ranger	8 Dec. 90	16	Dec. 90	11/9–11/13
America	28 Dec. 90	14	May 91	10/9–11/3
Roosevelt	28 Dec. 90	18	Jan. 91	10/31–11/19

a Not applicable.

b Trained for a drug interdiction deployment in January 1990 which was canceled.

When the air war started, each of the six CVBGs had a set of training experiences that differed from those of the others and, in some cases, was different than the "typical" inter-deployment training pattern. As a result of these variations, we see some prospect for examining the effects of differences in training experience on performance.

Different training patterns permit us to comment on the following:

- Training orientation: Soviet threat, drug interdiction, SWA;
- Time-compressed or standard pre-deployment training;
- Key training events compressed or missed during pre-deployment training;

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6 A seventh—the *Independence* battle group—took up station in the region soon after Saddam Hussein invaded Kuwait, but departed shortly before the war began. An eighth, the *Eisenhower*, was in the region only during August 1990.

- Training environment: In-theater vs. Continental U.S. (CONUS) operating areas;
- Composition of the force: With or without some escorts originally part of the assigned CVBG; and
- Flying hour differences in the 5-month period prior to Desert Storm.

1. Training Before Arriving in Theater

Pre-deployment work-ups of the early deployers focused on the North Atlantic Treaty Organization (NATO) European scenario used throughout the Cold War era. One CVBG, *Kennedy*, had trained for a drug interdiction deployment. The late deployers' training anticipated the Kuwait scenario to some extent, but these groups had 2 weeks or less in which to conduct operations in the SWA operating area prior to Desert Storm.

The pre-deployment training periods and major training evolutions of some groups were compressed because of time and support unit constraints. One group—*America*—compressed 10 months of pre-deployment work-up into 5 months; it had not been due to deploy until May of 1991. Some ships missed key evolutions such as OPPEs or Refresher Training; aviation units missed key evolutions or completed them in a shortened time frame.

Early deployers had the advantage of operating in SWA under the Desert Storm scheduling system (the Air Force Air Tasking Order). However, these units did not have access to instrumented ranges, simulators, and other training facilities available in CONUS. In addition, the coordinated training opportunities of the Red Sea and Persian Gulf CVBGs differed markedly.

Several escorts were originally scheduled to deploy with different carriers and had very little time to become integrated into their wartime CVBG.

None of the three early-deploying CVBGs had focused on SWA operations in the course of their training prior to deploying to the Gulf. Training of the *Midway* and *Saratoga* groups focused on a normal NATO European Cold War scenario. The SWA theater differed in terms of terrain and expected opposition, as well as strike scheduling procedures. This affected strike and defensive tactics.[7] The *Kennedy* had trained for a

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[7] The Japan-based *Midway*'s "normal" training differed from that of the CONUS-based *Saratoga* for reasons that have nothing to do with Cold War focus vs. SWA focus. In particular, the *Midway*'s air wing had limited access to flight simulators, training organizations, and instrumented ranges compared to the access enjoyed by CONUS-based wings. In addition, the *Midway*'s Wing did not train at Fallon.

drug interdiction deployment and had to reorient ship and air wing training very late in its training cycle.

By contrast, the late-deploying CVBGs had an opportunity to tailor their training to the SWA scenario. In September 1990, COMUSNAVCENT had advised carrier groups destined for SWA to concentrate on:

- Close Air Support (CAS),
- Joint integrated Suppression of Enemy Air Defense (SEAD),
- Joint tactical strike operations,
- Air Force Airborne Warning and Control System (AWACS) and tanker interoperability,
- Positive Identification and Radar Advisory Zone (PIRAZ) and associated Return to Force (RTF) procedures, and
- Minimization-of-communications procedures.

Midway, home ported in Japan, did not follow the typical inter-deployment training cycle in all respects because of limited access to training units and simulators. In effect, *Midway* and her air wing, CVW-5, were permanently deployed. They had limited access to instrumented ranges, and their Strike University training was administered by a detachment from Fallon located in Japan. The Afloat Training Group provided detachments for surface ship training, but this is typical of the standard Navy surface training cycle.

The *Midway* also trained and deployed on the originally planned schedule. The differences in its training reflected its Western Pacific home port status, rather than schedule compression. By the same token, the Cold-War-influenced "business-as-usual" orientation of the *Midway*'s and *Saratoga*'s training meant that they had trained for different terrain, tactics, and opposition than those to be encountered, compared to the CVBGs that trained with an eye to likely combat in Southwest Asia. None of the early deployers had incorporated ATO scheduling procedures into their pre-deployment training plans.

The dates in Table IV-2 make it appear that only the *America* group had a significantly compressed training cycle. In fact, however, the *Kennedy*'s was effectively compressed by the last-minute reorientation from drug interdiction to a normal deployment. Other groups experienced selective schedule compression (e.g., shortened Fallon detachments and FLEETEXs, missed Underway Refresher Training or SLATS.)

The *Kennedy* had the least typical work-up. Its training differed from that of the *Midway* and the *Saratoga* in these respects:

- Its air wing sent detachments to Fallon more than a year prior to deployment.
- Its FFARP and SFARP were compressed.
- Its FLEETEX (4 days) was shorter than the usual 3 weeks.
- It sailed with a different set of escorts than planned.
- *Kennedy* and two escorts had no RFT; two escorts had no OPPE.

The *Saratoga* group had the most normal work-up of the six CVBGs. The group deployed in August as originally scheduled and with its planned units. All planned training evolutions were accomplished on the standard inter-deployment schedule.

Of the three late-deploying CVBGs, the *America* had the most drastically compressed training cycle—less than 1 year instead of the year-and-a-half period normally allowed. It sailed with only one of its planned escorts. Three of its escorts—and the *America* itself—missed refresher training and one of its two F-14 squadrons had a shortened FFARP. One of its two F/A-18 squadrons had no SFARP. None of its air crews attended SLATS, and its air wing's time at Fallon was shortened from 21 to 16 days. On the other hand, the *America* air wing, CVW 1, was the only one of the six for which Fallon training was oriented to the Iraq-Kuwait scenario.

The other two late-arriving CVBGs—*Roosevelt* and *Ranger*—did not have to compress their pre-deployment training. The carriers, their escorts, and their air wings had normal pre-deployment training, although the Ranger's advanced exercise was only 4 days. Instead of a Cold-War focus these units' training was tailored to the Iraq-Kuwait scenario. In addition, the *Ranger*'s FLEETEX emphasized scheduling sorties so that, when the time came, Navy air would conform to CENTAF's ATO.

2. Training in Theater

The early-deploying battle groups enjoyed the advantage of training with the people alongside whom they would fight, and doing so in the theater. From October on, the early-deploying CVBGs conducted intensive work-ups during Desert Shield including joint strike planning, joint communications, and multi-national exercises. Their air wings flew daily over-water, live-ordnance strike sorties, and practiced refueling from Air Force tankers. In addition, these wings took part in several exercises in which air operations were scheduled and directed by the Joint Forces Air Component Commander (JFACC).

Both Desert Storm rehearsal exercises, designed to train Carrier Air Wing and CVBG staffs in the conduct of operations in accordance with the JFACC Air Tasking Order (ATO),[8] and major joint-Service exercises, in which air operations were also under the control of the JFACC, were conducted. Naval forces also conducted surface warfare exercises and major amphibious force/Marine exercises during Desert Shield.

Desert Shield training differed for the two Navy carrier task forces. Each consisted of two carrier battle groups which alternated between either the Red Sea or the central Persian Gulf and the Mediterranean. The Red Sea group—*Saratoga* and *Kennedy*—alternated monthly. During each turnover, the groups conducted two-carrier operations under the scheduling authority of JFACC. Consequently, these two CVBGs were very familiar with ATO procedures before the commencement of hostilities. The Persian Gulf CVBGs—*Midway* and *Independence*—only had one turnover during Desert Shield and did not practice multi-carrier operations on that occasion. In addition, *Midway* scheduled most of her flights over water; as a result, these flights did not come under the scheduling control of JFACC. Even so, *Midway* did participate in three major three-carrier exercises with *Saratoga* and *Kennedy*, and one two-carrier exercise with *Saratoga*. Mirror Image ATO rehearsals were conducted during all of these exercises.[9]

3. Joint Training

Commander-in-Chief Central Command (CINC USCENTCOM) and the Navy regard lack of joint training as an important deficiency of all CVBGs in the Gulf and, in response, the Navy has changed its FLEETEX to include other services.[10] CINC US Atlantic Command (USACOM) now conducts the major CVBG pre-deployment exercise called Joint Task Force Exercise (JTFEX). Strike scheduling for the JTFEX includes the

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8 The Air Tasking Order was supposed to specify the sorties that Air Force, Navy, and Marine aircraft would fly in the war. Since the Coalition flew some 3,000 sorties daily, the ATO was a massive document (upwards of 300 pages), and required a 48-hour cycle to assemble. The Navy found it difficult to comply with the ATO, partly because it had no electronic ATO transmission system. Even with electronic transmission, though, some observers argue that the ATO process is too inflexible for wars against agile adversaries.

For more on the ATO from a Navy and Marine perspective, see "The Air Campaign," by Norman Friedman, *U.S. Naval Institute Proceedings*, April 1991, p. 49; "From the Strike Cell," by Capt. Lyle G. Bien, USN, *U.S. Naval Institute Proceedings*, June 1991, p. 59; and "Marine Air: There When Needed," an interview with Lt. Gen. Royal N. Moore, Jr., *U.S. Naval Institute Proceedings*, November 1991, pp. 63–64.

9 "Mirror image ATO exercises" are rehearsals of strikes on expected Desert Storm targets conducted in accordance with ATO scheduling.

10 Based on interviews.

ATO and emphasizes aerial refueling by USAF tankers. In addition, the Navy now equips all deploying carriers with the Contingency Tactical Air Control Planning System (CTAPS), an electronic transmission system intended to make the ATO truly workable for Navy units.

4. Flying Hour Differences in the 5 Months Preceding Desert Storm

In general, we found hours flown and the proportion of flights originating from the ship rather than shore predictable, considering each air wing's employment and training phase. Important differences exist, however, and these differences represent potential areas for further analysis.

Tables IV-3 through IV-5 summarize flight statistics for the Fighter (VF), Attack (VA), Airborne Early Warning (VAW), and Tactical Electronic Warfare (VAQ) aircraft.[11]

Table IV-3 shows the proportion of flights which originated or terminated aboard ship. This is a potential indicator of training readiness because ship air (the environment in which Navy TACAIR operates) operations are more demanding than those flown from shore bases.

Table IV-3. Average Ratio of Ship-Based to Total Flights (All Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.–Dec.
Early-Deploying CVBGs							
CVW 17	*Saratoga*	0.81	0.96	0.95	0.99	0.97	0.94
CVW 3	*Kennedy*	0.54	1.00	0.99	0.98	0.99	0.90
CVW 5	*Midway*	0.15	0.66	0.97	0.99	0.98	0.75
Late-Deploying CVBGs							
CVW 2	*Ranger*	0.24	0.23	0.72	0.52	0.75	0.49
CVW 1	*America*	0.11	0.00	0.60	0.73	0.14	0.32
CVW 8	*Roosevelt*	0.00	0.00	0.34	0.86	0.32	0.30

As would be expected, the early deployers flew nearly all of their sorties from the ship during the 5 months prior to Desert Storm. For the late deployers, *America* and

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11 In the interest of brevity, we omitted the Air ASW (VS) and Helicopter ASW (HS) statistics. We have no performance data for these aircraft, because they did not participate directly in strike operations. VS did fly ECM missions in support of TACAIR strikes, and HS and VS were used extensively in the surface campaign.

Roosevelt flights were ship based 32 percent and 30 percent, respectively, of the time; 49 percent of flights were ship based for the *Ranger*. Both *Ranger* and *Roosevelt* experienced a near normal work-up in that the Navy had originally scheduled them to deploy in December 1990 and January 1991, respectively. *America* had a sharply accelerated—5-month compression—work-up.

Table IV-4 shows the average monthly flight hours per pilot for six aircraft types (F-14, F/A-18, A-6, A-7, E-2, and EA-6B). We would like to know what pilots did during those hours: were they intensively practicing the skills needed to perform well in their Primary Mission Areas? or were they often "boring holes in the sky" owing to the long distances they had to fly in the region? We have found in previous studies that the number of hours a pilot has flown (both over his career and more recently) correlates significantly with performance in ACM, carrier landings, air-to-ground ordnance delivery, and tactical air drops. (Hammon and Horowitz, 1990, 1992, 1995)

Table IV-4. Average Monthly Pilot Flight Hours (All Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.
Early-Deploying CVBGs							
CVW 17	*Saratoga*	26.7	39.0	35.4	37.6	26.1	33.0
CVW 3	*Kennedy*	24.2	42.8	40.3	13.7	41.2	32.4
CVW 5	*Midway*	14.0	13.8	22.6	35.9	29.1	23.1
Late-Deploying CVBGs							
CVW 2	*Ranger*	13.9	23.3	26.5	15.8	21.7	20.2
CVW 1	*America*	22.9	23.4	31.4	21.2	13.8	22.5
CVW 8	*Roosevelt*	13.4	16.0	16.3	24.7	9.8	16.0

We can use the flight hour data in Table IV-4 only for gross comparisons because the Navy programs pilots of different aircraft types for different numbers of monthly flight hours. (We discuss pilot flight hours per month by aircraft type below.) The *Roosevelt* air wing flew about 20 to 30 percent fewer average flight hours per pilot per month than *America* and *Ranger* during the 5 months preceding Desert Storm. The early deployers' monthly pilot flight hour averages correspond to the length of their participation in Desert Shield. The *Kennedy* and *Saratoga* air wings, which were in SWA for the entire 5 months, averaged over 32 hours per pilot per month. The *Midway* air wing, which deployed to SWA in October, averaged only 23 hours per pilot per month, nearly the same as the late-deploying *America* and *Ranger* air wings.

Table IV-5 shows average monthly night hours per pilot for all squadrons. We believe these figures are important for three reasons:

- Night flying is more demanding,
- Night flying better prepares the aviator for either night or day operations, and
- The Navy flew many Desert Storm strikes at night.

Table IV-5. Average Monthly Pilot Night Hours (All Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.
CVW 17	*Saratoga*	8.7	14.0	9.2	12.27	11.5	11.1
CVW 3	*Kennedy*	6.9	18.2	18.3	5.24	17.4	13.2
CVW 5	*Midway*	4.9	3.6	7.2	14.04	11.6	8.3
CVW 2	*Ranger*	2.2	7.2	10.1	4.77	9.1	6.7
CVW 1	*America*	6.3	5.0	12.5	6.64	4.7	7.0
CVW 8	*Roosevelt*	1.6	3.3	5.6	6.75	3.4	4.1

Note that the *Roosevelt* air wing flew fewer night hours (almost 40 percent less) than the two other late deployers. This pattern matches that for total monthly pilot flight hours.

Tables IV-6 through IV-10 compare monthly pilot flight hours for five different aircraft types.[12,13] We believe these tables yield important insight into pilot training. The Navy programs flying hours using a measure called Primary Mission Readiness (PMR). For each aircraft type, a certain number of monthly air crew hours equals 100 percent PMR. This number of hours allows enough time for each crew to accomplish the training events needed to progress through the continuation training program and to maintain air crews at the level of readiness specified by the Tactical Training Plan. In peacetime, the Navy seeks to have air crews fly an average of 88 percent PMR, distributed as 100 percent PMR during the 6 months before deployment and 115 percent PMR while deployed. During the remainder of the inter-deployment training cycle, the goal is 75 percent PMR.[14] The last column in Tables IV-6 through IV-10 show the average crew PMR percentage for August through December.

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12 Flight hours for two A-7 squadrons aboard *Kennedy* are included in Table IV-8.

13 These tables do not contain Naval Flight Officer (NFO) flight hours data. NFOs navigate, operate electronics, and track the tactical situation aboard multi-place Navy aircraft.) The primary difference between pilot and NFO hours results from differences in the number of pilots and NFOs in the squadron. Monthly pilot hours essentially represent monthly crew hours.

14 In FY 92 actual OPTEMPO was 87 percent PMR for TACAIR and ASW crews with 2 percent of that being flown in simulators. This has since been reduced to 85 percent PMR with 2 percent of that in simulators.

Table IV-6. Monthly Flight Hours Per Pilot (F-14 Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.	Average % PMR
CVW 17	*Saratoga*	Missing	33.5	34.6	26.9	31.6	31.6	127
CVW 3	*Kennedy*	Missing	34.5	11.7	34.6	27.5	27.1	108
CVW 5	*Midway*							
CVW 2	*Ranger*	16.8	18.8	21.8	Missing	20.5	19.5	78
CVW 1	*America*	21.5	24.5	25.7	23.3	11.7	21.3	84
CVW 8	*Roosevelt*	12.4	15.0	13.7	24.3	8.2	14.7	59

Table IV-7. Monthly Flight Hours Per Pilot (F/A-18 Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.	Average % PMR
CVW 17	*Saratoga*	18.1	29.8	28.2	30.5	21.8	25.65	103
CVW 3	*Kennedy*							
CVW 5	*Midway*	11.9	12.7	16.5	30.8	24.9	19.37	77
CVW 2	*Ranger*							
CVW 1	*America*	16.9	17.2	24.6	14.0	9.1	16.33	65
CVW 8	*Roosevelt*	12.3	11.7	12.7	19.2	8.4	12.84	51

Table IV-8. Monthly Flight Hours Per Pilot (VA Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.	Average % PMR
CVW 17	*Saratoga*	19.1	21.8	32.4	29.4	19.2	24.4	98
CVW 3	*Kennedy*	19.2	32.9	29.9	11.5	33.3	25.4	101
CVW 5	*Midway*	16.4	12.7	22.3	35.8	30.2	23.5	94
CVW 2	*Ranger*	10.6	17.5	23.0	14.9	16.8	16.6	66
CVW 1	*America*	11.1	22.9	25.1	20.0	10.4	17.9	72
CVW 8	*Roosevelt*	14.7	14.3	16.7	24.8	8.3	15.7	63

Table IV-9. Monthly Flight Hours Per Pilot (VAW Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.	Average % PMR
CVW 17	*Saratoga*	51.2	70.3	55.4	66.0	46.8	57.9	149
CVW 3	*Kennedy*	42.3	85.1	93.2	22.2	88.0	66.2	170
CVW 5	*Midway*	14.0	12.5	39.7	43.8	38.9	29.8	76
CVW 2	*Ranger*	18.4	36.1	42.7	12.2	38.8	29.6	76
CVW 1	*America*	47.6	39.6	57.8	34.1	19.0	39.6	102
CVW 8	*Roosevelt*	16.7	25.5	24.5	33.4	16.2	23.3	60

Table IV-10. Monthly Flight Hours Per Pilot (VAQ Squadrons)

CVBG		Aug.	Sep.	Oct.	Nov.	Dec.	Aug.-Dec.	Average % PMR
CVW 17	*Saratoga*	32.3	43.3	36.6	37.6	19.6	33.9	136
CVW 3	*Kennedy*	32.9	38.5	30.2	15.5	31.3	29.7	119
CVW 5	*Midway*	13.6	20.3	24.3	43.8	29.6	26.3	105
CVW 2	*Ranger*	10.2	30.8	26.9	20.2	16.9	21.0	84
CVW 1	*America*	24.8	17.6	36.5	20.0	25.4	24.9	100
CVW 8	*Roosevelt*	12.1	20.4	20.1	27.5	12.5	18.5	74

For F-14, F/A-18, A-6 and A-7 aircraft, 100 percent PMR is 25 flight hours per crew per month. For the E-2, 100 percent PMR is 39 hours per crew per month. None of the late-deploying air wings flew an average of 100 percent PMR between August and December, with the exception of the *America* VAQ and VAW squadrons. The *Roosevelt* F-14, F/A-18, VA, VAW, and VAQ squadrons flew an average of 59, 51, 63, 60, and 74 percent PMR, respectively. This is a surprisingly low number of hours for an air wing in its final work-up period. The average FY92 monthly air crew flight hours for all east coast Navy F/A-18s, for example, was 18.6 hours compared to 12.8 for the *Roosevelt* F/A-18 squadrons during the five months prior to Desert Storm. With the exception of the *Midway* F/A-18, A-6, and E-2, and *Saratoga* A-6 squadrons, the early deployers flew more than 100 percent PMR during the 5 months preceding Desert Storm. Similar data, not shown here, show the same trends for monthly night hours per pilot for these squadrons.

If more flight hours indicate better training, the data indicate that, in nearly every respect, the earlier deployers were better trained for what was to come than the late arriving battle groups. With few exceptions, they flew more total hours and more night hours per pilot in the 5 months preceding Desert Storm. More important, they flew those hours in the area and in the environment in which they would later fight. In terms of the command and control and strike scheduling environment, they were probably much less prepared when they arrived in SWA than the late deployers. However, they had from 3 to 5 months to familiarize themselves with the JFACC and ATO. Even so, there were differences in training among the late deployers. Whether these differences significantly affected performance during Desert Storm is not known.

C. SUMMARY AND PLAN FOR FURTHER ANALYSIS

The available evidence shows that the CVBGs were prepared for Desert Storm. All of the carriers met their ATO commitments with very low combat losses (a total of seven). With the exception of *America*, each was able to accelerate its operations in order to accomplish most prescribed training events. Most of the variation across CVBGs was in the area of Joint operations, inter-service refueling, AWACS procedures, communications, and ATO procedures. After the Gulf War, the Navy introduced the Joint Task Force Exercise (JTFEX) to practice joint operations with all Services and equipped aircraft carriers with the Contingency Tactical Air Control Planning System (CTAPS).

The Navy had to integrate escorts into two CVBGs later than usual. As a result, we would expect problems with air control and coordination. However, three facts suggest that surface units were successfully integrated into the CVBGs:

- The absence of major surface/air coordination problems,
- The apparent success of coordinated Tomahawk Land-Attack Missile (TLAM) and air strike operations, and
- The low number of surface or air mishaps.

We hypothesize that Navy standardization in areas such as surface ship air control, PIRAZ, and RTF procedures helped to integrate the surface/air wing team.

The question remains whether the CVBGs could have done better had they been able to accomplish all key training events in a more normal progression. Were there any discernible consequences of missed SLATS or FFARPS/SFARPS, accelerated Strike U training, shortened FLEETEXs, or training schedule compression? The available database contains information on training accomplishment and performance. In addition to the information discussed above, this includes SORTS C-ratings, Mission Capable Rates (MCR), and Full Mission Capable Rates (FMCR) over time for the CVBG units.

1. Training Accomplishment Data

The training experiences of the "Desert Storm Six" (Section B) gives bases for comparison of different training regimes among CVBGs before Desert Storm. Training orientation and training objectives varied, particularly between the early and late deployers. The training orientation and training objectives of the early deployers were aimed at a conventional NATO scenario. The *Kennedy* had trained for a drug interdiction deployment and had to shift plans immediately prior to deploying to SWA, resulting in a great deal of

schedule compression. The late deployers had the opportunity to orient their training toward a SWA scenario, but did not have the advantage of first-hand exposure to the actual Desert Storm operating environment until just before the war began. Pre-deployment training was time compressed for both the early deploying *Kennedy* and late deploying *America*.

Table IV-1 lists key training events. Whether a CVBG completed or had to shorten these events can form the basis for independent variables in an analysis of the training readiness of the Desert Storm carrier battle groups. Two of the carriers—*Ranger* and *Roosevelt*—did not complete an OPPE, and two—*Kennedy* and *America*—did not complete refresher training. The ommission of refresher training may have affected strike mission performance; it may also serve as proxy for CVBG training compression.[15]

We would expect key air wing training events to have a direct effect on air strike performance. All but two squadrons completed FFARP/SFARP, and one or more of the *Kennedy* and *Saratoga* squadrons did so over a year prior to deployment. (The *Kennedy* air wing training at Fallon also occurred more than a year prior to deployment.) Ordinarily, the FFARP/SFARP is scheduled to occur just before Fallon, which is conducted approximately 6 months before deployment. This timing is based on reducing the effect of crew turnover and skill depreciation prior to commencing the Intermediate training phase. The *America* air wing had a compressed Fallon detachment and no SLATS. These omissions may have had a direct effect on strike mission performance, which an analysis could reveal.

Compression and training orientation of the CVBG FLEETEX would be expected to be important factors. During the FLEETEX, the final exam for the ships, air wing, and staff, all surface and air units come together as a cohesive fighting unit. Three groups—*Kennedy*, *Ranger*, and *America*—had a compressed FLEETEX; *America*'s FLEETEX was oriented to the SWA scenario and emphasized ATO scheduling. None of *Kennedy*'s escorts and only one of *America*'s escorts were originally scheduled to deploy as part of the final Desert Storm CVBGs.

The training environment during the 6 months prior to Desert Storm is perhaps the most important single factor in the readiness of these carrier groups. The early deployers

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15 Missile certification would be more apt to have a direct effect; however, all missile units completed missile certification. In any case, we do not have performance data on individual missile strikes.

had the opportunity to familiarize themselves with the climate, terrain, and geography of the environment in which they would fight. Perhaps equally important, they were able to become familiar with the ATO methodology and multi-carrier operations. Even so, there was considerable variation across CVBGs in this respect. *Midway* participated in fewer multi-carrier operations and avoided using the ATO by scheduling strike exercises over water.

Flight hour statistics for the 5 months prior to Desert Storm show a great deal of variation across carrier air wings with respect to the percentage of ship operations, and monthly crew flight and night hours. The early deployers flew more hours and a higher percentage of ship operations during Desert Shield. Among the late deployers, the *America* pilots flew the most total and night hours during the 5 months prior to deploying. Even with the 5-month compression in their training work-up, were they better prepared than the other late deploying pilots? This is an empirical question, which can be examined. The squadrons aboard *Roosevelt*—which experienced a near-normal pre-deployment work-up—flew between 51 and 74 percent PMR compared to between 65 and 102 percent for the *America* air wing.

The number of carrier steaming days (OPTEMPO) during the 5 months prior to Desert Storm is also available. OPTEMPO is highly correlated with average numbers of ship operations shown in Table IV-3, and may be related to schedule compression for the late deployers. Data on coordinated Battle Group Inport Training (BGIT) sessions are also available.

SORTS data are available for the 6 months prior to Desert Storm. According to one staff officer, there was no clear relationship between C-ratings and schedule compression or missed key training events; nevertheless, there is some correlation between C-ratings and the availability of instrumented ranges (Brown, Gibson, and Marcus, 1991).

2. Performance Data

The bridge strike Bomb Damage Assessment (BDA) data is a promising way to gain real insight into the significance of variations in training on combat performance. Seventy-one bridge strike missions were evaluated by the Office of Naval Intelligence (ONI) and bomb damage assessments were made. The data include information on the quantity and type of ordnance delivered and number of hits by individual flights. The data are limited in that bridge damage is cumulative, i.e., the final bomb that destroys a bridge may have been preceded by bombs that weakened but did not destroy it.

3. Plan for Further Analysis

An econometric study of the BDA data using a multinomial logit model is feasible. This model relates the probability of success to the independent variables derived from the training accomplishment data and the overland strike database. The Office of Naval Intelligence (ONI) evaluated performance in terms of three possible outcomes: (1) unambiguous damage, (2) ambiguous damage, and (3) clear miss. Using the ONI data, the dependent variables describe the possible outcomes by a 0 or 1, depending on whether the event occurred. More than one formulation is possible. Aircraft crews also reported their own performance evaluation as hit, miss or uncertain. Crew evaluations may or may not be reliable although pilot reports appear to correlate with the ONI evaluations. Potential independent variables include quantitative and qualitative variables which describe the training history of each CVW, state variables, and crew experience variables.

Training History Variables

- Missed or shortened SFARP, Fallon, SLATS
- Time between FFARP/SFARP/Fallon and deployment
- Compression of the pre-deployment training time
- Length of time spent training with escorts prior to deployment
- Training orientation: Drug interdiction, SWA, or NATO
- Length and orientation of ITA, BGIT, and FLEETEX
- Training in SWA, including multi-carrier operations and ATO exercises
- Carrier steaming days during the 5 months prior to Desert Storm
- Flight statistics during the Desert Shield time frame and career flight hours of the air crews aggregated by carrier and aircraft type

State Variables

- Types and numbers of ordnance expended on the target
- Day or night mission
- Opposition encountered over the target
- Flight statistics during the Desert Shield time frame and career flight hours of the air crews, aggregated by carrier and aircraft type

The flying hour data are highly aggregated, compared to data available for similar analyses conducted in the past. We cannot identify recent or career flying hours for the

individual crew members who participated in each strike; only monthly averages by carrier and aircraft type are available. Whether the database is rich enough to support analyses at this level of aggregation is an empirical matter. The value of the potential payoff suggests that the research is worth doing, since it is one of our few chances to quantitatively link training experience directly to wartime performance.

V. AIR FORCE DATA ON TRAINING

A. INTRODUCTION

The Air Force deployed about 1,130 aircraft of 30 different types to Southwest Asia.[1] It flew a total of about 76,000 sorties before the air war started;[2] 2,720 of these were air-to-air training sorties,[3] and 26,178 were air-to-ground sorties.[4] This chapter describes the information we were able to collect on advanced individual and aircrew training, unit exercises, and flight operations before and during Desert Shield, and from combat operations during Desert Storm. The data were collected from wing histories and the statistical appendices to the *Gulf War Air Power Survey* (GWAPS). The data are too voluminous to be included here and are available from the authors upon request.

We present the data on process measures in two following sections:

B. Training before and during Desert Shield.

C. Data based on wing histories.

In this chapter, we present data from *only two* of the eight wings included in our database as representative of data available in the other wing histories. All the information we collected is identified in Appendix C, "Supporting Documentation for Air Force Data," and is available from Control and Distribution at the Institute for Defense Analyses.

B. TRAINING BEFORE AND DURING DESERT SHIELD

We hypothesize that the exercises and operations conducted in the Desert Shield environment provided superior combat training than did previous exercises. Further, we believe that, providing one survives initial combat activity, actual combat provides the best training for further combat. If this hypothesis is correct, it would follow that, other things

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1 GWAPS 1993, I-35.

2 GWAPS 1993, V-141, Table 46.

3 GWAPS 1993, V-163, Table 54.

4 GWAPS 1993, V-166, Table 55.

being equal, early-deploying squadrons were better prepared and performed better in the war than late-deploying squadrons.

This hypothesis is important in interpreting the data we have assembled, because, with the exception of F-117 performance in bombing, we do not have reliable measures of combat performance of USAF aircrews or units in the Gulf War. Most of the available data consist of process measures on the types and amount of training and operations before Desert Shield but not on combat performance. These data can tell us something about the extent of units' preparedness for combat. The F-117 performance data may support a partial test our of hypothesis. The F-117s of the 415th Tactical Fighter Squadron arrived in Saudi Arabia in August, and had much more time to train in the region than did the F-117s of the 416th Tactical Fighter Squadron, which arrived in December. It should prove possible to break down the available bomb damage data and compare 415th TFS performance with that of the 416th TFS. Data are available on the hit rates of about 50 pilots in over 2,000 target attacks by F-117A aircraft during Desert Storm, an average of about 40 target runs per pilot. Early arrivals, and thus pilots with more flight hours in theater, were there for about 22 weeks, compared to about 5 weeks for late arrivals.

Extensive information is available on the amount and character of training, exercises and operations conducted during 1990 and the first 2 months of 1991. This includes some performance evaluation and readiness data. Taken together, this information covers three distinct types of operations for the Air Force Wings in our sample:

- Normal training and operations prior to Desert Shield,
- Training and operations during Desert Shield, and
- Desert Storm operations.

Table V-1 provides some selected statistics from the first two periods. First, some squadrons in these wings deployed before others, and some squadrons never deployed. The 1st TFW's 94th TFS and the 4th TFW's 334th TFS never deployed, so data for these squadrons refer only to domestic training, exercises, and operations. Second, deployed units conducted different training exercises and operations than the non-deployed units: they flew more frequent and longer duration sorties.

Table V-1. Selected Statistics for Two Fighter Wings Before and During Desert Shield

			Pre-Desert Period (Jan–Jul 90)			Desert Shield Period (Aug 90–mid Jan 91)		
Date Deployed	Unit	Parent Wing	Sorties Flown	Avg Sortie Duration in hours	No. of Unit and TAC Exercises	Sorties Flown	Average Sortie Duration in hours	Unit Exercises
8 Aug 90	71st TFS	1st TFW	3,569	1.4	8	4,476.5 for the 71st and 27th Sqs combined	3.1 for the 71st and 27th Sqs combined	Weekly exercises plus two joint exercises.
9 Aug 90	27th TFS	1st TFW	3,676	1.3	7			
Not Deployed	94th TFS	1st TFW	3,500	1.3	9	2,209	1.5	1
10 Aug 90	336th TFS	4th TFW	1,762	1.9	16	1,922	2.1	
27 Dec 90	335th TFS	4th TFW	3,678	1.3	10	1,967	1.7	1
Not Deployed	334th TFS	4th TFW	3,213	1.6	14	1,543	1.2	1

[a] The figures in this table are derived the official histories of the 1st and 4th TFWs from January through July 1990 and from August 1990 until mid-January 1991, roughly the end of the Desert Shield period.

Table V-2 shows the kind of information that was available on CENTAF training exercises from September 1990 through January 1991. These exercises were designed to help prepare air crews for the combat environment they would face. Some of the exercises listed (e.g., "Package Training") were conducted on a daily or weekly basis; others (e.g., "Initial Hack") were conducted only once. Both this table and the more complete information we gathered provides information on exercise dates, the type of aircraft that participated, the exercise objectives, and the concept of operation. These tables do not provide information on which aircraft of a squadron or wing, if any, participated in a given exercise, or how often they participated, nor do they provide any meaningful measures of performance.

Table V-2. Desert Shield Training Exercises (sample data)

Exercise	Date	Types of Aircraft Participating	Total Sorties Flown	Objectives	Concept of Operations
Package Training	Weekly Sep 90 - Jan 91	All deployed aircraft types	Over 4,000 sorties estimated	Promote inter-operability of friendly forces, conduct integrated training, and exercise actual operations and procedures, planning, tactics, and C3.	Enhance unit training programs by formally establishing 2 days a week (afternoon and night) for flights, designate mission commanders for each package, and exercise the entire ATO process.
Initial Hack	24-26 Oct 1990	EC-130 AWACS	431	Increase OPTEMPO, C3, two carrier simultaneous operations, joint/combined planning, and tanker operations in multiple, simultaneous refueling tracks.	Exercise tanker and receiver flows to planned orbits and tracks; simultaneous interdiction, close air support, air-to-air operations; use Tabuk, Taif, and Fahad ranges/training areas; fly EC-130 sorties as required.

Table V-3 illustrates the kinds of data available on in-theater training. Its parent table lists the number of training sorties flown separately for the purposes of (1) air-to-air training and (2) air-to-ground training for 46 of the 158 days between 10 August 1990 and 15 January 1991. Training exercises were conducted every third or fourth day. The number of air-to-air sorties flown varied from none (on one of the dates listed) to as many as 30, with no readily discernible trend over time. The number of air-to-ground sorties flown on these dates also varied. These figures show a trend over time, from relatively small numbers at the start (e.g., 24 sorties on 14 August) to much higher ones later (e.g., 560 sorties on 8 January). On most of the 46 days, the number of air-to-ground sorties flown ranged between 213 and 269. Of course, part of this trend is due to the increasing number of aircraft over time during Desert Shield. Finally, the parent table provides a broad measure of the extent to which air-to-ground training was emphasized (26,178 air-to-ground), compared to 2,720 air-to-air sorties) during Desert Shield. This division of operational activity probably reflects the pre-war estimates of the mix of air-to-air/air-to-ground missions that would be tasked during Desert Storm.

Table V-3. CENTAF Training Sorties Flown (sample data)

Date	Air-to-Air		Air-to-Ground	
	Sorties	Training Objectives (all sorties combined)	Sorties	Training Objectives (all sorties combined)
10 Aug. 90	7	Provide dissimilar training. Refine/refresh air-to-air fighting capability. Improve weapon director and fighter aircrew interface/war fighting capability. Practice high value airborne assets (HVAA) protection. Improve E-3 weapons director proficiency.		Exercise all elements of Tactical Air Control System (TACS) that support close air support (CAS) and air interdiction (AI) missions. Confirm that the communications net was able to support the concept of operations.
14 Aug. 90			24	Develop and exercise command and control (C2) procedures and concept of operations of tactical air (TACAIR) force elements in support of land forces. Familiarize pilots and terminal controllers with local terrain, landmarks, and visibility.

All but the final row and column of entries in Table V-4 provide information on operational sorties flown on representative days by Air Force aircraft between 30 August and 4 October 1990 and illustrate the kind of data available through 14 January 1991. The table distinguishes tanker and intratheater airlift sorties from those engaged in "Tactical Support." According to the Air Force, these missions "provided the required security envelope for the massive airlift." The final row provides an average of the weekly figures from 30 August 1990 to 14 January 1991.

Table V-4. Desert Shield Operations Sorties Flown by Component Command (excerpt)[a]

Date	Tactical Support	Tanker	Intratheater Airlift	Total	To-Date
30 Aug. 90	137	25	103	265	265
6 Sep. 90	220	30	160	410	2,987
13 Sep. 90	370	42	215	627	7,013
20 Sep. 90	343	46	218	607	10,972
27 Sep. 90	245	49	199	493	15,064
4 Oct. 90	393	40	214	647	18,841
Average Representative Daily Number	310	56	188	549	Total through 14 January: 76,271

[a] Excerpt from Sheet 4 of Workbook 2 in our Air Force database.

More detailed information is available on operational activity by the following categories: combat air patrol, strategic reconnaissance (U-2, TR-1, RC-135), tactical reconnaissance, electronic combat (F-4G, EF-11, EA-6, EC-130), air refueling, and airlift.

Table V-5 turns to combat activity during Desert Storm. It shows that the Air Force carried out more interdiction sorties than any other type. Table V-5 divides Air Force missions into 13 categories; the original data are further divided into as many as 6 subcategories.

Table V-5. USAF Desert Storm Sorties By Mission Type

Mission Category	Number of Missions	Mission Category	Number of Missions	Mission Category	Number of Missions
Interdiction	24,292	Airlift	16,628	Support	203
Close Air Support	2,120	Reconnais-sance	1,311	Electronic Warfare	1,578
Combat Air Patrol	4,558	Refueling	11,024	C3	604
Offensive Counter-Air	6,422	Special Operations Forces	134	Training	174
Other	358			**TOTAL**	69,406

GWAPS data concentrate exclusively on the types and quantity of training and operational activities undertaken. It does not attempt to evaluate the strengths or

shortcomings of these activities or whether and how shortcomings, if any, were reduced or eliminated.

C. DATA BASED ON WING HISTORIES

This section provides information on aircrew and unit training that is carried on regularly in peacetime. Table V-6 provides an overview of unit flight training for the three squadrons of the 1st TFW for the 2nd, 3rd, and 4th quarters of 1990, i.e., over 7 months of wing activity prior to Desert Shield, and some part of its activity afterwards.[5] These figures, especially those for the average sortie duration, do not appear to be internally consistent. Our Air Force sources are aware of this fact, but claim that these are the figures they received and therefore reported. We calculate that the average sortie durations (hours/sortie) were 1.46, 1.60, and 1.50 hours for the 27th, 71st, and 94th TFS, respectively (rather than 1.33, 1.36, 1.31 shown in the table). As far as the utilization rates are concerned, we see that the actual number of sorties that each pilot flew over this period (18.8 or more monthly) is fairly close to the official objective (i.e., "Programmed Utilization Rate") of 20 sorties. This table shows that the 1st TFW was close to achieving the number of sorties that the Air Force judges appropriate to maintaining combat readiness. It provides no information about the effectiveness of that training.

Table V-6. Flying Hours Program, 1st TFW January-September 1990

Squadron	27 TFS	71 TFS	94 TFS
Hours Flown	8,100.2	8,955.3	7,737.2
Sorties Flown	5,538.0	5,613.0	5,151.0
Programmed Utilization Rate (sorties per pilot per month)	20.0	20.0	20.0
Actual Utilization Rate (sorties per pilot per month)	19.4	18.8	19.5
Actual Average Sortie Duration (hours per sortie)	1.33	1.36	1.31

[5] However, Table V-6 does not cover some of the 27th and 71st Tactical Fighter Squadrons' activities during August and September 1990, since they were deployed. These activities are covered by Table V-1.

Table V-7 provides examples of statistics on aircraft utilization available in our Air Force database, for the first half of 1990 (the parent table covers the period from January 1990 through March 1991). Some findings:

- Before Desert Shield (January through July 1990), the 1st TFW flew between 1,306 and 2,215 hours per month.
- During Desert Shield (August through December 1990), it flew between 2,540 and 3,037 hours per month, an increase of 94 and 37 percent, respectively.
- During Desert Storm, it flew 6,625 hours in January, a 407 percent increase over the 1,306-hour 1990 flying level, and 7,994 hours in February, a 261 percent increase over the 2,215-hour 1990 flying level.

Table V-7. Illustrative 1st TFW Aircraft Utilization Data, Early 1990

Year and Month	Squadrons	Hours Flown	Sorties Flown		Aborts		Average Sortie Duration
			Home Station	Deployed	Air	Ground	
Jan	F15C/D	2,061.0	1,247.0	272.0	7.0	75.0	1.37
Feb		2,215.5	1,172.0	254.0	9.0	67.0	1.35
Mar		1,306.7	939.0	155.0	5.0	49.0	1.38
Apr		2,148.0	1,034.0	322.0	3.0	57.0	1.47
May		1,994.7	1,181.0	196.0	5.0	81.0	1.26
Jun		1,554.8	1,125.0	70.0	10.0	57.0	1.22

Table V-8 reports the IG official performance evaluation of the 1st TFW in the "Eagle Thrust" series of operational readiness exercises conducted in the first half of 1990. Although clearly based on judgment, these output measures show a positive trend in performance.

Table V-8. Examples of 1st TFW Ratings in the Eagle Thrust Series of Operational Readiness Exercises

Activity	Eagle Thrust 90-2 January 9 and 11, 1990	Eagle Thrust 90-3 March 20-22, 1990
Initial Response	Not tasked	Not tasked
Combat Employment	Satisfactory	Satisfactory
Command and Control	Satisfactory	Satisfactory
Maintenance	Excellent	Satisfactory
Operations	Excellent	Excellent
Resources	Satisfactory	Excellent
27TFS/AMU	Excellent	Excellent
Command and Control	Excellent	Excellent
Sortie Generation	Satisfactory	Outstanding
AMU Support	Satisfactory	Excellent
Combat Turnarounds	Satisfactory	Excellent
Combat Sortie	Excellent	Excellent
Weapons	Excellent	Excellent
Intelligence support	Marginal	Excellent
Life Support	Satisfactory	Excellent

Table V-9 similarly reports "grades" (marginal, satisfactory, excellent, outstanding) from the "Dynamic Eagle" exercise series. These grades are estimates of performance in training, and constitute output data based on the professional opinions of Air Force judges concerning various aspects of unit performance. These grades give us some information as to the effectiveness of training. Note that only 9 of 26 tasked activities (over the 3 series) scored 3 or 4 on a 4-point scale.

Table V-9. Examples of 1st TFW Ratings in the Dynamic Eagle Series of Operational Readiness Exercises

Activity	Dynamic Eagle 90-3 April 13, 1990	Dynamic Eagle 90-7 June 8, 1990	Dynamic Eagle 90-8 July 8-9, 1990
Initial Response	Satisfactory	Satisfactory	Excellent
Command & Control	Satisfactory	Satisfactory	Satisfactory
Aircraft Generation	Satisfactory	Excellent	Satisfactory
Mobility	Satisfactory	Satisfactory	Satisfactory
Timing	NA	NA	Outstanding
Quality	NA	NA	Satisfactory
Mobility Work Areas	NA	NA	Excellent
Mobility Assets	NA	NA	Excellent
Unit Mobility Processing	NA	NA	Satisfactory
Aircraft Deployment	Outstanding	Outstanding	Outstanding
Regeneration	Not tasked	Not tasked	Excellent
Security	Satisfactory	Satisfactory	Unsatisfactory
Combat Employment	NA		Not tasked
Ability to Survive and Operate	NA		Not tasked

The ratings indicate that the training was adequate; they do not tell us the likely impact of giving greater emphasis to certain training activities and less emphasis to other kinds.

D. KEY FINDINGS

The Air Force collects and retains extensive amounts of process data on training, such as the number and frequency of training exercises, number of training and operational sorties, and hours flown. It collects and retains only limited output data in the form of evaluations of unit performance during peacetime training exercises and ratings of unit operational readiness resulting from nearly random inspections.

These data are not collected or retained on a systematic basis and are often incomplete. Much of the information we found is not kept in machine readable form, is difficult to find, and not easy to use. Despite assembling an enormous database, we found little data on pre-war operations and training that could be compared to the performance of

individual fliers or air crews or units during Desert Shield or Desert Storm. The Air Force did not retain information on which fliers participated in the unit exercises during Desert Shield.

We found only limited information on individual or unit performance in either training or combat. Thus, we can say little about the effect of training on performance. The F-117 "hit-or-miss" data provide an avenue for addressing some of these questions for a limited sample of the pilots who performed in combat, which is what all training is about.

VI. HIGHER LEVEL AND JOINT DATA ON TRAINING

A. INTRODUCTION

We were unable to find any useful data on high level component and joint staff training. Our interviews confirm that high level component and joint staffs worked very hard but conducted little actual training. Staffs at these levels devoted most of their pre-war efforts to managing the deployment and to war planning. They did not train new staff members and they did not conduct staff training exercises like those of the Army in the Battle Command Training Program (BCTP) and the Air Force in Blue Flag. Internal Look, the simulation exercise that CENTCOM conducted just prior to the Iraqi invasion, was intended to be a feasibility study and not primarily a training exercise.

In addition, it appears that what joint, high-level staff interaction there was did not force the Services to come to grips with contentious issues and left them unresolved. One such issue involved differences between the Army and the Air Force concerning the appropriate use of air power. Another was combat coordination between the Army and Marine Corps. Another was the use by the Navy of the Air Force ATO. These were key issues during the war and they might have been resolved had they been addressed in joint training exercises.

B. COMPONENT AND JOINT STAFF OPERATIONS

Although there are no specific data about high-level component and joint staff performance, several post-war books have identified a number of problems concerning component and joint staff operations. Three known problems are described below.

1. The Safwon Misunderstanding

General Schwarzkopf's staff arranged to meet the Iraqis to impose truce terms at the Iraqi town of Safwon, just north of the Kuwait-Iraqi border on the road from Kuwait City to Basra. When they did so, General Schwarzkopf believed that the town and nearby airfield were in U.S. hands. This was not true. Soon afterwards, the American

commander had to threaten to attack the Iraqis to get them to vacate, even though the cease-fire had already taken effect.

In *Crusade*, Atkinson (1993) explains this event as the result of a failure of communications and understanding between Army commanders at corps and division levels; so do Gordon and Trainor (1994). The question for the Army in this case is whether high level staff training might have sufficiently honed staff performance so that this kind of mistake might have been avoided (and perhaps whether training for war included training for how to handle the end of the war).

2. FSCL Failures and Failures of Air-Ground Coordination and Understanding

The Fire Support Coordination Line (FSCL) is alleged to have constrained the operation of Army attack helicopters. An example involves the FSCL limit at the 20th Easting. At 2100 26 February, the 11th Aviation Brigade began attacks into three "kill boxes." The Apaches were ordered not to attack beyond the eastern boundary of their kill boxes because the Air Force was supposed to take care of any targets that appeared there. When the Air Tasking Order was developed more than 1 day earlier, no one expected that the VII Corps would be in a position to launch helicopter strikes into this area so soon, or that the Iraqi Army would be retreating in large numbers through it. In the event, though, Apache pilots watched as hundreds of Iraqi vehicles proceeded northwards. They escaped because "in the limited time available, ARCENT could not portray to CENTCOM how successful Franks' deep attack had been and how devastating a strike east of the 20 grid line would have been." (Scales et al., 1993, p. 290)

It appears, on the basis of this example and others, that there were significant disconnects between the Army and the Air Force throughout the Gulf War. Would high-level joint-staff exercises before the war have led soldiers and airmen to see how constraining FSCLs would prove in a battle? And if they had, would it have been possible to overcome the rigidity inherent in the Army/Air Force system? Such exercises were never conducted.

3. Escape of the Republican Guard

The fact that much of Saddam's Republican Guard got away, now widely regretted, is variously explained in several accounts. In *Certain Victory,* Scales (1993) cites problems with the Air Tasking Order and the failure to destroy bridges and causeways that

permitted the Iraqis to get away. In *The General's War*, Gordon and Trainor (1994) cite the unanticipated ease and resulting speed of the Marines' head-on attack, and the fact that the Iraqis started pulling out so quickly that the Army was hard pressed to close off their retreat. They also cite the White House decision to end the war at 100 hours. These problems appear to be the result of command and control problems at the highest staff levels. This failure might have been avoided if high level staffs had exercised together, or even played a scenario on what to do when they succeeded.

C. PRE-DEPLOYMENT AND POST-DEPLOYMENT TRAINING

All Services conducted pre-deployment and post-deployment training for active and reserve component forces but there were no plans for most of this training. In the Army, pre-deployment training was provided to active component combat forces by other, usually active component, forces. In Germany, for example, V Corps units supported the pre-deployment training of VII Corps units. Eighteenth Airborne Corps units arrived in the desert expecting war to be imminent. When the war did not come, they decided to continue their training but discovered that they needed to bring more equipment and personnel from the CONUS to assist in their training. Both the pre-deployment and the post-deployment training helped to increase the combat capability of U.S. forces, but one wonders how much better they might have been or how much more efficient the training might have been had pre-war plans included provisions for this training.

VII. CONCLUSIONS

A. INTRODUCTION

Success in the Gulf War was due to a combination of factors—the key word is combination—that includes superior weapons, planning, leadership, logistics, intelligence, personnel, national commitment, training, and an enemy superior mainly in brashness. All of these factors but training have received considerable attention and analytical review; our research effort has been designed to fill this gap. It is clear that all services trained intensively and conscientiously in preparation for combat. However, there is little information on the precise nature or goals of training for that war and essentially no information on the output of training in terms of performance levels achieved by that training. We looked for such data, and with two exceptions, did not find any. In this chapter, we offer our conclusions.

B. TRAINING: PERFORMANCE DATA

1. The Services Produce Voluminous Records on Training

Military units of all services produce training plans and train individuals and units in accord with those plans. They evaluate the performance of individuals and units in many of these training activities. Many units, especially naval and aviation units, produce records of their peacetime operations. When these records are saved, it is possible to gather large volumes of data on peacetime training and operations. The Navy, for example, collects data on daily flying hours and retains them indefinitely in an automated data base. Unfortunately the bulk of these data are collected for budget or maintenance purposes and not for training. In the Army, for example, tank mileage is used as a measure of training OPTEMPO, but these data are collected and maintained as part of the Army maintenance system, not as part of a training system. As a result, the data say nothing about the training accomplished during those tank miles and nothing about how much the training may have improved the performance of the crews. The Air Force maintains extensive data on flying hours and type of sorties by pilot, but the data do not include information on performance in training, and most of the data are discarded after 1 year. If we started our search right

after the War, we might have been able to obtain significant amounts of data about recent training accomplishments in all of the Services; at the time of our study, however, we were unable to find much detailed data on Gulf War training except for that conducted by the Navy.

2. Most Performance-in-Training Data that Are Useful Are Not Saved and Assembled Centrally; the Available Data Have Limited Value for Training

The Army assesses performance in the course of training individuals and units. Using data on unit performance and on the training experience of those units' members, one might be able to assess the effects of training on performance in training. However, our review of Army records from the Gulf War period revealed that such data are not collected systematically or saved.

The Navy assesses performance in the course of certifying individuals and units prior to deployment and maintains these data in centralized data bases.[1] Recent improvements in data keeping should make this information more readily available in the future.

Although the Air Force assesses performance in the course of training individuals and units, most of the data collected and saved describe only the number and frequency of training events and sorties, but not the results of the training. One exception is tactical air drops, where navigators are regularly evaluated and their performance records are retained at the unit level. Thus, despite assembling an enormous database on pre-war operations and training, we found little data that would permit us to compare the performance of individuals or to assess unit performance in light of unit training.

Extensive information exists on Air Force assessments of unit performance in peacetime, in the form of "grades" given for unit performance in Operational Readiness Exercises (self evaluations) and Inspections (external evaluations). Unfortunately, these data are often incomplete.

The limited availability of training performance data, other than that of the OPTEMPO type, is more than a matter of administrative oversight. The quality of a unit's

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1 For example, the Navy regularly assesses air crew performance in landing on carriers, on bombing accuracy, and on air-to-air combat exercises. For more information on these data, see Colin Hammon and Stanley Horowitz, *Flying Hours and Crew Performance*, IDA Paper P-2379, March 1990, and *Relating Flying Hours to Air crew Performance: Evidence for Attack and Transport Missions*, IDA Paper P-2609, June 1992.

performance may be seen as a reflection of its commander and the dissemination of negative data could have an impact on his career. Here, it may be sufficient to say that the limited availability of training performance data is ultimately a disservice to efforts to identify the linkages between training and performance, a matter of genuine concern throughout the Department of Defense. In addition, it is now easily possible to collect and use pertinent training performance data without infringing on the privacy or culture of the military community. Incidentally, a commander's direct superiors usually have access to the information they need to accurately assess his unit's performance.

3. U.S. Forces Trained Well at the Individual and Tactical Levels

We interviewed members of all the Services and their accounts provide strong and credible evidence that all U.S. units trained in an intensive and conscientious manner. Moreover, our forces trained well at both individual and tactical levels (i.e., at the level of Army battalions, Air Force squadrons, Navy ships and squadrons, and below).

Although we have virtually no data to demonstrate the quality of training, the fact of the coalition's spectacular victory at a low cost in casualties reinforces the case that U.S. forces trained well at those levels.

4. U.S. Forces Performed Remarkably Well in Combat

During every phase of the war, U.S. forces performed according to plan, quickly won the war, and sustained few casualties. In any human enterprise as vast as the war against Iraq, there are bound to be mistakes. It is not surprising, therefore, that we found instances of various kinds of errors—fratricide, missed targets, and inaccurate intelligence—in the records and by interviewing participants in that war. Even so, the really stunning feature of U.S. forces' performance in that war is the extent to which potential human mistakes did not occur. For example, in the course of the thousands of sorties flown by the air arms of all the Services and our allies, and the myriad aerial interactions needed to refuel in the air and assemble to conduct raids on the enemy, the absence of mid-air collisions is notable.

5. Apart from Believable Anecdotal Evidence, We Have Little Data on Combat Performance at the Tactical Level

Although the U.S. forces performed very well overall, it is reasonable to believe that some units performed better than others. However, we have not found data that would

permit us to make systematic and objective comparisons to identify and assess such differences in performance and to attempt to link these differences to training. We have no data with which to compare one Army unit's training with that of another and their performance in combat. We have been able to collect a limited amount of data on Navy air strikes on bridges and on Air Force F-117 air strikes on targets with precision guided bombs. These data may allow us to examine the link between training and performance in these two specific cases.

The DoD did not retain and assemble the data needed to permit systematic examination of the effect of training on combat performance in the Gulf War. Thus, despite our overwhelming victory, this recent pre-war and wartime experience cannot be analyzed to improve the allocations of resources to training for combat now and in the future. Similarly, analysts cannot use that experience for insights into more accurately assessing the readiness of today's forces or more efficiently budgeting for tomorrow's forces.

C. TRAINING: IMPLICATIONS FOR IMPROVEMENTS

1. Even if We Had Good Data on Training, We Would Not Be Able to Relate Training to Combat Performance

This is a discouraging finding. It means that the Services have not established procedures that would enable them to learn as much as they might have learned from their experience in preparing for war. This finding bears a clear implication. We need to devise procedures that will ensure that all of the Services produce, save, and assemble data on performance in combat. We need also to take steps so that we can then relate that combat experience to the training of the units that took part.

2. U.S. Forces Did Not Systematically Train Higher Level and Joint Staffs

It appears that staffs devoted most of their pre-war efforts to managing the deployment and to war planning. They did not conduct training for new staff members, and they did not conduct staff training exercises such as those the Army conducts in the Battle Command Training Program. In addition, it appears that what joint, high-level staff interaction there was did not address differences between the Army and the Air Force concerning the appropriate use of air power.

3. Pre-Deployment and Post-Deployment Training Were Ad Hoc

Although all the services conducted pre- and post-deployment training, for most of this training, there were no plans. One wonders how much better U.S. troops would have been or how much more efficient this training might have been had pre-war plans included provisions for it.

VIII. RECOMMENDATIONS

A. ALL SERVICES

1. Collect and Retain Training and Operational Data

CINCs and Services must be responsible for collecting, retaining, and interpreting data on training and operations, both during peace and war. All Services should collect and retain data on training accomplishment and assessment, and on operational performance. CINCs should collect and retain joint assessment data on training and operations, in peace and war. Data of the lessons learned type, i.e., JULLS (Joint Universal Lessons Learned System) and CALLS (Center for Army Lessons Learned System), typically do not contain lessons learned about training or about performance improvements achieved through training.

Advances in computer and communications technology have made it possible to collect and retain data with much greater efficiency and much less cost than in the past; the DoD should take advantage of these changes. As much as possible, data should be collected by embedded systems, and maintained in a form that makes it accessible to those who need it. The guiding principles should be to enter the data only once, to save it permanently, and to make it accessible to others using currently available database management and communications systems. These systems can also protect the privacy of commanders and units since it is possible to ensure anonymity in a database system, and there is no need to identify individuals or units for purpose of analysis.

If peacetime data are to provide a useful basis for wartime planning, the same kind of performance data should be collected in peacetime and wartime. These data may be both objective and subjective and can be collected by CINCs and component commanders. To the extent possible, these activities should be the same in both peace and war. "Train as you fight and fight as you train."

At the Defense Manpower Data Center, the Department of Defense maintains detailed personnel data, including the names of all the members of all DoD units, when they joined those units, and the units in which they served and trained previously. We

recommend that the Services also maintain data on unit performance in training and in exercises. When assessments are made at the level of very small units (e.g., the performance of commander/gunner teams in tank gunnery, the performance of B-52 crews, etc.), then the Services should retain the results of those assessments, stamped for both time and place and for the names of the unit personnel. We also recommend that information normally part of an individual's Service and educational records be made available for analysis. If all of that information can be readily retrieved, it will be easier to test hypotheses concerning the relation between unit performance, on one hand, and the characteristics of units and of the individuals who compose them, on the other.

The Services already produce at least some of the subjective judgment and assessment data that we want to save, in the course of monitoring their current training. We recommend not simply that the Services retain and assemble these data, but also that they change their performance-assessment practices in ways that will support efforts to measure the effects of individual and unit training. In particular, the Services need to evaluate and maintain records on performance at the level of small units (e.g., an aircrew) and discrete tasks (e.g., a successful intercept or victory in a dogfight). That will make it possible to relate the training and experience of the individuals to the performance of the unit.

The Services should also collect and retain data on the performance of larger units and staffs. Indeed, our discussion on the performance of high-level staffs in the Gulf War suggests that neglect of staff training can lead to serious consequences. The challenge for the Services and CINCs is to assess the performance of larger units and staff in a way that will permit them to discern the effect of training on their performance. Various efforts to collect and analyze performance at the National Training Center and Red Flag, for example, show that some steps in this direction have already been taken and should, of course, be continued and enlarged.

2. Use the Lessons Learned Process

The Joint Universal Lessons Learned System (JULLS) and the Service lessons learned systems should include training and performance data as major items of interest for data collection and preservation. Although each Service collects Service-unique data, data on training should also be useful for joint and cross-Service purposes. To the extent possible, such data should be

- task oriented and tied specifically to a Joint Mission Essential Task List and to a Service Mission Essential Task List;
- collected at multiple levels concerning key individuals, e.g., unit commanders, pilots, key staff officers; small groups, e.g., crews, squads, ship departments, flights; basic combat units, e.g., battalion, ship, squadron; large component units, e.g., Corps, Fleet, Numbered Air Force, Marine Expeditionary Force (MEF) battle staffs; and Joint Task Force and CINC battle staffs;
- collected for enablers as well as units, e.g., battle staffs and intelligence organizations;
- similar across Services in nature and level of detail; and
- comprised of performance and evaluation data as well as training accomplishment data.

3. Plans and Commitments for Operational Assessments Should Be Made in Advance

During the Gulf War, the CINC was reluctant to allow outside evaluators of any kind into the theater. He was naturally concerned with defending against an Iraqi attack and winning the war. Had plans for training and assessment been made in advance and exercised, this reluctance might have disappeared and allowed the collection of truly useful training and performance data. In the future, the collection of these data should be made a normal and integral part of training exercises and actual operations.

4. Plan in Advance for Pre-Deployment and Post-Deployment Training

All Services and CINCs should plan and provide resources for pre-deployment and post-deployment training for active and reserve component forces. These plans should be based on the anticipation that there will be special tasks that need to be trained for and the recognition that, with prior planning, significant amounts of training can be accomplished.[1] Both pre-deployment and post-deployment training should include training and rehearsals for support forces and for Service and Joint battle staffs.

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1 The United States conducted extensive post-deployment, in-theater training in World War I, World War II, the Korean War, as well as the Gulf War.

5. Report Training Readiness on a Consistent Basis

Training data can and should be used as a basis for reporting training readiness. The Status of Resources and Training System (SORTS) lists three acceptable ways of determining training readiness:

1. Days of training needed to be fully trained.
2. Percent of crews operationally ready and available.
3. Percent of mission-essential tasks trained to standard.

The existence of these three ways of reporting training readiness leads to inconsistency because the Services use different measure. By linking the missions assigned to a unit by a CINC with that unit's assessment of its training readiness to conduct those missions, only the last measure provides a direct way of relating training readiness to the ability to conduct joint operations.

B. ARMY

1. Automate Data-Gathering for Operational Purposes

In the course of conducting future operations on the digitized battlefield, the Army can gather data for operational purposes that will also prove useful for evaluation of training and performance. Consider, for example, such immediate purposes as logistics, supply, medical evacuation, IFF (identification, friend or foe), fire support, and directions given by a headquarters to its subordinate units. To serve these ends, future vehicles—and even some individual soldiers—will likely have embedded sensors that will automatically gather and transmit a wide range of real-time, operational data, including vehicle identity and location.

These data would be transferred from individual sensors (e.g., those on a tank that record its location, heading and speed, main gun azimuth and fires, fuel and ammunition status, and tactical inputs concerning friendly and enemy forces) to data banks maintained elsewhere. Such data are already available in simulation systems such as SIMNET, and we may see a case of life following art.

As it develops Army XXI and the Digital Battlefield, the Army should make provisions for automatically collecting training and performance data at every level from the individual to the Army headquarters.

2. Using Operational Data for Analysis

Suppose that the Army does equip itself to gather data for operational purposes, as described above. If retained, such information might permit the Army to reconstruct its soldiers' actions in the kind of detail now possible only for the 73 Easting battle. Reconstruction along these lines would make it possible to assess individual and unit performance much more accurately than ever before and to develop insight and understanding not previously achievable.

In addition to gathering data for immediate operational purposes and after-the-fact performance evaluation, the Army should gather data that will permit it to assess the impact of training. Army efforts to do so should cover information of the sort completed for 73 Easting, and much else besides. Over time and through repetitions of training exercises, for example, the Army should seek to determine which tasks prove easy and hard to learn. It should also try to find out how long soldiers can retain skills without further training. Answers to these questions will permit Army units to teach soldiers more efficiently and better allocate resources to training.

C. NAVY

The Navy currently collects individual and unit training and peacetime performance data sufficient to meet most needs. These data should be stored and made available in automated databases that can be readily accessed. Aircraft squadrons and ships are equipped with desktop computers, and much of the data available now only in hard copy can now be made easily accessible in digital format.

Navy flying hour data are maintained in the Naval Flight Information System (NAVFLIRS). These data are recorded by flight and maintained indefinitely by the Naval Sea Logistics Center (NSLC) and the Navy Safety Center (NSC). These data are summarized by pilot, NFO (Naval Flight Officer) and by aircraft type at the end of each fiscal year and maintained in a computer database at the NSC. The NAVFLIRS provides records of time spent on instrumented ranges, ordnance delivered and miss distance, by crews exercising on an instrumented range; it also provides records of flight simulator hours. These data are kept locally and are not generally accessible for program or policy analysis. These data should be made accessible as the Navy automates.

In general, the Navy surface and submarine forces now have the capability to provide automated unit training data—e.g., the Type Commander Readiness Management System (TRMS)—to higher commands and to the research community. Additional data

that are currently kept by each unit and not required to be automated or forwarded should be maintained in a standardized database that is accessible for analysis. Particular attention should be paid to systematically structured data on performance in multi-ship exercises, since this is the closest peacetime analogue to performance in battle.

D. AIR FORCE

A future Air Force training record-keeping system should be structured to enable analysts and policy makers to (1) evaluate or estimate the degree of training readiness of Air Force units for combat activity at any time and (2) provide sufficient information to enable the service to allocate its training resources in ways that will maximize each unit's readiness and correct deficiencies found during evaluations. To achieve these two general goals the Air Force should create and maintain an automated database that will provide sufficient information to relate observed performance to the various types of training that produced it.

Although such an automated database does not currently exist, many items of information needed for it are already being collected. Additional items needed deal principally with reporting the various training exercises in which each pilot participated, the purposes these exercises were designed to serve, the tasks the individual pilots were asked to fulfill, and the quality of fulfillment. These items should also be collected and retained in an automated data base.

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GLOSSARY

ACM	Air Combat Maneuvering
ACR	Armored Cavalry Regiment
AHAS	Army Historical Archive System
AI	Air Interdiction
AMU	Air Mobility Unit
ARCENT	Army Central Command
ARPA	Advanced Research Projects Agency
ATG	Afloat Training Group
ATO	Air Tasking Order
AWACS	Airborne Warning and Attack Control System
BCTP	Battle Command Training Program
BDA	Bomb Damage Assessment
BGIT	Battle Group Inport Training
C2	Command and Control
C3	Command, Control, and Communications
CAC	Combined Arms Center
CALL	Center for Army Lessons Learned
CART	Command Assessment of Training
CAS	Close Air Support
CENTAF	Central Air Force
CENTCOM	Central Command
CINC	Commander-in-Chief
CINC USCENTCOM	Commander-in-Chief US Central Command
CMTC	Combat Maneuver Training Center
CNA	Center for Naval Analyses
CO	Commanding Officer
COMPEX	Competitive Exercise
COMPUTEX	Composite Training Unit Exercise
COMUSNAVCENT	Commander US Navy Control
CTAPS	Contingency Tactical Air Control Planning System

CVBG	Carrier Battle Group
CVW	Carrier Wing
(D)ARPA	(Defense) Advanced Research Projects Agency
DoD	Department of Defense
ECM	Electronic Counter-Measure
ETG	Engineering Training Group
FFARP	Fleet Fighter Air Combat Maneuvering Readiness Program
FLEETEX	Fleet Exercise
FMCR	Full Mission Capable Rate
FSCL	Fire Support Coordination Line
FTG	Fleet Training Group
GWAPS	Gulf War Air Power Survey
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
HVAA	High Value Airborne Assets
IFF	identification, friend, or foe
IG	Inspector General
ITA	Intermediate Training Assessment
JFACC	Joint Forces Air Component Commander
JTFEX	Joint Task Force Exercise
JULLS	Joint Universal Lessons Learned System
MAGTF	Marine Air Ground Task Force
MCR	Mission Capable Rate
MEF	Marine Expeditionary Force
METL	Military Essential Task List
MILES	Multiple Integrated Laser Engagement System
MISSILEX	Missile Exercise
NATO	North Atlantic Treaty Organization
NAVFLIRS	Naval Flight Information System
NFO	Naval Flight Officer
NSC	Naval Safety Center
NSLC	Navy Sea Logistics Center
ONI	Office of Naval Intelligence
OPEC	Oil Production Export Council
OPPE	Operational Propulsion Plant Examination
OPTEMPO	Operating Tempo

ORSE	Operational Reaction Safeguard Exam
PIRAZ	Positive Identification and Radar Advisory Zone
PMR	Primary Mission Readiness
RFT	Refresher Training
RTF	Return to Force
SEAD	Suppression of Enemy Air Defense
SFARP	Strike Fighter Advanced Readiness Program
SIMNET	Simulator Networking
SLATS	Strike Leader Attack Training Syllabus
SORTS	Status of Resources and Training System
SWA	Southwest Asia
TACAIR	Tactical Air
TACS	Tactical Air Control System
TFS	Tactical Fighter Squadron
TFW	Tactical Fighter Wing
TLAM	Tomahawk Land-Attack Missile
TRMS	Type Commander Readiness Management System
TSTA	Tailored Ship Training Availability
UCOFT	Unit Conduct of Fire Trainer
VF	Fighter Aircraft
UN	United Nations
USACOM	United States Atlantic Command
USCENTCOM	US Central Command
VA	Attack Aircraft
VAQ	Tactical Electronic Warfare Aircraft
VAW	Airborne Early Warning Aircraft
XO	Executive Officer

APPENDIX A

INTERVIEWS

APPENDIX A
INTERVIEWS

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BG Robert H. Scales, author of *Certain Victory: The U.S. Army in Desert Storm*

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APPENDIX B

SUPPORTING DOCUMENTATION FOR ARMY DATA

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APPENDIX C

SUPPORTING DOCUMENTATION FOR AIR FORCE DATA

APPENDIX C
SUPPORTING DOCUMENTATION FOR AIR FORCE DATA[1]

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[1] This document is stored in Control and Distribution, Institute for Defense Analyses, under IDA Log. No. HQ 95-47516/1.

Comparable Training, Exercise and Operations Data for Six AF Wings that Deployed to Southwest Asia are available in Respective Wing Histories Stored in IDA's Document Control and Distribution Office. These Histories are:

1. Log No. E94-259768—History of the 20th Tactical Fighter Wing.
   1 July 1990–30 June 1991. Volume 1: Narrative
2. Log No. E93-257743—History of the 33rd Tactical Fighter Wing.
   January–December 1990. Volume 1
3. Log No. E93-257741—History of the 37th Fighter Wing.
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4. Log No. E94-259765—History of the 42nd Bombardment Wing.
   January–December 1990. Volume 1: Narrative

   Log No. E94-259766–History of the 42nd Bombardment Wing.
   January–December 1990. Volume 1: Narrative
5. Log No. E93-257742—History of the 354th Tactical Fighter Wing
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   Log No. E93-257748—History of the 363rd Tactical Fighter Wing
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The purpose of this study was to determine the effect of training prior to and during Desert Shield on the performance of Service and Joint forces during Desert Storm. Our forces trained extensively and won the war. Voluminous records on training accomplishments were produced but not saved and assembled centrally for analytical review and lessons learned. Data on performance during combat, which would have great value for determining the effects of training, tend not, with a few exceptions, to identify the individuals who were involved. Recommendations are made for collecting, organizing, and using training and performance data during peace and war and operations other than war.

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