Command in Air War:
Centralized vs. Decentralized Control of Combat Airpower

by

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Abstract

This study answers the question, "What has been the impact of the Information Age on the Air Force's doctrinal tenet of "centralized control and decentralized execution?" It traces the evolution of command and control of airpower through operations Desert Storm, Allied Force, Enduring Freedom, and Iraqi Freedom and compares its practice with classic theories established by Huntington, Cohen, Van Creveld, and Air Force doctrine. In the absence of a peer superpower in the 1990s, U.S. decision-makers often resorted to the use of detailed constraints to gain direct influence on military operations. The more detailed the constraints from the strategic level, the closer the theater military commander held authority for planning air strikes, and the less proactive the air component was in coordinating with other components. The Air Force developed the Air Operations Center (AOC) to put together battlespace information; it is not yet possible to do this at lower levels, so the AOC has become dominant in controlling air operations. Initially resistant to get involved in ongoing missions, commanders found the AOC was needed to accomplish some "time-sensitive targeting" missions; however, they have also learn to delegate to speed up the processes. But the insertion of the AOC into ongoing operations also led to distribution of tasks—where before the aircrew had performed the whole "kill chain" sequence, now the aircrew often performed only the end game tasks. This distribution could increase the potential for system accidents because people tend to drift from procedures during slack times and thus to be dis-integrated when the system becomes tightly coupled. Technology has not changed the fundamental principles of command and control. The information, telecommunications, sensor and weapons technology have altered the way these humans perform their jobs, and even the jobs they perform. But commanders still need to cultivate a learning organization. Uncertainty and the coupling of diverse organizations still require that they balance empowerment with accountability by developing depth in the command relationships among their subordinates. Commanders can best gain this depth through deliberate delegation, a bruising debate, and assessment of results rather than management of specific details.

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Acknowledgements

I did not understand at first when a professor, after reading my proposal for this dissertation, said, "I commend you on your willingness to tackle this project." The truth is, I did not know what I was getting into. That I have not exhausted the subject is certain; that I have not clearly communicated all I have learned is due entirely to my own shortcomings; but that the work has become more than I thought it could at first is due to the tremendous contributions of many people.

The journey began when the people at the School of Advanced Air and Space Studies believed in me enough to give me their support, both material and moral.

The people at MIT proved the value of that institution through the challenge of meeting the often un-stated but ever-present standards. David Mindell's writings and classes were the basis for a lot of the ideas in this book. He allowed me freedom with ideas but guided me through the process, giving me reassurance that I was on the right path. Sheila Widnall modeled some of the principles in this book—she let me do the writing, but sent me back to the drawing board until it made sense to me. Joe Sussman boosted my morale by being interested enough to offer to help, and Ted Postol challenged me to be honest just by being that way. Michael Schrage set an example for me and spurred by reading my drafts, taking the time to give me an honest opinion, and challenging me to get real.

The people at the Air Force Historical Research Agency, especially Joe Caver, made it easy to get access to but kept me from getting lost in the incredible quantity of data available from the recent conflicts.

Many military professionals gave generously of their time to explain the inner workings of this system I have labeled "CAOS." I can only hope I have done justice to the conscientious way they approach the difficult job of making decisions under uncertainty. Many of their names appear in writing, but I would like to thank them for taking the time to educate me: "Calvin," "Zam," "UB," "Stilly," "Alien," "Zing," "Goldie," "Knob," TSgt Frank Lofton, TSgt Bryan Lanning, Col Jeff Hodges, Col Gary Crowder, Maj. Gen. David Deptula.

There were other professionals, some of them retired military officers and some not, who work tirelessly to develop and implement the technology and procedures. Many of these doors opened through Ed Green, who put me in touch with talented and dedicated Mitre people like Carmen Corsetti, Mike Carpenter, and Jack Sexton, Roger Dumas, and Ed Enos. TSgt Dave Pacheco made it possible for me to have a home at Hanscom Air Force Base to see what goes on in the world of C4ISR.

Perhaps the most influential were my family. My wife and kids and I became a much stronger team during the research and writing of this thesis by resolving the tension between work and family.

While my wife was home-schooling, I had to learn to get work done when I really wanted to play with my kids. Fortunately, they got me to play sometimes. Their support and love kept me sane.

And to the One who is really in control, my Lord. In my heart I plan my course, but You determine my path.

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List of Illustrations

Acronyms

AAA	Anti-Aircraft Artillery
ABCCC	Airborne Battlefield Command and Control Center
AC2A	Aerospace Command and Control Agency
ACCE	Air Component Coordinating Element
ACE	Air Command Element
ACO	Air Control Order
ACP	Air Control Plan
ACTD	Advanced Concept Technology Demonstration
ADOCS	Automated Deep Operations Coordination System
AFATDS	Advanced Field Artillery Tactical Data System
AFC2ISRC	Air Force Command and Control and Intelligence, Surveillance, and Reconnaissance Center
AFM	Air Force Manual
ALO	Air Liaison Officer
AOC	Air Operations Center, see also "CAOC"
AOD	Air Operations Directive
ASOC	Air Support Operations Center
ASR	Air Support Request
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
BCD	Battlefield Coordination Detachment
BCL	Battlefield Coordination Line
BDA	Battle Damage Assessment
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, and ISR
CAFMS	Computer-Assisted Force Management System
CAS	Close Air Support
CAOC	Combined Air Operations Center, see also "AOC"
CAOS	Combat Air Operations System
CCO	Chief of Combat Operations
CENTAF	Central Command Air Forces
CENTCOM	Central Command
CIA	Central Intelligence Agency
CFACC	Combined Forces Air Component Commander, see also "JFACC"
CFC	Combined Forces Commander, see also "JFC"
CFLCC	Combined Forces Land Component Commander, see also "JFLCC"
CFSOCC	Combined Forces Special Operations Component Commander, see also "JFSOCC"
CINCPAC	Commander-in-Chief Pacific Air Forces
CLIOS	Complex Large-scale Integrated Open System
COCOM	Combatant Command Authority
COP	Common Operating Picture
CRC	Control and Reporting Center
CRP	Control and Reporting Post
CTAPS	Contingency Theater Air Planning System
CTCB	Combined Targeting Coordination Board, see also "JTCB"
DAL	"Developing Aerospace Leaders" initiative
DASC	Direct Air Support Center
DASC-A	Airborne Direct Air Support Center

DEAD	Destruction of Enemy Air Defenses
DMPI	Desired Mean Point of Impact
EFX	Expeditionary Force eXperiment
ETAC	Enlisted Tactical Air Controller
F2T2EA	Find, Fix, Target, Track, Engage, and Assess
FAC	Forward Air Controller
FAC-A	Airborne Forward Air Controller
FM	Field Manual
FSCL	Fire Support Coordination Line
GCCS	Global Command and Control System
GPS	Global Positioning System
HARM	High-speed Anti-Radiation Missile
HUMINT	Human Intelligence
IADS	Integrated Air Defense System
IDM	Improved Data Modem
IFF	Identify-Friend-or-Foe
IPs	Initial Points
ISR	Intelligence, Surveillance, Reconnaissance
IT	Information Technology
ITS	Interim Targeting Solution
JAC	Joint Analysis Center
JCAS	Joint Close Air Support
JCT	Joint Critical Target
JDAM	Joint Directed Attack Munitions
JEFX	Joint Expeditionary Force eXperiment
JFACC	Joint Forces Air Component Commander, see also "CFACC"
JFC	Joint Forces Commander, see also "CFC"
JFLCC	Joint Forces Land Component Commander, see also "CFLCC"
JFSOCC	Joint Forces Special Operations Component Commander, see also "CFSOCC
JGAT	Joint Guidance, Apportionment, and Targeting cycle
JIPTL	Joint Integrated Prioritized Targeting List
JSOA	Joint Special Operations Operating Area
JSOAC	Joint Special Operations Air Component
JSOTF	Joint Special Operations Task Force
JSTARS	Joint Surveillance Targeting and Radar System
JTAC	Joint Tactical Air Controller
JTCB	Joint Targeting Coordination Board, see also "CTCB"
JTIDS	Joint Tactical Information Distribution System
JTSTM	Joint Time-Sensitive Target Manager
JTT	Joint Targeting Toolkit
LANTIRN	Low-Altitude Navigation and Targeting Infra-Red for Night
KEZ	Kosovo Engagement Zone
KI	Killbox Interdiction
KLA	Kosovo Liberation Army
LGB	Laser Guided Bomb
MAAP	Master Air Attack Plan
MAP	Master Attack Plan
MARLO	Marine Liaison Officer
MC2A	Multi-sensor Command and Control Aircraft
MEF	Marine Expeditionary Force
MTI	Moving Target Indicator

NALE	NAval Liaison Element
NATO	North American Treaty Organization
NCW	Network Centric Warfare
NFZ	No-Fly Zone
NSC	National Security Council
NVG	Night Vision Goggles
OAF	Operation Allied Force
ODA	Operational Detachment Alpha
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OPC	Operation Provide Comfort
OODA	Observe-Orient-Decide-Act
OPCON	Operational Control
PACAF	Pacific Air Forces
PGM	Precision Guided Munition
PSAB	Prince Sultan Air Base
RAF	Royal Air Force
RMA	Revolution in Military Affairs
ROE	Rules of Engagement
RPV	Remotely Piloted Vehicle
RTS	Real-time Targeting System
SAC	Strategic Air Command
SAM	Surface-to-Air Missile
SAR	Synthetic Aperture Radar
SAS	British Special Air Service
SCAR	Strike Coordination and Reconnaissance
SCIF	Secret Compartmented Information Facility
SEAD	Suppression of Enemy Air Defenses
SEATO	SouthEast Asia Treaty Organization
SIPRNET	Secure Internet Protocol Router NETwork
SODO	Senior Offensive Duty Officer
SOLE	Special Operations Liaison Element
SOP	Standard Operating Procedure
SOTAC	Special Operations Tactical Air Controller
SPINS	Special Instructions
STO	Space Tasking Order
SWC	Space Warfare Center
TAC	Tactical Air Command
TACC	Tactical Air Control Center
TACP	Tactical Air Control Party
TACON	Tactical Control
TACS	Theater Air Control System
TADIL	TActical Digital Information Link
TAGS	Theater Air-Ground System
TBMCS	Theater Battle Management Core Systems
TCT	Time-Critical Targeting
TLAM	Tomahawk Land Attack Missile
TST	Time-Sensitive Targeting
TWM	Target Weaponeering Module
UAV	Unmanned Aerial Vehicle
U.N.	United Nations

USAF	U.S. Air Force
VOIP	Voice Over Internet Protocol
VTC	Video Teleconference
WOC	Wing Operations Center
WMD	Weapons of Mass Destruction
WWMCCS	World-Wide Military Command and Control System
XML	eXtensible Markup Language

Cast of Characters

Name and rank	Role
Albright, Madeleine	Secretary of State during Allied Force
Altobelli, Mark, Maj., USAF	Chief, MAAP Cell in Combat Plans Division during Enduring Freedom
Backes, Gary, Lt. Col., USAF	Time Critical Targeting Cell team member and instructor in Iraqi Freedom
Boomer, Walter, Lt. Gen., USMC	Commander, 1 MEF during Desert Storm
Boyle, Edward, Col., USAF	Chief, Flex Targeting Cell during Allied Force
Bush, George H.W.	U.S. President from 1989-1993 (during Desert Storm)
Bush, George W.	U.S. President from 2001-present (during Enduring Freedom and Iraqi Freedom)
Butler, Michael	Mitre Engineer for Cursor-on-target
Carlson, Bruce, Lt. Gen., USAF	Commander, 8th Air Force during JEFX 04
Cheney, Richard	Secretary of Defense during Desert Storm, Vice President during Enduring Freedom and Iraqi Freedom
Clark, Wesley, Gen., USA	Supreme Allied Commander Europe (SACEUR) during Allied Force
Cline, Mark, Maj., USAF	Chief, MAAP Cell in Combat Plans Division during Enduring Freedom and Iraqi Freedom
Clinton, William J.	U.S.President from 1993-2001 (during Allied Force)
Coe, Richard, Maj., USAF	F-15E Weapon Systems Officer in Enduring Freedom and Iraqi Freedom
Cohen, William	Secretary of Defense during Allied Force
Conway, James, Lt. Gen., USMC	Commander, 1 MEF during Iraqi Freedom
Corder, John, Maj. Gen., USAF	CENTAF DO after reorg during Desert Storm, similar position to CAOC Director
Corsetti, Carmen	Mitre Program Manager for JEFX
Crigger, James, Col., USAF	Director of Operations, CENTAF during Desert Storm
Crowder, Gary, Lt. Col., USAF	Deputy C-3 in Allied Force and Senior Offensive Duty Officer in Enduring Freedom (by function if not name)
Deptula, David, Lt. Col./Brig. Gen., USAF	Chief of Iraq Cell, Campaign Plans in Desert Storm and CAOC Director in Enduring Freedom
Fogleman, Ronald, Gen., USAF	Chief of Staff of Air Force, 1994-1997
Franks, Frederick, Lt. Gen., USA	Commander, U.S. Army VII Corps during Desert Storm
Franks, Tommy, Gen., USA	CFC during Enduring Freedom and Iraqi Freedom
Glenn, Kevin, Maj., USAF	Chief, ISR Cell in Combat Operations Division in Iraqi Freedom
Glosson, Buster, Brig. Gen., USAF	Director, Campaign Plans Division during Desert Storm
Haave, Christopher, Lt. Col., USAF	Commander, 81st Fighter Squadron during Allied Force
Hagenbeck, Franklin, Maj. Gen., USA	Commander, CJTF-Mountain during Operation Anaconda
Hathaway, David, Maj./Lt. Col., USAF	Chief of Air Campaign Strategy for USCENTAF and Asst Strategy Division Chief in Enduring Freedom and Iraqi Freedom
Haun, Phil, Maj., USAF	A-10 FAC-A during Allied Force
Hodgdon, Jeffrey, Col., USAF	Chief of Time Critical Targeting Cell in Enduring Freedom and Iraqi Freedom
Horner, Charles, Lt. Gen., USAF	JFACC during Desert Storm

Jumper, John, Gen., USAF	Chief of Staff of Air Force, 2001-present
Keenan, William, Lt. Col., USAF	Chief of Combat Operations in Desert Storm
Kimmons, Jeffrey, Brig. Gen., USA	Commander, CENTCOM J-2 during Enduring Freedom and Iraqi Freedom
Knaub, Brett, Maj., USAF	Senior Air Planner in USCENTCOM J-3 Operational Plans Branch for Enduring Freedom and Iraqi Freedom
Koechle, Mark, Lt. Col., USAF	A-10 FAC-A during Allied Force
Lanning, Bryan, Sgt/TSgt, USAF	Enlisted Tactical Air Controller with 24 Mech Division in Desert Storm and Joint Tactical Air Controller with 101 Airborne (Air Assault) Division in Iraqi Freedom
Leaf, Daniel, Maj. Gen., USAF	Commander, ACCE to CFLCC during Iraqi Freedom
Lofton, Frank, SSgt, USAF	Enlisted Tactical Air Controller with 19th Special Forces Group (SFG), 2nd Battalion (Bn), Operational Detachment Alpha (ODA) 923 and 20th SFG, 1st Bn, ODA 2025 in Enduring Freedom; V Corps Air Support Operations Center in Iraqi Freedom
McKiernan, David, Lt. Gen., USA	CFLCC in Iraqi Freedom
McPeak, Merrill A., Gen., USAF	Chief of Staff of Air Force, 1990-1994
Mikolashek, Paul, Lt. Gen., USA	CFLCC during Enduring Freedom
Moore, Royal, Maj. Gen., USMC	Air Commander of MAGTF during Desert Storm
Moseley, T. Michael, Lt. Gen., USAF	CFACC during Enduring Freedom and Iraqi Freedom
Murray, Stephen, Maj., USAF	Chief of Assessments, Enduring Freedom and Iraqi Freedom
Peters, F. Whitten	Secretary of Air Force, 1999-2001
Phillips, Robert, Lt. Col., USAF	Chief of night "Change Cell" in Desert Storm
Powell, Colin, Gen., USA	Chairman, Joint Chiefs of Staff during Desert Storm and Secretary of State during Enduring Freedom and Iraqi Freedom
Renuart, Gene, Maj. Gen., USAF	Commander, CENTCOM J-3 during Enduring Freedom and Iraqi Freedom
Rice, Donald	Secretary of Air Force, 1989-1993
Roberts, Neil, Petty Officer, USN	Navy SEAL during Operation Anaconda
Rumsfeld, Donald	Secretary of Defense during Enduring Freedom and Iraqi Freedom
Ryan, Michael, Gen., USAF	Chief of Staff of Air Force, 1997-2001
Sams, Walter, Lt. Col., USAF	Air Liaison Officer in Desert Storm and F-16 pilot in Iraqi Freedom
Schwartzkopf, Norman, Gen., USA	CENTCOM commander during Desert Storm
Sexton, Jack, Maj.	Chief of Plans, USCENTAF after Desert Storm
Short, Michael, Lt. Gen., USAF	CFACC during Allied Force
Trace, Bryan, Wg Cmdr, RAF	Asst Chief, TCT Cell during Iraqi Freedom
Tritschler, Phil, Lt. Col., USAF	Assistant Chief of Combat Operations in Desert Storm
Wald, Charles, Lt. Gen., USAF	CFLCC during first two months of Enduring Freedom
Wallace, William, Lt. Gen., USA	V Corps Commander in Iraqi Freedom
Waller, Calvin, Gen., USA	Deputy Commander, CENTCOM during Desert Storm
Warden, John, Col., USAF	Director of Checkmate during Desert Storm
Welch, Larry, Gen., USAF	Chief of Staff of Air Force, 1986-1990
Widnall, Sheila	Secretary of Air Force, 1993-1997
Young, Shelley, Capt., USN	JAG for CENTCOM during Enduring Freedom

Chapter 1

Introduction

On 2 April, 2003, the U.S.-led coalition seemed to have won the war in Iraq. In 21 days, they had invaded Iraq, pushed past Iraq's regular army and paramilitary fighters, and entered the city of Baghdad. When a group of Iraqis climbed a statue of Saddam in Firdos Square and looped a rope around its neck, U.S. Marines backed an armored vehicle up and pulled it down. The cheering crowds went wild.[1]

About a year later, Arabs found cause for indignation and horror that silenced the cheering. On 28 April, 2004, CBS News broadcast the first ugly images of prisoner abuse at Baghdad's Abu Ghraib prison. It was a prison where Saddam Hussein had tortured thousands of prisoners during his reign. Now it appeared the Americans were no better. Copies of the pictures were sold on the Arab street, confirming fears that Americans were the "Great Satan" that its enemies claimed. Groups like Ansar Al-Islam incorporated the pictures into their recruiting literature, and Abu Musab Zarqawi's Tawhid and Jihad movement cited abuses of Iraqi women as justification for the kidnapping and beheading of several western hostages.[2] The actions of the U.S. troops had become the best propaganda for the Militant Islamist movement.

Worse still, the abuses at Abu Ghraib seemed to be part of a larger pattern that included similar abuses in Afghanistan and at Guantanamo Bay, Cuba. These were not isolated incidents.

In fact, had they been isolated to special cases, directed from the top as exceptions based on clear and present danger, they may have been more palatable. The U.S.'s enemy in this war was one that did not wear uniforms, did not organize in large military formations, and did not respect the traditional laws of war—indeed depended on their ability to break the laws in horrifying fashion. Finding and defeating them depended heavily on the ability to collect intelligence from the terrorists themselves—human intelligence (HUMINT)—rather than more technical forms. In fact, it required interrogation—and probably methods of interrogation more coercive than allowed by the same laws of war the terrorists regularly flaunted.

To obtain the required intelligence, the Bush Administration had to choose whether to keep tight control of the situation and only authorize specific instances of coercion or to allow more discretion to the soldiers down the line. The administration chose the latter. Top lawyers wrote a series of memoranda that declared the Geneva Convention did not apply, authorized certain interrogation methods, and

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[1] "U.S. Troops Topple Saddam's Statue," CNN.com, 9 April 2003. N.p., internet, available at http://www.cnn.com/2003/WORLD/meast/04/09/sprj.irq.int.war.main1400/, accessed 18 February 2005.
[2] Phillip Carter, "The Road to Abu Ghraib," Washington Monthly, November 2004, available at http://www.washingtonmonthly.com/features/2004/0411.carter.html#byline, accessed 18 February 2005.

narrowed the interpretation of "torture."[3] Soldiers were given the leeway they needed to be more proactive than traditional law allowed.

Certainly, what happened at Abu Ghraib went beyond the intentions of those memos. It is probable the administration meant to give soldiers a tool for use in extreme cases, and did not want to handcuff soldiers by making them wait for approval when fleeting opportunities to use this tool arose. But the result was a deep scar in the honor of the U.S. and its military, one that could have dire consequences for success in the war in Iraq and the war on terror.

Though the venues are different, policy makers and air commanders face similar decisions about the control of combat airpower. During the first 21 days of Iraqi Freedom, the air component had formed a joint "Time Sensitive Targeting" cell that launched over 50 rapid-reaction raids in the war, some as quickly as 15 minutes from intelligence tip to bomb drop.[4] Many aircraft were sent to orbit over Iraq and await tasking from the Air Operations Center (AOC) in Saudi Arabia, who would get intelligence and then send the target coordinates to the aircraft as quickly as possible. But there were more aircraft than AOC-validated targets. So, as we will see later, the pilots of some aircraft started asking ground troops on other frequencies whether they had need of the bombs that the pilots would inevitably have to take home when their time ran out. Although the pilots called back to clear these impromptu attacks through the AOC, most of the time the people in the AOC had no way to determine what the target was, not to mention whether it was valid. They had to either refuse to clear the attacks or rely on the pilots and ground controllers to ensure the attacks were safe and in line with the strategy.

These are the decisions about which this book is written. It is about something called control. It is not about the way people make decisions as much as it is about the interaction of the many such decisions that are made in different parts of the system that employs airpower in combat. It is about how to turn policy into military actions that achieve desirable political goals. And it is about whether this has changed during the Information Age. The ultimate question is, "What has been the impact of the Information Age on the U.S. Air Force's doctrinal tenet of 'centralized control and decentralized execution?'"

It is no secret that control of military action is elusive at best. The most rational grand strategy developed by policy-makers can appear irrational because of military actions that are counterproductive. As policy gets translated into actionable plans, it must pass through many different layers. The actions that result may not be the ones that were intended. In addition, policy-makers cannot foresee all the situations that may face the troops. Those who are applying the force must be able to react. But they may not react in ways that the policy-makers would choose. This is one of the reasons political scientists have

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[3] Carter.

[4] Tony Cappacio, "U.S. Launched More Than 50 'Time Sensitive' Strikes in Iraq," *Bloomberg.com*, 14 April 2003, accessed through the Early Bird at http://ebird.dtic.mil on 14 April 2003.

such difficulty analyzing strategy. Differences in individual perceptions, organizational routines and interests, and power may impinge on any desired strategy, altering its execution in ways that may seem incomprehensible at times.[5]

That is why decision-makers constantly try to gain more visibility into military actions. In this they are in luck, since the same technology that now allows military forces to respond more rapidly to changing information also allows the decision-makers to remain in the loop, should they so desire. This seems to pose a dilemma. There is an apparent tension between the desire to control the actions of the military forces and the desire to allow them to make the most of their information capabilities to respond rapidly. This tension has a long history behind it, as we will see later. But the prominence of this issue in all facets of society in recent years has led many scholars to propose that we are in the midst of a technological revolution that demands an appropriate response from those who wish to remain competitive.

For example, the same tension exists in the business world. For a century and a half, the trend in the American business firm was toward the ability to centrally control massive corporations. From single-unit, owner-managed enterprises with independent merchant distributors in the early 19th century, the American firm developed into a colossal, centrally-managed behemoth in the late 20th century. The evolution was enabled by technology that allowed professional managers to more efficiently control and

[5] The writings of Robert Jervis and Graham Allison illustrate some of the ways analysis of strategy will fall short if it looks only at what a "rational" actor would do in a given situation. Although the two differ slightly in their levels of analysis, they both point out that it is difficult to anticipate exactly what will be the resultant of international strategy in any given situation. Robert Jervis, *Perception and Misperception in International Politics*, (Princeton: Princeton University Press, 1976), 28. Jervis proposed that it is essential to analyze a decision-maker's beliefs about the world and his images of others in order to understand crucial decisions. He also acknowledged that other "levels of analysis," such as bureaucratic politics, the nature of the state and domestic politics, and international politics also play roles. In fact, analysis at all these levels may be necessary to explain a single decision. Jervis, 15 explains the four levels, then on 17 he proposes that "domestic politics may dictate that a given event be made the occasion for a change in policy; bargaining within the bureaucracy may explain what options are presented to the national leaders; the decision-maker's predisposition could account for the choice that was made; and the interests and routines of the bureaucracies could explain the way the decision was implemented." Graham T. Allison, *Essence of Decision: Explaining the Cuban Missile Crisis*, (New York: Harper Collins, 1971). Allison concentrated on three levels of analysis, the Rational Actor Model (Model I), the Organizational Process Model (Model II), and the Governmental (bureaucratic) Politics model (Model III). He showed that analysis of policies and actions becomes significantly richer when the analyst considers not only what he or she would have done in the policy-maker's shoes, but what organizational routines may have influenced the information and options available, and what power struggles may have dictated the choices. On 258, he proposes "Model I fixes the broader context, the larger national patterns, and the shared images. Within this context, Model II illuminates the organizational routines that produce the information, the alternatives, and action. Within the Model II context, Model III focuses in greater detail on the individual leaders of a government and the politics among them that determine major governmental choices." I think his evidence equally supports the conclusion that Model I may in some circumstances furnish the proposed solution and Models II and III modify the execution of that solution, similar to Jervis' proposal.

coordinate production and distribution. This all happened despite tremendous cultural opposition and government regulation.[6]

So it is significant that in the last three decades, society and the business firm have shifted in the other direction. Whereas strategy formerly aimed at controlling the actions of the firm, now it aims at constructing relationships among different companies and coordinating the use of resources so operations can be flexible yet focused. With today's information technology, workers can retrieve all the information they need at the right time and place to make decisions on the spot, where they are most crucial.[7] Now firms are working on transforming the marketplace by allowing other companies to perform parts of their operation for them, depending on their core expertise. They "interlink" the "value chains" of suppliers, the firms, and the customers to make the entire market more efficient.[8]

Some analysts point to this change in society and business as a sign that the military must also change. Indeed, the character of warfare also seems to be changing. Analysts say the military must prepare to fight *netwar*, "an emerging mode of conflict (and crime) at societal levels, short of traditional military warfare, in which the protagonists use network forms of organization and related doctrines, strategies, and technologies attuned to the information age."[9] Technology has enabled these new modes, because communication is faster, cheaper, and of higher quality. But netwar is not only about the technology. Networks are plastic organizations, emphasizing the linkages among actors – ties that are constantly being formed, strengthened, or cut.[10] Most importantly, these analysts claim, "it takes networks to fight networks."[11]

To this end, the story goes, the U.S. must capitalize on the current information revolution to transform itself. The military must change its organization, doctrine, and strategy. The organization must retain its command and control capability while becoming flatter—attain faster response by eliminating some hierarchical levels in favor of pushing information out to all players at the lower levels. Doctrine should be built around what they call "battle swarming," a process of bringing combat power to bear at

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[6] Alfred D.Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business*, (Cambridge, Mass.: Harvard University Press, 1977), 497.

[7] Manuel Castells, *The Rise of the Network Society*, 2nd ed., (Malden, Mass.: Blackwell, 2000, 177-8. Although Castells says the change has occurred with the information revolution, he also says the impetus for organizational change may have preceded the technology, and in fact driven the technology, 185.

[8] Michael Porter and Victor Millar, "How Information Gives You Competitive Advantage," *Harvard Business Review*, July-Aug 1985, 149-160 explains the concepts of value chain and interlinkage, and N. Venkatraman, "IT-Enabled Business Transformation," *Sloan Management Review*, Winter 1994, 73-87 discusses transforming businesses and marketplaces.

[9] John Arquilla and David Ronfeldt, "The Advent of Netwar (Revisited)," in Arquilla and Ronfeldt, editors, *Networks and Netwars: The Future of Terror, Crime, and Militancy*, (Santa Monica, Calif.: RAND, 2001), 6.

[10] Phil Williams, "Transnational Criminal Networks," in Arquilla and Ronfeldt, editors, *Networks and Netwars: The Future of Terror, Crime, and Militancy*, (Santa Monica, Calif.: RAND, 2001), 67.

[11] Arquilla and Ronfeldt, 15.

nearly any time and place based on real-time information.[12] The term "Network Centric Warfare" refers to a concept that "translates information superiority into combat power by effectively linking knowledgeable entities in the battlespace."[13] Its proponents argue that command and control should not be envisioned as a sequential process as it has been in the past—gathering data, analyzing, making a decision, then implementing it. Instead, sensors, actors, and decision-makers should be networked so all decision-makers have a shared awareness of the battlespace. Commanders at the lowest levels will have enough information to take initiative and speed up the response to changing battlefield conditions.[14]

Opponents of NCW argue that linking all actors will further centralize decision-making, eliminating a middle layer, called the operational level of war, that is now the link between strategy and tactics. The lowest level will possess the information necessary to make decisions, but will be paralyzed by political limitations and will not really have any initiative.[15]

On the other hand, it may be that this centralization of control is desirable. Perhaps the reason it has always been desirable to maintain independence of the troops on the battlefield is that the commanders in the rear (and certainly the heads of state) did not know what was happening on the battlefield. If these remote decision-makers gain as much or more knowledge than the troops, maybe they should make the decisions. It could be that the only limitation on centralized control should be the ability to move the information around to the appropriate place.[16]

The U.S. Air Force's answer to this tension is the tenet of "centralized control and decentralized execution."[17] The phrase, now captured in a joint publication as well as Air Force doctrine, captures the concept of striking a delicate balance.[18] But the language is confusing. Are control and execution separate phases or functions? If they are separate phases, the tenet declares that the central authorities should develop a plan, allocate the resources, and then at a certain point in time pass it off to the executors. In fact, another joint publication calls for "unity of effort, centralized planning and direction,

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[12] John Arquilla and David Ronfeldt, "Looking Ahead: Preparing for Information-age Conflict," in *In Athena's Camp: Preparing for Conflict in the Information Age*, John Arquilla and David Ronfeldt, editors, (Santa Monica: Rand, 1997), 439-40. They propose that information revolution should be the basis for a Revolution in Military Affairs (RMA). RMAs are rare, but when they occur they bring major paradigm changes to warfare, and those who are quick to capitalize on them reap great rewards. The U.S. is currently well-positioned to capitalize on this revolution – the only nation positioned to construct a truly global information network, and is already in the lead in developing military command and control based on information systems.

[13] David S. Alberts, John J. Garstka, and Frederick P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2nd Ed (revised), (Washington: DOD C4ISR Cooperative Research Program, 1999), 2.

[14] Ibid., 74, 91, 118-9.

[15] Milan Vego, "Net Centric is not Decisive," *Proceedings*, January 2003, available at http://www.usni.org/Proceedings/Articles03/PROvego01.htm.

[16] Robert R. Leonhard, *The Principles of War for the Information Age*, (Novato, Calif.: Presidio Press, 2000), 180.

[17] Air Force Doctrine Document 1, *Air Force Basic Doctrine*, September 1997, 23.

[18] Joint Publication 3-30, *Command and Control for Joint Air Operations*, 5 June 2003, I-3.

and decentralized execution."[19] However, often there is not enough information about the enemy to develop a complete plan before the designated hand-off. With today's sensors and communication technology, the central decision-makers can develop only the shell of a plan and then fill in details in real time, so the two phases may overlap. So maybe the two terms represent two separate functions, implying that the central decision-makers decide what to do and what resources to allocate, regardless of whether it is during or prior to execution, and those on the scene execute the plan with the resources given them. But what does it mean to "execute?" Weapons technology increasingly facilitates launching weapons from remote locations. If this is the case, certainly the best people to push the button are those with the greatest knowledge of the entire situation – in many cases, the central decision-makers.

On the surface, these arguments seem to point to a choice. Should policy-makers use the sensor, weapons, communications, and information technology to increase their own ability to make decisions or to empower lower-level decision-makers. If there is a revolution in military affairs underway, we had better figure out which way is right and head in that direction or risk major defeat in the future.

But first, we had better understand what we are talking about and what is really happening in this revolution. The issues surrounding centralized versus decentralized control are clouded by the fact that they cover a range of categories that are seldom delineated in the discussions. There are civil-military arguments, as when the military claimed President Lyndon Johnson and Secretary Robert MacNamara should not have been personally picking targets during the Rolling Thunder campaign in Vietnam. The military was similarly frustrated by the the North Atlantic Council's monopoly on target approval authority in Kosovo. There are arguments within the military, between theater commanders and their subordinates about how far the superior should get into the planning details. Such was the case in Kosovo between the Combined Forces Air Component Commander, Lt. Gen. Michael Short, and the NATO Supreme Allied Commander Europe, Gen. Wesley Clark. Then in the 2001 war in Afghanistan, airmen again claimed that the Combined Forces Commander, Gen. Franks, and his staff intervened improperly in matters that should have been handled by his air component. Then there are arguments, between the commanders on the battlefield and those in the rear, over the direction of actions in progress. In almost every conflict, pilots claim the planning staff intervenes in the execution of the missions, which should be the domain of those closest to the action. And over all this lurk the constant battles among the services, such as the battle between the Army and the Air Force over who should control the aircraft that are supporting ground troops. The Army claims the centralized process used by the Air Force is too cumbersome to respond to the needs of the ground troops. It seems that each level thinks another is too involved in the details.

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[19] Joint Publication 3-0, *Doctrine for Joint Operations*, 10 September 2001, x.

This study will look at these arguments as separate but related issues. It will examine the control of combat airpower, as opposed to land or sea power, since airpower's speed and range make it especially affected by the arguments between centralized and decentralized control. It will focus on developments in the U.S. Air Force, the service that has been most active in defining the doctrinal architecture for command and control of combat airpower. However, it will also capture the differences in the way other services prefer to function. The study will determine how technology and control have affected each other in this, the age of information.

There is very little study of the control of combat air operations in the scholarly literature. Many writers have evaluated the effectiveness of various airpower strategies.[20] But most of these are concerned with the effectiveness of air operations in decisively contributing to victory. There are many works that document the conduct and results of air operations in specific wars.[21] There are still others that analyze the development of airpower, including the forces that shaped strategy, tactics, doctrine, and technology development.[22] None of these look at the process of turning policy into actions that achieve the policy goals.

There are works on command and control of military forces. Many of the classic works have the limitation that they were completed before the advent of military airpower, so their applicability is limited to general principles.[23] Marshal Tukhachevsky was one of the first of these classic military writers to discuss the need to combine the effects of land, air, and sea power throughout the depth of the battlefield. His solution was a delicate balance of top-down directive control and freedom for the front-line forces to

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[20] Robert Pape, *Bombing to Win: Air Power and Coercion in War,* (Ithaca, N.Y.: Cornell University Press, 1996) and Daniel L. Byman, Matthew C. Waxman, and Eric Larson, *Air Power as a Coercive Instrument* are two good places to start. Pape does an indepth study of denial versus punishment strategies, concluding that strategic bombing of populations has never been as effective as bombing military targets to convince an enemy he cannot win. Byman and Waxman present a less detailed but more balance look at the factors that make airpower effective as a coercive instrument.

[21] The list really is too long to document here. This is probably the area where most airpower history has been focused: determining whether airpower was decisive in a particular conflict. Here are several of interest. Alfred C. Mierzejewski, *The Collapse of the German War Economy, 1944-1945: Allied Air Power and the German National Railway*, (Chapel Hill: University of North Carolina Press, 1988) gives an excellent account of the success of tactical airpower in doing what strategic bombardment could not: topple the German war machine. Robert Futrell, *The United States Air Force in Korea, 1950-1953*, (Washington: Office of Air Force History, 1983) is probably the most comprehensive work on the Korean war. Mark Clodfelter, *The Limits of Air Power: The American Bombing of North Vietnam*, (New York: The Free Press, 1989) is a must for anyone who wants to understand why airpower did not and then did work in Vietnam. Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Air Power in the Persian Gulf*, (Annapolis: Naval Institute Press, 1995) is the Gulf War Air Power Survey in published format.

[22] Lee Kennett, *The First Air War, 1914-1918*, (New York: The Free Press, 1991) looks at the development of airpower in WWI. Michael Sherry, *The Rise of American Air Power: The Creation of Armageddon,* (New Haven, Conn.: Yale University Press, 1987) is what I would consider a broad view of the emergence of strategic bombing in the United States. However, Sherry is a bit polemic in places and never puts the broad views into a systems framework that can be used to develop policy. Benjamin Lambeth, *The Transformation of American Air Power*, (Ithaca, N.Y.: Cornell University Press, 2000), is also a very comprehensive look at the many factors that have influenced the development of airpower in the last three decades.

[23] For example Sun-Tzu, Clausewitz, Jomini, Moltke, Mahan, Corbett.

take the initiative when the fog and friction of battle demanded it.[24] This is very similar to the Air Force's doctrinal language.

Many well-known works on command and control focus on the civil-military dimension. Samuel Huntington's *The Soldier and the State* proposes the correct method of civilian control is what Huntington calls "objective control." This is a form of control that nurtures the professionalism of the officer corps in order to harness the strengths of the military and ensure the state's security. He claimes the incorrect method is to maximize the power of the civilians over the military by making the military conform to the ideals of the group in power – what he calls "subjective control."[25] Objective control supposedly allows the civilians to accept the military for what it is—indeed cultivate it—while maintaining effective control over it.

Huntington's argument has been oversimplified by critics and fans alike to mean that, for maximum security, civilians and the military should remain clear of each other's turf. This oversimplified version holds that a state needs a chain of command with civilians in charge and a professional military, but the civilians should not delve into the details of military affairs and the military should not be allowed to delve into political affairs.

Eliot Cohen set out to correct this oversimplification. His book *Supreme Command: Soldiers, Statesmen, and Leadership in Wartime* proposes that, in war, the civil-military relationship must be anything but laissez-faire. Claiming that the U.S. had fallen prey to a misrepresentation of Huntington's work, Cohen laments the practice of what he calls the "normal" theory of civil-military relations. This theory demands that civilians make the war and then let the military run it. "Taken to extremes, it would free civilians of responsibility for the gravest challenges a country can face, and remove oversight and control from those whose job most requires it."[26] On the contrary, he shows that Lincoln, Clemenceau, Churchill, and Ben-Gurion were successful because they got deeply involved in military matters during their respective wars.

Cohen's assessment of wartime civil-military relations is tough on those who think there should be a distinct line between civilians and the military. He claims the trouble with the relationship during the Vietnam war was not too much civilian control but not enough. When the Joint Chiefs of staff presented only an all-out solution, the Johnson administration made them largely irrelevant. The military made no effort to conform to the constraints within which the civilians thought they had to live. There was no

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[24] Richard Simpkin, *Deep Battle: The Brainchild of Marshal Tukhachevskii*, (New York,:Brassey's, 1987), 165.
[25] Samuel P. Huntington, *The Soldier and the State: The Theory and Politics of Civil-Military Relations*, (New York: Vintage Books, 1964), 80-85.
[26] Eliot A. Cohen, *Supreme Command: Soldiers, Statesmen, and Leadership in Wartime,* (New York: The Free Press, 2002), 13.

detailed discussion or argument about the ends, ways and means of the war.[27] Cohen's assessment of the George H.W. Bush administration also runs against the grain of popular mythology, proposing the Gulf War of 1991 was a story of "abdication of authority" by the civilian leadership.[28] The Clinton administration fairs no better: "Far from abusing the military by micro-managing it, the Clinton administration abused it by failing to take the [1993 Somalia] war seriously and inquire into means, methods, and techniques."[29] Cohen's overall prescription is that civilians must: "demand and expect from their military subordinates a candor as bruising as it is necessary; that both groups must expect a running conversation in which, although civilian opinion will not usually dictate, it must dominate; and that that conversation will cover not only ends and policies, but ways and means."[30]

If Huntington's and Cohen's works are viewed as complementary, then together they propose a formula for command and control that advocates empowering subordinates to develop plans but then grilling them on the details and holding them accountable. But they were written to apply to the policy-makers, so they only cover one part of our spectrum. And both analyses were based almost completely on land warfare, although Cohen applied his to situations that included airpower.

Martin Van Creveld treated the next level down in his *Command in War*. In it, Van Creveld proposed a framework within which military commanders should think about controlling their organizations in battle. He pointed out that throughout history, organizations have dealt with the fog of war in basically two ways: they have either tried to get more information or they have tried to organize to be able to work with the uncertainty by training the lowest levels to work in the absence of clear direction. Those who chose the latter route have either made their forces robots or trained the lower divisions to work semi-autonomously on specific tasks.[31] To Van Creveld, the essence of genius in this respect was to use technology to its limitations, then make those limitations work for you. This was the genius behind Napoleon's corps system.[32] Van Creveld's advice to all commanders would be to 1) use a "directed telescope" to gather information to inform command decisions without burdening the troops, and 2) develop organizations that can operate in uncertain conditions when the battle outpaces the command decisions.

However, this advice may fall short when it comes to today's air war. The full impact of the information revolution was not felt until after the release of the book in 1985. Since then, it appears the Air Force has undergone a transformation in its control of combat operations. Although much of the technology for this transformation was developed before 1985, the organizational and operational

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[27] Cohen, 180.
[28] Cohen, 198.
[29] Cohen, 201.
[30] Cohen, 206.
[31] Martin Van Creveld, *Command in War*, (Cambridge, Mass.: Harvard University Press, 1985), 269.
[32] Ibid., 59.

implementation of the transformation evolved through the wars, experiments, and doctrinal development in the 1990s, as well as in response to a change in the security environment (facilitated by the collapse of the Soviet Union).

Besides, Van Creveld gives almost no attention to war in the air – his case studies examine nothing but land warfare. Command in air war, and especially today's air war, is different. Air war involves smaller numbers of units under a single command and the units act over much longer ranges with much greater speed and precision and less regard for enemy military actions.[33] "Battle" in air war looks much different from "battle" on the ground. In air war, units that do not know each other converge from geographically separated bases to fly relatively short duration engagements together against an often unseen enemy that is not necessarily the target—more of an obstacle. Afterward, they disperse again. As a result, the motivational part of command is much more difficult to consolidate. But the control part is more routine. The men and women who fly the aircraft are dependent on communications to perform even the routine parts of their missions, like taking off and landing. They are accustomed to relying on others to coordinate with everyone in the air to ensure their safety and efficiency. Over the long distances involved, whoever has the information about what lays ahead may be in the best position to control the mission. In today's air war, with today's technology, this advantage goes to the people in the rear. If Van Creveld's instruction is to be followed, it must first be shown to withstand the translation to air war in the information age.[34]

There are only a few works that have examined the specific question of whether the control of combat airpower should be centralized or decentralized. These generally treat the issue of differences among the military services. RAND analysts James Winnefeld and Dana Johnson proposed that the Joint Forces Air Component Commander (JFACC) was a solution to a long-time problem with airpower: the lack of unity of control. Ever since the dawn of military airpower, the U.S. had struggled to bring the disparate air forces from separate services into coordination to serve the larger military strategy. The

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[33] Keneth C. Allard, Lt Col, USA, *Command, Control, and the Common Defense*, (New Haven, Conn.: Yale University Press, 1990), 155-7.

[34] There are unpublished works that attempt this task. The subject has been treated by master's theses from students at Air University. One student in particular attacked the subject of centralized vs. decentralized control by studying complexity theory. David K. Gerber, Major, USAF, "Adaptive Command and Control of Theater Airpower," (master's thesis, Air University, 1997), applied lessons about complex adaptive systems to the Air Force's current system for planning and directing air operations and found the current system too centralized. He claims the Air Force tries to manage the micro-level details in order to develop a macro-level strategy – a task for which there really is no good theory right now. Gerber proposed the Air Force should use more general, mission-type orders and then use information technology to monitor the implementation of the details and adjust as necessary. Another, Mustafa R. Koprucu, Major, USAF, "The Limits of Decentralization: The Effects of Technology on a Central Airpower Tenet," (master's thesis, Air University, 2001), points out that, despite the elevated importance of "decentralized execution," the air component has always striven for centralized execution. It was mainly held back by the lack of technological capability. This technological capability is coming of age today, leading to the need for a re-examination of what constitutes over-centralization. Any attempt to decentralize execution must at least acknowledge this trend and its roots.

problem was highlighted in Vietnam, where the use of route packages rendered airpower inefficient and ineffective.[35] In another work specifically aimed at the argument of centralized versus "organic" control, Lt Col Stephen McNamara looked at the history of airpower for the lessons that could apply to today's system. He found that the centralized control of air at the operational level was non-negotiable to the Air Force--the service had learned too many hard lessons about breaking airpower up into "penny packets" to turn back. However, he noted that ground commanders thought the JFACC concept was too slow to adapt to their needs. The solution lay in the ability of the JFACC to keep control while relinquishing the details of the daily flights to decentralized authorities.[36]

Because the subject of the control of airpower in the information age has not been treated often in the scholarly literature, the prevailing view of combat air operations is stunted. When people think of air war, they think of arguments over whether a given strategy was decisive in war. They think of a service that has forever struggled to prove its worthiness to be independent--a service that, some say, leans on the technology of the aircraft and the doctrine of strategic bombardment. They think of the Air Tasking Order as a tool for micromanagement—an overreaction to failures to achieve unity among diverse air forces from different services. They certainly do not think of the two thousand people in the AOC who are attempting to control air operations and produce the results. They do not see this as a system of interrelated parts where, try as they might, these people in the AOC are controlled even as they attempt to control.[37] Until we are able to see this complexity, we will not be able to engineer the system to produce our desired results while avoiding harmful side effects.

This study will develop a more complete picture of the way airpower is controlled in combat—and the consequences to the different types of control. It will do this by developing a deeper understanding of air power as a system, placing the above theories in their proper context within that system, and accounting for the interaction among them. It will use primarily historical methods to do this. Yet it will attempt to add to the body of knowledge about human-technology systems and about this system in particular. The questions it will answer along the way are:

1. *How has the Information Age affected the command and control of combat airpower?*

Certainly, there have been significant technological developments. But there were also differences in the international security environment, the organization of the U.S. military, and the types of wars the U.S.

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[35] James A. Winnefeld and Dana J. Johnson, *Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991*, (Annapolis: Naval Institute Press, 1993), 63-82.

[36] Stephen J. MacNamara, Lt Col, USAF, *Airpower's Gordian Knot: Centralized vs. Organic Control*, (Maxwell Air Force Base, Ala.: Air University Press, 1994), 151-154.

[37] There is, of course, at least one exception. Anyone who has ventured to read the colossal Gulf War Air Power Survey, in all ten parts of five volumes, cannot long hold onto the above misperceptions. Thomas C. Hone, "Command and Control," Part II of *Gulf War Air Power Survey*, Washington, D.C., 1993, is an exceptional treatment of the very type this author can only hope to approach. I hope to add a temporal dimension to this analysis to distill the effects of time, technology, and human innovation.

fought. The interaction among these factors must be addressed to see whether there have been any fundamental changes in command and control or if new modes have arisen for specific circumstances.

2. *Have these changes impacted the military's adherence to the doctrinal tenet of "centralized control and decentralized execution?"* Whether the changes have been fundamental or have arisen because of specific circumstances, people have alleged that commanders and policy-makers have not adhered to this tenet. As we discussed above, the arguments span different parts of the spectrum, and often talk past each other. The study will discover what happened in each case, what part of the system was affected, and what the overall effect on the system was.

3. *Is there a general formula that better characterizes command and control of the system?* Our approach will lead us to the factors commanders should consider when determining how to delegate authority. But we will also recommend a general formula for command and control of combat airpower, filtering the theories through the evidence from our study. This will be a sort of repairing or synthesis of these theories, and should be a more precise way to describe command and control.

4. *Where are these changes heading?* Many things may have affected and been affected by technology, but there are most likely limits to this interaction due to the way humans interact in the system. In order to discern the future of warfare, we have to recognize these limits. We will recommend factors to consider during development of new technology and practices.

Two basic methodological problems present themselves in answering these questions. We want to be able to analyze the different issues hidden in the argument using only the applicable facts for each issue, so we do not confuse apples and oranges. But we also want to discover whether there are interactions among these different issues.

To discover the facts pertinent to each issue, we will study the same historical period several times, using a different viewpoint each time. We will concentrate on four wars: Operation Desert Storm in 1991, Operation Allied Force in 1999, Operation Enduring Freedom in Afghanistan from October 2001 through March 2002, and Operation Iraqi Freedom in March and April of 2003. We will revisit these wars five times, but each time we will use a different lens to see the salient characteristics.

These lenses are the frameworks that guide the analysis of each particular issue. History is not a completely objective process of laying out facts in chronological order. Each historian is guided by an agenda formed by the knowledge he or she has of the subject, for this guides the selection of sources and the prioritization of material from those sources. Later, a more mature agenda, often explicitly informed by other thinkers, helps the historian "weave [a central] theme into a historical narrative."[38] Each time we traverse the period of our study, we marshall evidence from interviews of those who participated,

[38] The previous thoughts on bias in the selection of sources and narrative come from the teachings of Dr. David Mindell, from whom also the quote in David A. Mindell, *Between Human and Machine: Feedback, Control, and Computing before Cybernetics*, (Baltimore: Johns Hopkins University Press, 2002), 16.

briefings they used to convey their ideas at the time, notes and logs they took at the time, and official reports on lessons learned. But each time these sources come from those in a different part of the system. Thus, each time we traverse the period of our study, a new story emerges to consider a new angle on the central question.

Constructing interactions among these different viewpoints is a problem tailor-made for "systems thinking." We will analyze the issues as if all the players involved were part of a system, which we will refer to as the Combat Air Operations System (CAOS), a "system" that is not explicitly recognized as such in any literature. In showing the interactions among the above issues, we will be in effect constructing a system by linking diverse players in feedback loops. The word "system" is over-used in everyday language. A good definition would probably have to include interacting components having well-defined (although not necessarily well understood) behavior or purpose.[39] Humans in the system organize themselves in some type of hierarchy, which means some decision-makers coordinate the actions of larger groups than others.[40] Decision-makers at the higher levels impose constraints on lower levels to make the actions of the lower levels adhere to some desirable emergent characteristics—this is the essence of control in systems thinking.[41] But the decisions they make often do not account for the existence of feedback loops. The delays from cause to result and the confounding effect of multiple feedback loops cause people to misjudge the effect of their actions and often take action that makes a problem worse.[42] This study will show many cases where the type of control used at one level affected operations at many other levels, well beyond the predictable, because of similar delays and feedback loops.

We will therefore portray these interactions by treating the CAOS as a complex, large-scale, integrated, open system (CLIOS). Using the information gleaned from our five stories, we graphically represent the issues as components of subsystems. The five issues cross multiple subsystems, so they share certain components—this is what produces the interactions. The graphical technique is a way to impose rigor on the analysis. Indeed, this book cannot present the entire process to the reader without

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[39] Ludwig von Bertalanffy, *General System Theory: Foundations, Development, Applications*, revised edition, (New York: George Braziller, 1969) and Nancy G. Leveson, *Safeware: System Safety and Computers*, (New York: Wesley-Addison Publishing Co., 1995) expound on the shortcomings of the classical analytical approach. C.L. Magee and O.L. de Weck, "An Attempt at Complex System Classification, in *Proceedings of the ESD Internal Symposium*, (Cambridge, Mass.: Massachusetts Institute of Technology Engineering Systems Division, 2002) gives probably the best overall definition of a system, if one is dealing with systems that are made of substantial human and technological components.

[40] James D. Thompson, *Organizations in Action*, (New York: McGraw-Hill, 1967), 59.

[41] Nancy G. Leveson, *Safeware: System Safety and Computers*, (New York: Wesley-Addison Publishing Co., 1995), 138.

[42] John D. Sterman, *Business Dynamics: Systems Thinking and Modeling for a Complex World*, (Boston: McGraw-Hill, 2000), 26-8.

becoming too confusing.[43] The results presented here are the product of several iterations of research, developing a model, researching hypotheses that the model-building brings up, then refining the model. Thus, the graphical depiction and the research each impacted the other. Obviously, only the final results are presented here. But this rigor helps keep us from proposing interactions from pure speculation.

This, then, is the story of the impact of the Information Age on the tenet of centralized control and decentralized execution.

Throughout the 1990s, during wars for less than vital interests and in the absence of a peer superpower, U.S. policy-makers often used specific constraints that gave them direct influence over ongoing air operations. This occurred because of a feedback loop between technology and national security strategy. With the Soviet Union removed as a major threat to the U.S., American politicians were free to intervene with military force in many situations that were less than vital. But they used military force with the caveat that it could not entail high costs, especially in terms of civilian and U.S. military lives. So airpower was the tool of choice, and it needed to be a surgical instrument at that. In fact, policy-makers were so keenly aware of this need that they often chose strategies that depended on their ability to control military action by ROEs and target approval instead of becoming intimately involved in discussing and tracking military plans. The Air Force found airpower somewhat wanting for effectiveness within the imposed constraints. The solution was to develop impressive loops of sensors and communications technology—"sensor-communication loops"—that allowed better real-time decision-making in the AOC.

The constraints affected the way the Joint Force Commanders (JFC) defined command relationships. The tighter the constraints from the strategic level, the less the JFC empowered component commanders under him. The less these components were empowered, the less likely they were to overcome cultural barriers and coordinate with each other, regardless of their technological capability to communicate. Yet at the same time, the need for integration of these components increased, because airpower became more tightly integrated with the attack sequences of other components—whether it was through using special operations troops as sensors or through providing information to these ground troops from sensors on the aircraft.

The Joint Force Air Component Commanders (JFACCs)—those who were placed in charge of the air operations in this study—initially tried to stay out of ongoing missions, but two parallel trends brought the air component into the time-sensitive targeting business. First, sensor-communications loops that the Air Force developed to help accomplish the complete control cycle also made it possible to direct

[43] Rebecca S. Dodder, Joseph M. Sussman, Joshua B. McConnell, "The Concept of the 'CLIOS Process': Integrating the Study of Physical and Policy Systems using Mexico City as an Example," presented to the MIT (Massachusetts Institute of Technology) Engineering Systems Symposium, Cambridge, Massachusetts, 31 March 2004, 2,4.

the missions. In fact, the air component gained much more success at intervening in these missions than at assessing the aggregate results of operations. At the same time, because of policy constraints, airpower was called on to accomplish missions that required rapid but very precise response. To accomplish these, someone had to pull information together quickly and feed it to the strike aircraft. The two trends came together to pull AOC people as well as analysts from all over the globe into the business of aiding ongoing air strikes.

In some cases, this has led to a re-distribution of tasks that used to be performed in the cockpit—and a corresponding change in the aircrew's role. The proportion of missions for which the aircrew can pre-plan their route and attack sequence has shrunk. The ability of the people in the AOC to contribute useful information in real time has increased. The ease with which this information can be passed to the weapons has increased—in some cases, with a GPS-guided munition, the weapon only needs accurate coordinates. So in some cases, the aircrew's job became one of delivering the munitions based on information provided by someone else. But the training and capability of the aircrew has not decreased. In fact, with new sensors on the aircraft, they are capable of even more autonomous work. The result is an increase in the number and complexity of ways that an attack can occur.

This can be dangerous or helpful. In some situations, commanders want their troops to be able to show initiative and exploit opportunities. In other cases, the risk that these adaptive exploitations may be harmful to the overall strategy outweighs the potential military benefit. But even in cases where strict adherence to orders is required, people often drift away from established procedures if their drifting is not observed and corrected. Then, in an emergency, they are often unable to revert to the established procedures, and human initiative can go astray. This is what happened in the shoot-down of two Black Hawk helicopters over northern Iraq in 1994.

In the end, the theories we considered can be synthesized to form a better overall description of the control of combat airpower. "Centralized control and decentralized execution" is a good concept at any level, but suffers from lack of precision. Cohen and Huntington's combined theory that civilians should empower the officer corps but engage them in a bruising debate and then hold them accountable is also appropriate for military commanders and their subordinates. Likewise, Van Creveld's directed telescope is a way for policy-makers to get a feel for the military actions to keep involved in the discussion and hold the military accountable. At all levels, commanders should set the goals and the strategic vision for the organizations under their command. They should organize command relationships and empower their subordinates to come up with their own plans to accomplish the goals. The commanders should also maintain a running dialog to challenge the details of those plans, and then use a directed telescope to track their accomplishment and make adjustments to the strategy.

The aim of this method of command and control is to produce something we will call "depth" of command relationships. This depth is a measure of the extent to which diverse players at the scene of battle can be coordinated, prioritized, and re-directed when the situation calls for it. It is not simply pushing information and authority down, but extending the spiral of empowerment and accountability so the decisions made on the scene are consistent with the larger strategy. With sufficient depth, commanders can make deliberate decisions about when to allow subordinates to exploit opportunities; without it, they must either prescribe their subordinates' actions or allow them complete independence.

It is possible to look at the solution as a trade space. With knowledge of the trade-offs, policy-makers and commanders can make their own judgments about the amount of authority to delegate. The basic trade-off at each level is between specific results and empowerment. The factors that should inform the trade-off are the certainty of the effects needed for success and the requirement for interactions among different organizations to achieve these effects. A commander at any level can specify, constrain, and even in some cases direct specific results in great detail with today's technology. But the more a commander relies on these specific constraints and direction, the less empowered his or her subordinates will be. The less empowered the subordinates are, the less they will be able to integrate with others and innovate to adapt to new challenges. So in limited cases where the policy-maker or commander knows exactly what needs to happen and the actions do not require complex interaction among the players, it is appropriate to use specific direction of the details. The more uncertain the actions needed and the more complex the interactions required, the greater the need for adherence to the general formula for command and control.

The next eight chapters will tell this story. Chapter 2 lays an historical foundation and outlines the issues involved. It tells the story of the control of combat airpower from World War II through Vietnam – a story that shows the control of airpower has varied among different type wars and even among different missions within the same war. In the process it exposes confusion about the terminology of the arguments and attempts to lay them out in plain language.

Chapter 3 develops the approach for the rest of the book. It defines the necessary terms and explains the CLIOS framework. It then shows how we will think about the CAOS—what will be included, who the important stakeholders are, and what the subsystems are. By fitting the historical foundations into a systems framework, it also shows what areas will be explored in the rest of the book.

Chapters 4 through 8 perform this exploration. Chapter 4 discusses the relationships between policy-makers and military commanders throughout the 1990s, analyzing the methods of control at this level.. Chapter 5 shows the effect of these different methods on the ability of the different military organizations to work together. Chapter 6 shows how the AOC has become what Bruno Latour called a "centre of calculation" in order to use sensor-communications loops to plan, direct, and assess airpower

missions. However, the "centre" was far more successful at using these loops to intervene in ongoing missions than to assess the aggregate results. Chapter 7 shows that this intervention was necessary in many cases to perform some of the politically-constrained missions airpower was given; yet commanders still learned to delegate in order to shorten the Observe-Orient-Decide-Act (OODA) Loop. Chapter 8 portrays these new modes of controlling airpower as a move toward what Edwin Hutchins called "distributed cognition." Technological development has brought more people into the attack sequence or "kill chain," reducing the portion of that chain that any single member—including the aircrew—performs. This is occurring in all types of time-sensitive targeting, including close air support and armed reconnaissance type missions.

Chapter 9 analyzes the potential for accidents in the CAOS. It proposes that the distribution of the tasks involved in air strikes makes the CAOS more complex and more susceptible to what Scott Snook calls Practical Drift. It is left to Chapter 10 to extrapolate some of the potential implications for the future of the control of combat airpower.

The venerable Carl von Clausewitz warned that all wars must be judged by the peculiarities of the times in addition to general laws of war.[44] Yet his 18th century work on the nature of war is treated as wisdom in military classrooms to this day. This work does not debate whether there has been an Information Revolution. It is enough to recognize there has been a significant amount of technological development in the last two decades, much of which has changed the way airpower is commanded and controlled. The true challenge is to recognize how deeply those changes reach. Have the fundamental truths been altered, or just their implementation?

[44] Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret, (Princeton: Princeton University Press, 1989), 593-4.

Chapter 2

Historical Foundations of Airpower Control Issues

Some would say there is no issue here. Air Force basic doctrine presents a well-thought-out way to think about the trade-offs between centralization and decentralization of control. The Air Force's key tenet is "Centralized control and decentralized execution." According to the 1997 version of Air Force doctrine, these two sides of the issue allow commanders to "focus on those priorities that lead to victory," while achieving effective span of control and fostering "initiative, situational responsiveness, and tactical flexibility."[1]

However, this is a rather recent and evolving doctrinal tenet. The year 1992 was the first time Air Force doctrine spelled out the above reasons for the tenet in any detail. It explained that the tenet evolved to correct deficiencies in World War II, where airpower was divided up ineffectively, and Vietnam, where airpower was controlled too tightly at too high a level. It was first identified as a tenet in 1971.[2] But in the 1971 version, the wording was "centralized allocation and direction and decentralized control and execution."[3] It was the 1975 version that first called for "centralized control, decentralized execution, and coordinated effort."[4] Then in 1979, the document attempted to lay out the division of labor between higher echelon and lower echelon commanders. It said the former should "define the missions and tasks, and then direct lower echelons to conduct the operations," while the lower echelons should be responsible for "details for mission planning."[5] In fact, this edition claimed, the principle of "decentralized execution" reflected an "aspect of our national character," which was to trust and enable individuals to perform to the best of their abilities.[6]

But there is widespread doubt about whether the Air Force follows this doctrine. Research papers coming out of Air University, the Air Force's school of professional military education, often characterize the system used by the Air Force to employ airpower as overly hierarchical or centralized. Some propose the Air Force should strive for a more decentralized organizational structure, which would strengthen

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[1] Air Force Doctrine Document 1, *Air Force Basic Doctrine*, (Washington: HQ USAF, 1997), 23.
[2] Air Force Manual 1-1, *Basic Aerospace Doctrine of the United States Air Force*, Vol. II, March 1992, 113-115.
[3] Air Force Manual 1-1, *United States Air Force Basic Doctrine*, 28 September 1971, 2-1.
[4] Air Force Manual 1-1, *United States Air Force Basic Doctrine*, 15 January 1975, 3-1.
[5] Air Force Manual 1-1, *Functions and Basic Doctrine of the United States Air Force*, 14 February 1979, 5-2.
[6] AFM 1-1 (1979), 5-3. This explanation of the evolution of Air Force doctrine is actually a summary of a more complete discussion given in Mustafa R. Koprucu, Maj, USAF, "The Limits of Decentralized Execution: The Effects of Technology on a Central Air Force Tenet," (Master's thesis, School of Advanced Airpower Studies, 2001), 1-5.

command and encourage networked forces to innovate and adapt to unforeseen situations.[7] This is in line with the Network Centric Warfare recommendations in Chapter 1. Others accept the fact that, as central decision-makers gain the ability to collect and process information about the battles, the decision-makers' headquarters may be the best place to make many of the decisions that are currently delegated.[8]

The concept of "centralized control and decentralized execution" is confusing, and it means something different to everyone involved. Further, the language is ambiguous. What is "control" to one person may be "execution" to another. In fact, is not control a part of execution? The 1971 AFM 1-1 seemed to think so.

This chapter will delineate the different arguments about control. It will look at arguments that are commonly presented to validate the need for either centralized or decentralized control of combat airpower, and separate them into arguments about how far into the details each hierarchical level should get. At the politico-military strategic level, policy-makers in different wars have shown different propensities to get involved in putting constraints on tactical actions. Generally, the more limited the aims of the war, the more detailed this intervention has been. At the operational level, officers in the Army Air Forces and Air Force have always striven for centralized control of air forces by an airman with the authority to command unity of effort. The different services have always had different ideas about the best way to control airpower. At the tactical level, the amount of control that the commanders have exercised over tactical missions has varied with the type of mission. Because the Air Force has historically preferred to perform deep strike missions to hit key enemy vulnerabilities, the Air Force has always tried to pre-plan as many of the details as possible. They have had to learn and re-learn how to relinquish direction of mission details to ground troops on the battlefield when they fly supportive missions like close air support. Lurking over all these arguments is an affinity for technological advances that allow decision-makers at each level to get more information (and make more decisions) about the actions of the levels below. In fact, the military is constantly striving for technological development that changes the character of some of the arguments.

The Levels of War

The "levels" of war as just described are abstractions that prescribe different functions in war based on different hierarchical levels. In his classic *On War*, Carl von Clausewitz spent considerable effort ensuring he separated the levels of war, which for him were policy, strategy, and tactics. Policy was the domain of the government, strategy of the general, and tactics were the battlefield actions.[9]

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[7] David K. Gerber, Maj, USAF, "Adaptive Command and Control of Theater Air Power." (Master's thesis, School of Advanced Airpower Studies, 1997), 173-4.
[8] Koprucu, 77-8.
[9] Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret, (Princeton: Princeton University Press, 1989), 128.

Today, we recognize these three levels as the strategic, operational, and tactical levels of war. The strategic level of war is the level where the overall aims of the war are determined. Here governments try to figure out how to incorporate military action into their overall grand strategy. Many times writers will also include another, "politico-military strategic" level, which is the level that deals with military strategy as opposed to grand strategy. This differentiates the Secretary of Defense and the Joint Chiefs of Staff, who could be expected to delve more deeply into military details, from the National Security Council as a whole. For our purposes, the two will be considered the same—we will call them "policy-makers" or "strategic level decision-makers." The operational level of war is where plans are made to maneuver military resources to bring them into action at the right time and place in the "battlespace" (a term that includes the air, the space, and even the information). This is the link between these battle actions and the strategic level aims. The actions themselves happen at the tactical level of war. Here is where the military units actually do things that kill people and break things—or whatever it takes to put the right pressure on the enemy.[10]

Strategic Level and the Nature of the War

At the strategic levels, state governments have always striven to improve their control over the instruments of their power. For example, in the 16th and 17th centuries, Maurice of Nassau taught European states how to tame their armies by establishing drill procedures. Soldiers whose every move was governed by procedure had to practice daily to perfect their skills. This kept them out of trouble during peacetime and made them much more effective and controllable during war—double the benefit. The stability provided by these improved armies allowed the states to concentrate on overseas trade and, later, conquering and controlling the overseas lands with the same armies.[11] The leaders during this period were often both governor and general, with Napoleon being one of the last of this breed in the western world.[12] But Napoleon realized he could not control his huge army at all times. He developed the corps system—he split his army into corps that marched and sustained themselves separately. Then he developed the ability to gather and process information on their operations and to make them conform to an overall design—to exert control (although this was operational level control).[13]

It appears that the level of details the policy-makers try to manage depends on something we will call the "nature of the war." Clausewitz claimed the most fundamental job of the strategist is to figure

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[10] Joint Publication 3-0, *Doctrine for Joint Operations*, 10 September 2001, II-2-II-3.
[11] William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000.* (Chicago: The Chicago Press, 1982), 45-6 talks about the Chinese and overseas ventures, 126-132 explains the logic behind establishing drill, 143 concludes with the feedback loop whereby armies allowed more overseas ventures, providing more taxable income, allowing bigger armies, and eventually European nations outpaced the others, setting the foundation for imperialism.
[12] Chiang Kai-shek and Mao Tse-tung were both governors and generals, so this model survived elsewhere.
[13] Martin Van Creveld, *Command in War*, (Cambridge, Mass.: Harvard University Press, 1985), 97.

out what the nature of the war is.[14] It was also Clausewitz who first explicitly established the virtual axiom that war is an instrument of policy—an instrument that is limited by policy. But in the same breath he related that policy does not extend to the operational details.[15]

The policy-makers may give more or less independence depending on the portion of the "spectrum of coercion" they are trying to use. Coercion implies a coercer trying to influence a target in order to obtain an end state that would not otherwise occur. The influence may be an attempt to keep the target from doing something (deterrence), or to get the target to change its course—either stop doing what it is doing or take some new action (compellance). The "spectrum of coercion" therefore has deterrence on one end, progresses through diplomatic measures to compel, then to forceful measures to compel, and ends with pure brute force on the other end. The nature of every conflict will fall somewhere on that spectrum.

Whether or not the target is coerced is the target's decision, to be made based on the target's calculation of the costs and benefits involved. However, this is anything but a sanitized calculation. Motivation, culture, perceptions, bureaucratic politics, and organizational processes combine to make it difficult to tell what decision a target will make and when.[16]

This calculation becomes even more muddled when the coercer uses force. Compellance can involve direct use of force and/or actions that will result in the use of force if they are not halted—if the target modifies its behavior, the action is halted; if not, force is used.[17] The more directly force is responsible for modifying the target's behavior, the closer the compellance comes to resembling pure brute force. Brute force takes; compellance commands: "give it to me!" Brute force pushes; compellance commands: "Move!" Brute force halts the target by incapacitating it; compellance tells the target to stop. Of course, in each case, compellance either threatens force or applies some measure of force to convince the target it is serious, and promises 1) more pain if the target does not comply and 2) an end to the pain if

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[14] "The first, the supreme, the most far-reaching act of judgment that the statesman and commander have to make is to establish by [the nature of their motives and of the situations which give rise to them] the kind of war on which they are embarking; neither mistaking it for, nor trying to turn it into, something that is alien to its nature. This is the first of all strategic questions and the most comprehensive." Clausewitz, 88-9.

[15] "...policy converts the overwhelmingly destructive element of war into a mere instrument. It changes the terrible battle-sword...into a light, handy rapier – sometimes just a foil for the exchange of thrusts, feints and parries." Clausewitz, 606.

[16] The concept of asymmetry of motivation was a major contribution made by Alexander George and William Simons, *The Limits of Coercive Diplomacy*, 2nd Ed., (San Francisco: Westview Press, 1994), 281-2). They contend in some cases this asymmetry is fixed by the nature of the conflict, but in others the coercer can create an asymmetry in its favor by sticking to its own vital interests while avoiding those of the target and by offering carrots to the target. Wallace J. Thies, *When Governments Collide: Coercion and Diplomacy in the Vietnam Conflict, 1964-1968*, (Berkeley: University of California Press, 1980), 376-389 proposes it is extremely difficult to control escalation because, first of all, it is difficult to ensure the coercer's actions will match its intentions and, second, it is difficult to predict what message will actually be received by the target even if this match is achieved.

[17] Thomas C. Schelling, *Arms and Influence*, (New Haven, Conn.: Yale University Press, 1966), 10.

the target complies. So the tricky part is, it is often hard to tell compellance from brute force—compellance can often become brute force if the target does not comply.[18]

World War II was a case where compellance became almost complete brute force. The Allies' demands of unconditional surrender ensured a high level of motivation on the part of both Germany and Japan. The U.S. knew it would have to fight to the end. In fact, Japan surrendered before the U.S. had to invade; Germany did not. Japan was compelled; Germany was defeated by brute force.[19] However, in both cases, the U.S. and the Allies used all the effort they could muster, with the intent to eventually defeat the enemy through brute force.[20] This is because the interests were high enough to warrant the massive destruction that accompanies the use of brute force. So we can say World War II took place at the brute force end of the spectrum. It is instructive to see how control of airpower was handled in this, the age of Total War.

For the most part, President Franklin Roosevelt and Gen. George Marshall stayed out of the business of telling the airmen what to do. When the air plan for the war in Europe, AWPD-1, was offered by the airmen, it was passed without comment by these policy-makers. At Cassablanca, when the RAF and the Army developed plans for the Combined Bomber Offensive, it was Gen. Ira Eaker who spoke for the U.S. Eaker was an airman, and not even the senior one at that (although he was arguably the most qualified to talk about the bombing campaign).[21] The distinguishing characteristic of airpower control in this war was the absence of involvement by policy-makers, with the exception of the dropping of the atomic bombs on Hiroshima and Nagasaki. Because the interaction among governments in World War II occurred toward the brute force end of the coercion spectrum, strategic decision-makers were able to give the military significant freedom to operate. The interests at stake were so vital that the decision-makers were able to give the military clear goals and accept a great deal of collateral damage.

However, it is worthwhile to note that there was a critical feedback loop that was not established during this war. The media was unable to obtain accurate information about the bombings of Europe and Japan, and were generally sympathetic to the war effort with the reports they gave. With the

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[18] There are different strategies for using force for compellance. Robert A. Pape, *Bombing To Win*, (Ithaca, N.Y.: Cornell University Press, 1996) delineates two: punishment and denial. Denial is essentially the same as brute force only with the hope that the enemy will acquiesce before it is necessary to bludgeon him to death.

[19] It is of course debatable whether Germany was completely defeated – there were portions of the army that were still capable of fighting when the cease fire was signed. The distinction is made between Germany and Japan to show that, although the outcomes differed by a significant degree, the Allies had the same intentions in both cases.

[20] It is true that on the surface, it is hard to justify fire-bombing and atomic bombs other than as instruments of coercion—removed from that era of total war, it is hard to imagine viewing an entire country as the enemy. But here Michael Sherry's point is convincing: airman were merely doing all they could to create more destruction without coherent thoughts as to how they would end the war. If asked how bombing would end the war, airmen usually answered that it would destroy the economy. Marshall and Roosevelt did not think bombing would end the war, but that it would prepare for an invasion. Michael S. Sherry, *The Rise of American Airpower: The Creation of Armageddon*, (New Haven, Conn.: Yale University Press, 1987), 236-7.

[21] Sherry, 148-9.

overwhelming support of the American public, undiminished by contrary press feedback, the U.S. government was not forced to confront the harshness of its military's actions at the time.[22] Doubtless the subsequent analyses of area bombing in Germany and especially Japan have been one of the factors pressing the U.S. military toward its reach for greater precision. The "period" of this feedback loop was dramatically decreased by the time the U.S. fought in Vietnam.

In Vietnam, the U.S. government was determined to be more aggressive in its control over the military forces. It is probable this reaction was due to more recent events than World War II. In Korea, President Truman's failure to subjugate Gen. MacArthur's battlefield strategy to a prudent grand strategy had goaded China into the war.[23] Then, in the Cuban Missile Crisis, President Kennedy had been repeatedly frustrated at his inability to control the actions of his forces. The military's failure to remove missiles from Turkey as he had directed left open the possibility that the U.S. would have to respond to a Soviet counterstrike against nuclear weapons if the U.S. chose to attack the Cuban sites. An errant U-2 flight over the Soviet Union at the height of tension came dangerously close to provoking military action. Then the Air Force failed to disperse its fighter aircraft after the president ordered them to do so.[24] In fact, it was in the immediate wake of these events that Secretary of Defense Robert McNamara ordered the development of the World-Wide Military Command and Control System (WWMCCS) to tie together all military and civilian communications and establish a centralized command and control system.[25] With this capability, McNamara (who had seen the value of quantitative managerial methods in industry) hoped to be able to precisely control the application of military force and respond "flexibly" to any conflict. This was the policy that led to the source of the greatest argument over centralized and decentralized control in U.S. military history.

The conflict in Vietnam took place on a very different part of the coercion spectrum than World War II had occupied—at least for the U.S. In World War II, the U.S. had thrown everything at its enemies ("everything but the kitchen sink" may apply in Japan's case, but the kitchen sink—invasion—was on its way when Japan surrendered). In Vietnam, the U.S. tried to influence the North Vietnamese with a strategy described as "calibration." The trick was to pick the level of force that would 1) convince Hanoi to stop supporting the Viet Cong because it could not defeat the U.S., but also 2) avoid solidifying the North Vietnamese, provoking the Chinese, arousing world opinion, or precluding eventual

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[22] Sherry, 132.

[23] The entry of the Chinese into the Korean War is a more complex issue than this implies. See William Stueck, *The Korean War: An International History*, (Princeton: Princeton University Press, 1995), 85-126 for a good explanation. Stueck says it was the "will and influence of a commander in the field" combined with the "almost pathological concern of U.S. officials to avoid any hint of weakness to the enemy," that, when combined, "produced the reckless UN offensive of late November and forced the Chinese hand," 125

[24] These are some of the incidents used as evidence of the effect of organizational processes on strategy in Allison, 139-142.

[25] Pearson, 51-54.

negotiations.[26] The aim was not so much to defeat the target (North Vietnam), but to communicate to him that it was better for him to acquiesce than to face a determined U.S.[27]

The difference was the interests involved. Vietnam was not the true focus of the Vietnam War for the U.S. Presidents Kennedy and Johnson accepted the logic of containment laid out as far back as NSC-68, meaning that containment of the Soviet Union required confronting communism wherever it surfaced. They therefore felt compelled to honor all treaty obligations, including the SouthEast Asia Treaty Organization (SEATO). But this set up a vicious cycle. To convince the Europeans, Japan, and Taiwan that U.S. commitments were credible, U.S. leaders thought they had to do whatever it took to honor the SEATO treaty. So while Kennedy initially avoided sending any combat troops, the level of involvement got ratcheted up gradually until Johnson eventually had over 500,000 in Vietnam to protect this credibility. The detailed attention McNamara and Johnson gave to the means involved in Vietnam blinded them to the fact that the means were gradually outstretching the ends.[28]

Nowhere was this detailed attention more visible than in the air campaign known as Rolling Thunder in 1965-1968. It was a campaign where the intensity of the bombing and the location of targets were gradually calibrated to put increasing pressure on Hanoi until it acquiesced. Accordingly, policy-makers chose all the targets and many of the tactics. The Commander-in-Chief Pacific (CINCPAC), Admiral U.S. Grant Sharp, chose targets in cooperation with his subordinate commanders, sent them to the Joint Chiefs of Staff who forwarded them to Secretary McNamara for consideration at the weekly Tuesday luncheon. No military member was present at this luncheon until late in 1967. Yet at this meeting, policy-makers imposed specific constraints on the bombing campaign. Some of these constraints seem appropriate, especially given their strategy. For example, the imposition of restricted areas around Hanoi and Haiphong were consistent with the desire to communicate with the leadership in Hanoi (although these restricted areas precluded implementation of the military's desired strategy of sudden, intense, sustained pressure—this was a difference of opinion in strategy). But many of the constraints specified tactical details that affected the pilots. Aircraft were not allowed to hit surface-to-air missiles (SAMs) until photographs had been analyzed, by which time the SAMs had usually been moved. In September 1965, they were for the first time allowed to strike bridges – but only two specific bridges,

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[26] John Lewis Gaddis, *The Strategies of Containment: A Critical Appraisal of Postwar American National Security* Policy, (New York: Oxford University Press, 1982), 246-7.

[27] I agree with this interpretation by H.R. McMaster, Maj., USA, *Dereliction of Duty: Lyndon Johnson, Robert McNamara, the Joint Chiefs of Staff, and the Lies That Led to Vietnam*, (New York: HarperPerennial, 1997), 62. It is an operationalization of Schelling's description of conflict as a process of communication with the enemy, 234-245. But Schelling was being more descriptive than prescriptive. Thies points out that although war definitely is communication, it is a type of communication where the message received by the enemy cannot be easily controlled, 376-389.

[28] Gaddis, 240-44.

simultaneously, and only once.[29] These restrictions affected the way the airmen had to fly their missions—and denied them the ability to apply force in what they thought was the most effective way.

But policy-makers learned that military actions can drastically affect their strategies. They learned that television has the ability to create a feedback loop from the battlefield to the home front and give strategic consequences to tactical events. In late 1967, the Vietcong and North Vietnamese launched a coordinated campaign to draw the U.S. and South Vietnamese troops out of the cities of South Vietnam so they could attack the cities. Their intent seems to have been to attack civil authorities to undermine the confidence of the people and stoke the coals of revolution in the south. They succeeded in drawing troops out of the cities, but the U.S. and South Vietnamese forces were still able to repulse the attacks, which began on 30 January 1968—the lunar new year, or Tet. However, the fighting was so bloody and brutal that it shook the Americans' confidence in leaders who had told them the U.S. was winning the war. Gen. William Westmoreland, the commander of all U.S. troops in the war theater, tried to seize the opportunity to ask for a large number of reinforcements, sufficient to mobilize the reserves. But President Johnson perceived he had run out of the political capital required for this kind of escalation. He decided to withdraw from the race for re-election. The year 1968 was a year of violent protests and political turmoil in the U.S., and its leaders had no choice but to back out of a war that simply appeared too costly. Tet was a tactical victory for the U.S. in many respects, because it broke the back of the Viet Cong and left the North Vietnamese regulars as the only force capable of uniting Vietnam—it turned the guerilla struggle into a conventional war. But it had strategic consequences that not even the North Vietnamese had anticipated.[30]

The military took a different lesson from the war—the comparison of the ineffectiveness of airpower during the restricted Rolling Thunder campaign and the effectiveness of the all-out Linebacker campaigns. In 1972, the North Vietnamese Army invaded South Vietnam in an attempt to unite the country by conventional force. The U.S. and South Vietnamese defeated the attempt with ground forces and a heavy conventional air attack. But the South Vietnamese government, excluded from peace talks between the U.S. and the North Vietnamese, refused to accept the ensuing peace agreement, and talks broke off. So in December of that year, the U.S. launched an all-out bombing campaign, including B-52 strikes on Hanoi, after which the three parties (North and South Vietnam and the U.S.) did in fact negotiate a peace agreement. Many in the military, especially airmen, saw the war as a lesson that airpower should only be employed with full power and without political constraints. They saw

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[29] Sharp, 86-7. These are all Admiral Sharp's personal recollections, but given his position, should be valid. McMaster obtained the same information from the archives and gives specific examples where the strategic level held authority to cancel for weather, 233, and to pick specific targets, 250, 255, 286.

[30] George C. Herring, *America's Longest War: The United States and Vietnam*, 1950-1975, 2nd Ed., (New York: Alfred A. Knopf, 1986), 186-220.

Linebacker as a vindication of the power of airpower when used effectively, and Rolling Thunder as a warning of what happens when it is used ineffectively.[31] In 1978 Sharp wrote: "The aims or objectives of an international political strategy may...be limited, as were ours in Vietnam, but the actual application of military force required to achieve those aims cannot and *must not* be tactically limited." (emphasis in original)[32]

But this comparison between Rolling Thunder and Linebacker is not the only interpretation of the events of the Vietnam War. The two operations occurred in totally different wars. Linebacker was attempting to get the U.S. out of the war; Rolling Thunder was trying to win it. By the time Linebacker took place, President Richard Nixon had politically isolated North Vietnam from the Soviet Union and China, and did not have the same worries about intervention that Johnson did during Rolling Thunder. In addition, the war was a guerilla war during Rolling Thunder; it was a conventional war after the Tet Offensive, especially when the Linebacker operations took place. Bombing had relatively little effect on the ability of the Viet Cong to operate in South Vietnam; it had a large effect on the conventional North Vietnamese regulars.[33] Certainly the relaxing of restrictions allowed airpower to perform more effectively. Just as certainly, the restrictions were an important part of Johnson's strategy.

So it is important to understand the difference between World War II and Vietnam in order to comprehend the strategic-level issues involved in centralized control and decentralized execution. World War II occurred in an age of total war, where all the resources of the combatants were involved in the war effort and, therefore, were considered fair game for attack. The Allies were asking for unconditional surrender, using every bit of brute force at their disposal. In addition, the press was not able to relate the horrors of war as efficiently as they do today. Therefore, strategic-level decision-makers were able to give the military commanders significant latitude to prosecute the war in the most militarily effective way. By contrast, Vietnam was a war of limited aims for the U.S. Whether or not the grand strategy of coercion and communication could have been successful with better implementation in Vietnam is outside the scope of this study. But given this strategy, it was natural that the political decision-makers wanted a high level of control over the actions of the military, and especially airpower—the military forces in closest contact with the North Vietnamese government and civilians. Politicians also learned that tactical actions have strategic consequences. It is interesting to note, however, that the types of controls Johnson and McNamara attempted to exert became counterproductive: the controls limited the destructiveness of U.S. airpower, but did not keep military force from hardening the resolve of the North

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[31] Mark Clodfelter, *The Limits of Air Power: The American Bombing of North Vietnam*, (New York: The Free Press, 1989), 206-210.
[32] Sharp, 270.
[33] Clodfelter, 203-206.

Vietnamese or turning Americans against the war. Instead, they created severe friction between the military and civilians, rather than the close cooperation necessary in war.

Command Relationships at the Operational Level

At the operational level, the biggest issue throughout the history of U.S. military airpower has been the struggle to gain unity of effort from all air forces. In this matter, officers from air and ground forces have differing opinions.

Airmen, of course, are the ones who have always claimed airpower should be unified under a single commander. Because aircraft can move much faster and farther during a battle than ground troops, airmen have always seen less need to constrain aircraft to support of a geographical area the way ground troops are constrained. Commanders of air forces can be given responsibility for areas that are an order of magnitude larger than their ground peers. In fact, airmen claim, if aircraft are constrained by a ground commander's geographical view, they will be wasted. Aircraft may be waiting on the ground to support a ground commander who is not engaged with the enemy, while another ground commander is in desperate need of more aircraft but cannot obtain them. As Brig. Gen. William "Billy" Mitchell put it in 1925,

> The system of command of military air power should consist in having the greatest centralization practicable. An air force now can move from one to two thousand miles within twenty-four hours. Military elements on the land or water can move only a fraction of this...To assign air force units to any one of these ground organizations would result in the piece-meal application of air power and the inability to develop the maximum force at the critical point."[34]

Air Force officers credit the Goldwater-Nichols Defense Reorganization Act, over six decades later, for finally setting the conditions to allow a single airman to command all air forces in the 1991 Gulf War.[35]

On the other hand, ground officers have always put priority on synchronizing ground and air operations. Probably the first to put this need in writing was the Soviet Marshal Tukhachevsky. Writing between the two world wars, he realized that airplanes and tanks had opened up the opportunity for a new type of maneuver combat after World War I. He predicted that future wars would be won by the side that was able to coordinate the many heterogeneous actions of the different types of forces throughout the depth of the battlefield. To do this, commanders would have to concentrate these forces on clear

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[34] William Mitchell, Brig. Gen., USA, *Winged Defense: The Development and Possibilities of Modern Air Power Economic and Military*, (New York: Dover Publications, 1988), 217. Giulio Douhet, the Italian who was probably the first and most outspoken air advocate, also came down clearly on this point: "It is only when we arrive at the term 'Independent Air Force' that we perceive an entity capable of fighting on the new battlefield, where neither army nor navy can take any part. Planes operating under command of the army or navy can be considered as no more than auxiliary weapons," Guilio Douhet, *The Command of the Air*, translated by Dino Ferrari, (Washington: Air Force History and Museums Program, 1998), 33.

[35] David A. Deptula, Maj. Gen., "Air Force Transformation: Past, Present and Future," *Aerospace Power Journal*, Fall 2001. Available at http://www.airpower.au.af.mil/aichronicles/apj/apj01/fal01/phifal01.html, accessed 10 Oct 02.

objectives, but avoid "firm" control or a "tight rein."[36] Later, this was to be the idea behind Airland Battle doctrine that the U.S. Army would develop to defeat the numerically superior Warsaw Pact. It is combined arms doctrine, the idea that the most important effect of a weapon system is not its killing potential, but the enemy reactions it causes. Ground officers see the benefit of having complementary capabilities, so that one weapon causes the enemy to react in a way that leads him right into another weapon.[37]

The issue, then, was over command relationships. Airmen wanted to have an airman in command of all air forces, with the authority to task the aircraft on a theater-wide basis. Those on the ground wanted the aircraft to be organic to the ground units so the actions would be synchronized for the greatest effect. Different experiences in World War I had sparked this argument. Then during the years of peace between the world wars, the U.S. Army was plagued by years of short budgets and fights for scarce resources as well as the sheer boredom that peacetime brings for militaries. These factors elevated the argument to a bitter fight for independence of the air arm that went way beyond the question of who would command air forces during wartime.

During World War II, the issue came to a head in the Army. During the campaign in North Africa, Army Air Forces units had been split up into what was later called "penny packets" under the control of ground commanders. The ground commanders used the aircraft to support their individual ground units, who were largely confined to geographical areas. At one point, II Corps Commander Gen. Lloyd Fredendall told Northwest African Air Forces commander Lt. Gen. Carl Spaatz that he wanted aircraft constantly flying over his troops and concentrating only on the enemy troops immediately in front of them during an attack.[38] This made it difficult for the allied air forces to coordinate an attack on the German army as a whole, not to mention defeating the Luftwaffe to gain air superiority. The British and American chiefs of staff were in the midst of trying to solve these disputes when Field Marshall Erwin Rommel attacked the U.S. 1st Armored Division and destroyed half its tanks. The allies stopped the attack by throwing in reserves, but it was a fiasco. Even though air had played only a small part in the effort, the battle of Kasserine Pass became the force that drove ground and air commanders to work out their coordination problems. As a result, in 1943 the doctrine document FM100-20 specified that there would be an air commander equivalent to the ground commander.[39]

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[36] Richard Simpkin and John Erickson, *Deep Battle: The Brainchild of Marshal Tukhachevskii*, (McLean, VA: Pergamon-Brassey's International Defense Publishers, 1987), 150-51.
[37] Robert R. Leonard, Lt Col, USA, *The Principles of War for the Information Age*, (Novato, Calif.: Presidio Press, 1998), 69-71.
[38] David Syrett, "Northwest Africa, 1942-1943," in Benjamin Franklin Cooling, editor, *Case Studies in the Achievement of Air Superiority*, (Washington: Air Force History and Museums Program, 1994), 241-2.
[39] David Syrett, "The Tunisian Campaign, 1942-43," in Benjamin Franklin Cooling, editor, *Case Studies in the Development of Close Air Support*, (Washington: Office of Air Force History, 1990), 170-74. It also stated that the

But the doctrinal solution did not end the problems with unity of airpower effort. In Korea and Vietnam, air resources were not parceled out to ground commanders, but they certainly did not achieve unified, coherent effort. Air Force, Navy, and Marine air efforts were now three separate campaigns, and the best coordination they could muster was to attempt to de-conflict missions so one service did not interfere with another. In both conflicts, the theater commanders recognized that the situation was undesirable and attempted to rectify it near the end of the war. In Korea, Navy and Air Force aircraft finally worked together on a single target during the raids on the hydro-electric plants on 23 June 1952.[40] This marked the beginning of continued cooperation between the two services, where each would at least inform the other of its plans and sometimes even request support for a particular operation.[41] Then in 1953, General Mark Clark, the U.N. commander, directed the Navy to participate with the Air Force in a Joint Operations Center, so that the planning for both services was accomplished jointly.[42] This was late in the war and probably had little impact, but was at least an acknowledgement of the desirability of unified, joint effort.

Despite the solution near the end of Korea, the same problem occurred in Vietnam. Neither the Air Force nor the Navy would relinquish control of its resources to the other, so there could be no overall commander. Instead, Admiral Sharp designated Maj. Gen. Joseph Moore, commander of the 2nd Air Division of the Pacific Air Forces (PACAF), the "coordinating authority" for Operation Rolling Thunder attacks. He could not communicate well enough with the Navy to exchange information on a mission-by-mission basis, so he worked with the Navy's Task Force 77 to come up with an arrangement that would allow the two services to stay out of each other's way. The answer was to divide the country into seven geographical areas called "route packages" (There were only six numerical designations, but route package VI was divided into VIA and VIB). Moore gave the Navy four and the Air Force three (although the Air Force had the largest area). This allowed the Navy to plan its own missions without coordinating with the Air Force, and vice versa.[43] But it precluded any sort of coherent timing of effects that would have been necessary for McNamara's calibration. It also hampered cooperation between the two services for the use of resources, intelligence, or even lessons learned.

If the lack of unity hampered the attacks in Operation Rolling Thunder, it was worse for the ground war in the south, where aircraft were required to coordinate closely with ground troops. Here the support was primarily provided by U.S. Air Force, Marine, and Vietnamese Air Force aircraft. But the

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priorities for airpower would be air superiority, interdiction, and then close air support (CAS). This is the genesis of the continuing controversy between the Air Force and the Army over CAS

[40] Robert F. Futrell, *The United States Air Force in Korea*, Revised Edition, (Washington: Office of Air Force History, 1991), 489.

[41] Ibid., 492.

[42] Futrell, 676.

[43] William M. Momyer, Gen., USAF (ret.), *Air Power in Three Wars (WWII, Korea, Vietnam)*, (Washington: Office of Air Force History, 1978), 90-91.

U.S. Air Force and Marines practiced different doctrine and coordinating procedures, so there were overlapping systems with no manager to de-conflict the separate air forces. Gen. Westmoreland suggested to Admiral Sharp that the large number of ground troops and resources in South Vietnam warranted a single air manager. Sharp disagreed.[44] In 1968, when the Tet Offensive began, President Johnson issued a special directive ordering the defense of the Marine base at Khe Sanh, because of the historical analogy a loss there would have made with the French disaster at Dien Bien Phu.[45] With this heightened importance, both the Air Force and the Marines scrambled to send all the air sorties they could muster to the rescue. The result was near chaos, because the only coordination between the two was essentially through ad hoc arrangements. The flow of aircraft was uneven, causing shortages during some critical times and bottlenecks of too many aircraft during some quieter times. Westmoreland forcefully insisted that all air operations be controlled by a "single air manager" from the Air Force, namely Vth Air Force Commander Gen. William Momyer. This move caused such controversy the decision was eventually appealed all the way to President Johnson. Marines especially claimed it was not as effective as their own system. Regardless, the arrangement did not occur until after the battle for Khe Sanh (Operation Niagra) was over.[46]

Throughout the period, then, officers in the Army Air Forces and Air Force strived for the authority to manage all air resources. These officers thought only a single manager could properly direct the resources to the highest priority missions so they would not be wasted by local commanders who did not have a theater-level view. But their efforts were hampered by the different services' fears about relinquishing their assets to a commander of another service. Each thought this arrangement would mean they would lose total "control."

Different Levels of Control for Different Tactical Missions

There is another level to the arguments. The airmen who strove for this central authority learned over and over that the type of control that was appropriate varied according to the type of mission. The type of control that was appropriate for strategic bombing missions differed from that necessary for successful close air support (CAS).

When aircraft flew on CAS missions, they developed ways to work closely with the soldiers on the ground to find targets. In Europe during World War II, the centralized control of these missions, requiring a full day for scheduling a target, was ineffective at supporting the D-day invasion and even proved dangerous to friendly troops. Americans developed a method of scheduling a steady stream of

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[44] John S. Sbrega, "Southeast Asia," in Benjamin Franklin Cooling, Ed., *Case Studies in the Development of Close Air Support*, (Washington: Office of Air Force History, 1990), 456.
[45] Todd P. Harmer, "Enhancing the Operational Art: The Influence of the Information Environment on the Command and Control of Airpower," (Master's Thesis, School of Advanced Airpower Studies, Maxwell Air Force Base, Ala., 2000), 42-3.
[46] Sbrega, 457-63.

aircraft over an armored column, with a VHF radio in the lead vehicle to assign targets as the aircraft arrived. Later, an airborne forward air controller took over this function. Thus, although the aircraft were still scheduled and routed by a centralized "Combined Operations Center," they were often given targets on the scene.[47] In the Southwest Pacific, the same sequence occurred. At first, air strikes had to be scheduled a day in advance. Target acquisition was difficult, especially in the jungles, so ground troops tried to mark the targets with smoke. It was 1944 before the ad hoc forward air observer team brought aircrews into contact with the ground forces. By the end of the year, communications with the ground were an accepted part of close support. There was never any operational control of aircraft by ground commanders—they could only request strikes. The ground controllers were air personnel who accompanied the ground forces.[48] Still, the airmen learned that the best people to pick targets for close air support aircraft were those on the scene.

Strategic bombing was a different matter. The targets for bombing raids on Japan by the 20th and 21st Bomber Commands were basically directed from Washington. The Japanese targets were picked and put into mission folders by U.S. Army Air Forces Chief Gen. Henry "Hap" Arnold and his Committee of Operations Analysts.[49] Arnold and XX Air Force Chief of Staff Lauris Norstad (also located in the U.S.) were decidedly hands-on in their direction of the 21st Bomber Command operations, too. When Gen. Haywood Hansell did not live up to their expectations as commander of the 21st Bomber Command, they replaced him with Gen. Curtis LeMay. They pressed both the commanders for incendiary attacks on Japan, at one point even specifying the tactics the B-29 crews should use (although LeMay is given credit for the final low-level tactics that produced most of the destruction).[50]

This involvement by high-level officials is understandable, given their complexity and the interests the Army Air Forces had in strategic bombing. Throughout the period between World War I and World War II, the Army Air Corps had developed a strategic bombing doctrine. During the war, the Army Air Force staked its bid for independence on the efficacy of strategic bombing. After the war, the new Air Force was convinced the strategic bombing of Japan, including fire bombing and the atomic bombs, had been the decisive factors in the victory.[51] Added to this, the missions deep into enemy

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[47] W.A. Jacobs, "The Battle for France, 1944," in Benjamin Franklin Cooling, editor, *Case Studies in the Development of Close Air Support*, (Washington: Office of Air Force History, 1990), 251-275.
[48] Joe Gray Taylor, "American Experience in the Southwest Pacific," in Benjamin Franklin Cooling, editor, *Case Studies in the Development of Close Air Support*, (Washington: Office of Air Force History, 1990), 332-3.
[49] Sherry, 219-225. See also Kenneth P. Werrell, *Blankets of Fire: U.S. Bombers over Japan during World War II*, (Washington: Smithsonian Institute Press, 1996), 52-53, 102, 128.
[50] Werrell, 138, 151-157.
[51] *The United States Strategic Bombing Surveys*, (reprinted by Air University Press, Maxwell Air Force Base,Ala., 1987), may have contributed to this interpretation. This document actually covered the many facets of the war fairly well. As such, it may have given many different interests fuel for their fires. At times it extolled the virtues of strategic bombing, claiming "no nation can long survive the free exploitation of air weapons over its homeland," 110. In others, it acknowledges the importance of "air control" or railway attacks. Alfred C. Mierzejewski, *The*

territory were dangerous and involved the cooperation of bombers and pursuit fighters, which were not stationed together. High-level Army Air Force officials took great interest in the details of these missions because of their political significance as well as because of their complexity.

Because of this interest in strategic bombing, the new Air Force did not pay as much attention to close air support as the Marines following World War II. The lessons were not lost—the Army Air Forces had collated the lessons learned from close support in World War II into FM 31-35. But these were a mix of lessons from two theaters, each of which used significantly different procedures. They were developed to work primarily with the Army, who placed heavy reliance on organic artillery and preferred aircraft for the deeper strikes except in critical situations. By contrast, the Marines had learned all their lessons on the beaches of the South and Central Pacific. After World War II, Marine air and ground troops organized around the amphibious assault mission. Consequently, the Marine air wings were finely tuned to working with forward air observers to provide close support, while the Air Force placed more emphasis on deep strike operations.[52]

Because of this difference in concentration, the Marines were ready for Korea; the Air Force was not. The early battles to defend the Pusan Perimeter consisted of many desperate situations requiring close support of troops who were in contact with the enemy. The Air Force had to re-learn the value of coordination with ground troops. Fifth Air Force had to improvise to get air controllers out with the ground troops and set up a communications net. They also flew slow, unarmed T-6 Mosquito trainer aircraft that could loiter over the front lines to help locate targets and direct attacks against them.[53] But the ground troops, not the airborne forward air controller, were the ones who needed to pick the targets—the FAC was only an airborne extension of the soldiers' eyes.[54]

After Korea, the Air Force did not incorporate the lessons into doctrine, and ran into some of the same problems in Vietnam. In the beginning, cumbersome command and control procedures kept CAS from being responsive to the ground commanders' requests. But by the end of the war, Army veterans of World War II and Korea considered CAS in South Vietnam the best they had ever experienced.

The Air Force had to re-learn to decentralize the target-picking and traffic control functions of CAS. The "single air manager" did not have a lot of say in CAS. During the defense of Khe Sanh, while the argument over a single air manager was taking place, the management of aircraft was chaotic, with an uneven flow of aircraft and congestion over target areas. Still, with the help of a modified C-130 called

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collapse of the German War Economy, 1944-1945: Allied Air Power and the German National Railway, makes a good case that it was in fact the bombing of the German transportation system that had the greatest effect on Germany's ability to prosecute the war. Certainly gaining air superiority was also an important factor in both the European and Pacific theaters.

[52] Futrell, 704-5.

[53] Ibid., 705-6.

[54] Ibid., 43-44.

the Airborne Battlefield Command and Control Center (ABCCC), forward air controllers (FAC), and close communications, aircraft and ground troops worked well together, and air support is credited with saving Marines at Khe Sanh from the fate of the French.[55] This seemed to show that with close air support, control at the scene during the missions is more important than centralized control—the job of the operational level is to get the planes there.

By contrast, the intense, 11-day bombing campaign in 1972 that brought all three sides back to the bargaining table was a decidedly centralized affair. Known as Linebacker II, this was a massive B-52 effort to strike Hanoi and coerce the North Vietnamese into giving in to U.S. and South Vietnamese terms for ending the war. President Richard Nixon gave the military almost carte blanche, telling them, "This is your chance to use military power effectively to win this war and if you don't I'll consider you personally responsible."[56] Gen. J.C. Meyer, commander of Strategic Air Command (SAC), decided the operation would be planned in Omaha, Nebraska, at SAC headquarters, on the other side of the world from the theater where the strikes would take place. Trying to overcome time zone differences, communications problems, and a general culture that placed predictability over innovation, SAC put out a plan that the 8th Air Force staff in Guam considered tactically unsound. They flew it anyway, and the first nights of flying led to near-disastrous losses of B-52s.[57]

Of course, the fact that the initial missions were a disaster suggests that this centralization was a mistake. Indeed, one of the fixes was for SAC to relinquish many of the details to the 8th Air Force staff at Anderson Air Force Base in Guam. But this actually had the effect of aiding centralized control, not decentralizing it. On the first four nights, although the bomber operations were planned in Nebraska, the support from fighters was arranged by 7th Air Force in Saigon. The communications difficulties and time-zone difference meant 7th Air Force had been getting the orders so late that they were unable to arrange the best support. Starting on December 26, the two staffs in theater were able to coordinate better tactics and better support for the massive bomber raids.[58] The complexity of the missions demanded centralized control, and moving the planning to the theater helped consolidate control of all airpower. Sometimes, holding authority at too high a level dilutes centralized control.

Through these conflicts, the air commanders had to learn that there was a difference in the amount of details they could manage centrally for different missions. Because strategic bombing went after fixed targets, required the coordination of many different types of airpower, and held high political visibility, the details for these missions were determined by high-level officials. But in each war, the Air

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[55] John S. Sbrega, "Southeast Asia," in Benjamin Franklin Cooling, Ed., *Case Studies in the Development of Close Air Support*, (Washington: Office of Air Force History, 1990), 423, 470, 456-63.
[56] Richard Nixon, quoted in Marshall L. Michel III, Col (retired), USAF, *The Eleven Days of Christmas: America's Last Vietnam Battle*, (San Francisco: Encounter Books, 2002), 55.
[57] Michel, 59-69.
[58] Ibid., 185-9.

Force had to re-learn that the success of CAS missions depends on the ability of those on the scene to determine the details on the spur of the moment.

Technology's Role

Technological development was an integral part of all three of the preceding categories, so it remains an integral part of the arguments. States (and their policy-makers and commanding generals) have always grasped at technology that allowed them to better influence the actions of their militaries. Railroads and telegraphs went hand in hand because, whereas the one allowed more rapid flows of goods and people, the other was necessary to communicate when and how much was flowing and to synchronize the supply with the demand.[59] But in the same period, the range and accuracy of rifles increased, making the American Civil War such a deadly affair that the Europeans refused to learn any lessons from it. Using railroads and telegraph, the Chief of the Prussian General Staff, Helmuth von Moltke, could precisely plan and direct the strategic deployment of his armies, but his field generals could not ensure their men would fire with discipline in battle. The Prussian solution was to re-train the entire army to use new, standardized tactics. In the Franco-Prussian War in 1870-71, to the amazement of all the world, a citizen-soldier Prussian army quickly defeated Europe's best professional army. The Prussians allowed their troops to spread out and make better use of cover, while the French still massed in columns for their attacks.[60] The Prussians had taken advantage of the new technology and found new ways to influence the troops using it, while the French had stayed with their old tactics to maintain control at the expense of the new capability that technology afforded.

At first, aircraft were seen as a way to ameliorate these control problems. In World War I, the airplane was initially a favorite method of directing artillery fire. The pilot, with his 10,000 foot vantage point, could see much more of this expanded battlefield than any commander on the ground. But getting the information to the ground was difficult. At first, the pilot had to land or drop notes to communicate. Then, the aircraft were equipped with wireless telegraphy so they could tap Morse code. Aircrews directed the artillery to fire, watch for the muzzle flash and the ensuing explosion, and relay the accuracy of the shot. It was a tedious method, but better than any alternative.[61] The aircraft could also bring other useful information to the ground troops. However, it was difficult to remember and accurately relay all the information. So the aircrew began using aerial photography, which was at the time over a half century old. Now the aircrew could bring high-fidelity representations of the battlefield back. This was great for

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[59] Alfred D. Chandler, Jr., *The Visible Hand: The Managerial Revolution in American Business*, (Cambridge, Mass.: Harvard University Press, 1977), 195 – "The railroad and the telegraph marched across the continent in unison." On the use of these instruments in the military, the consummate work is Dennis Showalter, *Railroads and Rifles: Soldeirs, Technology and the Unification of Germany*, (Hamden, Conn.: Archon Books, 1975).

[60] McNeill, 250-53.

[61] Lee Kennett, *The First Air War, 1914-1918*, (New York: The Free Press, 1991), 33-4.

situations of low urgency. When time was of the essence, the aircrew still had to try and take what they saw and translate it into digital beeps over wireless, with all the loss of information that entailed.[62]

So the aircraft was a sort of "directed telescope," in Van Creveld's parlance. But in World War I, armies realized it could also be used to strike the enemy. So the commanders needed a directed telescope to keep track of the aircraft as well. But the speed and range of aircraft took the problems posed by the rifle another order of merit—the "battlefield" was now more appropriately a "battlespace" that went as far as an aircraft could fly. Wireless was not much help, because the receivers were large and heavy and the aircraft were noisy. By the end of the war, radio sets in the aircraft allowed commanders on the ground to influence the actions of the aircraft out to a limited distance of about three miles.[63] In World War II, radio was the standard method of communication, although it still could not reach as far as the aircraft could fly. However, there was another problem. Even if a commander could communicate with the aircrews, he still had to piece together many bits of information to understand what was happening in the huge geographical area (or, more appropriately, volume) that could be encompassed by the "battlespace."

The first systematic attempt to deal with this problem was the air defense system that helped the Royal Air Force (RAF) defeat the Luftwaffe in the Battle of Britain during World War II. The RAF had constructed radars called Chain Home on the coastline of the island to warn them of approaching enemy aircraft. They had also established a Royal Observer Corps who could watch for and help identify the enemy aircraft. Radar contacts were sent from the Chain Home radars to the Fighter Command Center at Bentley Priory, near Stanmore, Middlesex. Here a filter center cross-checked all the contacts to try and eliminate redundancy. Then the operations room next door sent all the information to the group headquarters. Observers sent their information by radio to the groups' headquarters, who disseminated it up the chain to Stanmore and down the chain to the sector headquarters. Inside the command center, group, and sector headquarters, workers executed a well-choreographed dance to take the information from the phone lines and radios and transfer it to a table-top map. This map was a similar, standardized representation at all levels, except as the scope of the headquarters increased from sector through command, it represented a correspondingly larger portion of the total area. The groups made the decisions about which squadrons would attack which enemy formations. They passed orders to the sectors, who took over to control the fighters by radio. The sectors directed the fighters to contact with the enemy until the fighters were within sight, at which time the fighters took over. After the battle, the sector again took over to direct the fighters back to base.[64]

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[62] Ibid., 36-38.
[63] Charles G. Crawley, Lt Col, USA, "How Did the Evolution of Communications Affect Command and Control of Airpower: 1900-1945?" (Unpublished thesis, Air University, 1996), 11.
[64] Derek Wood and Derek Dempster, *The Narrow Margin: The Battle of Britain and the Rise of Airpower, 1930-1940*, (Washington: Smithsonian Institute Press, 1990), 118-119.

This system assembled a picture of the entire air situation using bits of information from many sources. The bits of information were simple enough—position, altitude, heading, type, number, friendly/foe—that they could be passed from person to person over telephone or radio without losing much information. The headquarters took them and ascribed to them a relationship that gave them meaning beyond what any of the individual reporters, radar, or observer, could have ascertained. The headquarters was then in a better position to make the decisions about who should attack where. But, since the fighters had a better view of what was happening in the narrower confines of the actual engagement, they took over command at contact.

By the time the U.S. fought in Vietnam, much of the equipment was better, but the concept of operating was about the same. The U.S. had an organized system for developing a representation of the air "battlespace" by combining mostly inputs from ground radar systems, called Control Reporting Posts (CRPs) or Control Reporting Centers (CRCs), various models of airborne radar aircraft designated EC-121, and a signals intelligence aircraft designated the RC-135 Rivet Joint. Although these sensors far surpassed the RAF's capabilities, they still communicated with each other primarily by voice.[65] Operators from the CRCs had to call the 7th Air Force's Tactical Air Control Center (TACC) by land line or radio to give them information. At the TACC, operators transferred the information to a plexi-glass display to create an integrated representation of the air picture. If aircrew on the EC-121 aircraft wanted to direct a friendly aircraft to an intercept with the enemy, they called the pilot on the radio and relayed the instructions. By the late 1960s, Air Force officials saw that they had the need to automate the exchange of information. The capability seemed to be there as well: both the Navy and the Marines had rudimentary datalinks to link some of their radars, and the Air Force began a project called Seek Dawn to accept this information as well as its own radar and Rivet Joint information. In fact, the program made headway and developed the ability to perform this integration at one of the subordinate TACCs in Vietnam. However, the Air Force cancelled the program in 1970 when it was deemed too costly and complex for a war that the Air Force thought was almost over. So the USAF had significantly better sensors in Vietnam than the RAF had in the Battle of Britain, but the USAF was still unable to create an automated, integrated representation of the "battlespace."

It is important to note, however, the significant difference between the ability to assemble details about the "battlespace" in the air and on the ground. The previous two discussions from the Battle of Britain and Vietnam dealt with air-to-air missions. Air forces had successfully developed the ability to use radar as a sensor to get information on airborne targets back to command headquarters and act on it quickly. No such success had been made with ground targets. The U.S. did use RF-4s, RF-101s, and unmanned vehicles to take aerial photography in Vietnam, but these had to be processed after the aircraft

[65] Koprucu, 35-7.

landed, and were therefore only useful for planning future missions. During the course of planned missions, the enemy would of course react, providing targets on the ground that often had to be attacked within a specific time period.

Because of the difficulty of assembling a picture of the ground, there were two ways to attack these targets. One of them, as previously mentioned, was CAS. When the enemy targets were close to friendly ground troops, the friendly troops could act as the sensors, detecting the targets and requesting strikes. Then they would even direct the aircraft to the target. By Vietnam, the U.S. had an elaborate system of liaisons and controllers set up to perform this function. The Air Force also had the ABCCC to talk to the strike aircraft, act as traffic manager, and even make some decisions about the priority of the strikes. But where there were no friendly ground troops, there were no "sensors" to help the aircrew find dynamic ground targets. The only way to find and attack these targets was to fly around and look for them with the sensors on the aircraft—usually the aircrew's eyes. In World War II, the allies were highly effective using this method (called armed reconnaissance) to interdict the German transportation system. However, it required a high degree of air superiority and a lot of aircraft relative to the area to be searched.[66]

Essentially, on this type of mission, the pilot performs almost the whole command loop: he is the sensor, the targeteer, the decision-maker, and the pilot.[67] The only way for someone else to become involved in the loop is for the pilot to relay his knowledge of the target and its surroundings over the radio. But the pilot cannot transfer his knowledge—only try to describe it over the relatively low-bandwidth channel that is voice communication. This would give that person a significantly lower-fidelity picture of the target area than the pilot. So it was usually better to constrain the pilot using rules of engagement (ROEs) that dictate what type of target he could and could not attack and when. As we will see later, this would change as the military developed the technology to allow commanders to insert themselves into these loops.

Technology, then, affected the arguments about control of airpower in two major ways. First, commanders constantly tried to gain the ability to monitor and track airpower—to use a "directed telescope" to assemble a picture of where the aircraft were in relation to each other and the enemy. Second, to specify details about the missions, commanders needed to find the targets. Radar helped solve this for air-to-air missions, but no comparable technology emerged for air-to-ground missions. Therefore, the details of missions to attack emerging ground targets had to be released to those on the scene.

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[66] Eduard Mark, Aerial Interdiction in Three Wars, (Washington: Center for Air Force History, 1994), 408. Mark contends that it was because of the lack of air superiority and the lower number of aircraft that the effectiveness of armed reconnaissance fell off sharply after World War II.

[67] There are exceptions. When the AC-130 fixed-wing gunships were developed during Vietnam, they had infrared, low-light level television, and radio frequency sensors to aid the aircrew in detecting targets, even at night. However, these were still on-board sensors.

Conclusions

These comparisons make it clear that there are several different arguments hidden underneath the umbrella of the "centralized control and decentralized execution" issue. At the strategic level, there is an argument over what level of details the policy-makers should be concerned with. This is partly an issue of civil-military relations, and partly a question of how to use pre-planned constraints like ROEs and target approval to influence military action. Admiral Sharp's view of this issue was that the civilian policy-makers should determine the aims of the war and then let the warriors run the war. Perhaps he and other officers who disagreed with the way the Vietnam war was run were conditioned by the fact that World War II and Korea were run in much different manners. The civilians had been much more hands-off, leaving the military to develop and direct the war plans. In fact, these officers probably saw a trend—there were political limitations placed on airpower in Korea that had not been there in World War II, and now Vietnam had multiplied these limitations. They perceived that the effectiveness of airpower decreased accordingly, and did not wish to see the trend continue.

But the question remains whether this was a trend or an indication of the different strategies employed in different situations. It appears the amount of control the strategic level decision-makers wanted varied with the portion of the coercion spectrum on which they were working in a given conflict. The policy-makers were gauging the amount and type of violence that would achieve their positive aims without negatively affecting the political situation. The Johnson administration's strategy for keeping this balance required a high degree of control.

Below the level of civil-military relations, there are other control arguments. The Air Force continuously struggled to gain the authority and then the ability to control all air resources so they could be integrated into a coherent effort. This struggle probably began in World War I and was nurtured by the desire of the airmen for an independent service. However, in the airmen's mind the need for this "centralized control" was proved in Africa during World War II. The Army Air Forces were unable to mount sufficient resistance to the Axis air forces to gain air superiority while they were broken up into "penny packets" under the command of ground forces or subject to the strategy of defending ground forces like an umbrella. There had to be an airman with the experience and knowledge of how to best use airpower's flexibility and offensive capability and, simultaneously, the authority to command all air forces. However, even though this principal was recognized and written in Army doctrine during World War II, it still was not realized. In both the Korean and Vietnam wars, the air effort was divided among the services in the beginning. In both wars, commanders called for a single manager or commander near the end. The first war with a joint air commander was still to come.

Still another level down from this part of the argument, another emerges: not all missions are created equal when it comes to the level of control they receive. Much of the planning for the B-29

missions into Japan was done by analysts and commanders in Washington. But ground support missions had to be planned closer to real time. It was in World War II that the concept of forward air controller was born. Later, in Vietnam, the same split emerged. Bombing missions into North Vietnam were subject to approval by President Johnson and Secretary McNamara at the Tuesday luncheons. B-52 missions during Linebacker II were planned in Nebraska at first—even when SAC was convinced to relinquish the detailed planning to the theater, the aircraft still took off with the mission planned in detail. But fighters, FACs, and ABCCC again learned how to coordinate in real time with the troops on the ground and to find and interdict enemy targets in South Vietnam.

At each of these levels, the organizations involved were trying to make the military actions conform to some plan. Each tried to figure out what was happening in the "battlespace" and adjust it. This involved getting information and then assembling it into some kind of representation that allowed them to see how to make these adjustments. But the speed and range of aircraft made this difficult. When targets were in the air, radar helped get the information. But to attack emerging targets on the ground, there was no parallel technology, so the principle "sensors" remained the aircrew and ground troops.[68]

The history we have used to understand the concepts of centralized and decentralized control does not adequately describe the "system" we must study. Throughout the period from World War II through Vietnam, the Air Force learned repeatedly that airpower was more than just strategic bombing. In each conflict, Air Force pilots had to re-learn the principles of decentralized control vital to close air support. Yet although the pilots and ground observers learned how to work with each, the Air Force did not place as much effort on the missions that required this type of decentralized control as it did on the strategic bombing mission. After World War II, officers in the new Air Force were convinced that strategic bombing had won the war. The strategic bombing mission required the highest technology and, therefore, the most funding. In terms of the detailed planning required, it was the most complex: the combination of known targets and high threats lent themselves to a high-level effort to plan and coordinate multiple resources with great precision. From the inception of the Air Force until 1982, every single Air Force Chief of Staff was a bomber pilot, formed in the culture that valued such detailed, centralized planning. The Air Force could not change equipment and tactics while its top generals saw such "limited" wars as Korea and Vietnam as flukes compared to the important mission of deterring the Soviet Union.[69] We need to see how this system developed from the Vietnam error to its present state.

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[68] There was an EC-121 variant called Igloo White that attempted to locate moving targets electronically, using a primitive phenomenology to monitor the Ho Chih Minh Trail for movement of people and trucks. This was probably a fore-runner of the E-8 JSTARS that will be discussed later. Lambeth, 44.

[69] Mike Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945-1982*, (Maxwell Air Force Base, Ala.: Air University Press, 1998), 236-7. Also see Thomas P. Ehrhard, "The Armed Services and

But we can already form a picture of the main issues to address in the study. The control of airpower varies with the type of war, the command relationships, the type of mission, and the technology. An answer to the question about centralized versus decentralized control must at least address these issues. But a complete answer must also determine whether there is any interaction among them. For this, we need a "systems" approach.

Innovation: Function, Structure, Culture," adapted from "Unmanned Aerial Vehicles in the United States Armed Services: A Comparative Study of Weapon System Innovation," (dissertation, Johns Hopkins University School of Advanced International Studies, June 2000), 24 for a list of the service chiefs. Ehrhard calls this a "monarchic" type of organization, and discusses its implications for innovation in the Air Force.

Chapter 3

The Combat Air Operations System

In reality, what has happened is that a new air-ground system has come into existence where you no longer talk in terms of one being supported and the other supporting. That would be like asking if the lungs are in support of the heart or if the heart is in support of the lungs. It's a single system.

Arthur Cebrowski, Vice Admiral (Ret)
Quoted in Army Times, *25 Nov. 2002*

Whenever a problem is too complicated to completely comprehend on the surface, you can bet it will be described as a system. Similarly, when someone says s/he is using a "systems approach" or "systems thinking," that usually means the solution will include a broad spectrum of factors that would not be obvious to the casual observer.

From what we have covered so far, it certainly seems the problem at hand calls for a systems approach. We saw in Chapter 2 that the argument over centralization is an onion—each time you peel away a layer, there's a fresh, new argument. What looks like delegation at one level looks like micromanagement at another. It may even be that different levels of centralization are appropriate for different situations—different wars, different missions, and different levels of technology. However, there are interactions among all these factors, so we cannot look at any of them in isolation and determine the answer. We need a method that takes the interactions into account

In this chapter, we will develop a systems approach as a framework for the rest of the study. We will define the key terms in the argument, concepts that later will help us classify the historical evidence and sort out what is centralization and what is decentralization. Then we will determine what is involved in what we are calling the Combat Air Operations System (CAOS). This is an imaginary system, in that it is not seen as such right now. It is a technology-enabled but extremely social grouping of different organizations that all influence the employment of airpower in combat. We will define it in terms of four subsystems that are all influenced by the actions of key players in a policy sphere—a complex, large-scale, integrated, open system (CLIOS). Finally, we will find those areas that are key to understanding what types of authority are delegated or held and why. This will be the basis for the rest of the study.

Combat Air Operations

First, let us define the scope. We are talking about combat air operations, but even that categorization could be too broad for us to handle. All three words have connotations beyond what will be studied here

Combat will be used mainly in a conventional sense. In Chapter 2, we defined a spectrum of coercion, with deterrence on one end and brute force on the other. The type of combat we will analyze can take place in any part of this spectrum, as long as the potential for purposeful violence—violence with a political end in mind—exists. The cases we will examine will be mainly those where one conventional, uniformed military fights against another conventional, uniformed army to gain an advantage in a political struggle. However, we will at times include examples of unconventional warfare, where non-uniformed insurgents struggle to change an existing political order. We will not, however, venture into the realm of the use of nuclear weapons.

The focus is on the control of airpower. Airpower includes everything that uses the air as a medium to escape the friction and geographical barriers of the earth's terrain and rapidly project influence. This includes weapons from the Army, Navy, Air Force, and Marines. It also includes many non-weapons. In fact, the term "airpower" could be used to refer to everything that enables those air vehicles to perform, including the logistics, maintenance, and ground crews. It certainly includes functions that project influence by delivering troops, supplies, information, or humanitarian aid rather than bombs.

We will focus mainly on the type of airpower that delivers destructive influence. This is not because it is more important; but the delivery of lethal force has the potential to create a bigger immediate impact in terms of its effects on the humans. That is why the issue of who should control it is so divisive. A misplaced bomb can kill the "wrong" people, raising questions about the competency or even intentions of those who are employing force for political ends. Principles that apply to this most explosive form of airpower will be easier to apply to the rest than the inverse.

Effects-based Operations

Another word for influence is effects. "Effects-based operations" is an expression used in the military today to describe the process of using military force to produce a predictable result or impact, rather than mere destruction. As we will see later, the air planners in Desert Storm were probably the first to explicitly use this type of planning. The definition has since been clarified and expanded so that the purpose of effects-based operations is now to create a physical stimulus that starts a chain of events that, if properly planned, will eventually cross into the cognitive domain and affect the decision-maker.[1] When we use "effects" in this book, it is to signify that the phenomenon in question applies to more than just destruction—it could be any type of result airpower is capable of creating.

One reason for the emphasis on effects is to enable leaders to specify what they want to happen instead of how it should happen. A commander could specify that the enemy army be unable to use

[1] Edward A. Smith, *Effects Based Operations: Applying Network Centric Warfare in Peace, Crisis, and War*, Department of Defense Command and Control Research Program, November 2002, 304, available to download at http://www.dodccrp.org/publications/pdf/Smith_EBO.PDF.

external power sources for the next seven days instead of telling the air commander to destroy all electric power plants. That frees the air commander to determine the best way to do that. It also frees the higher commander to also specify that the rest of the country needs to maintain access to electric power, either continuously or after the seven days. But it puts the onus on the commander to determine what he or she wants to happen instead of how, which can be difficult, especially if the commander is an expert at the how.

Command and Control

This is part of the challenge of command and control. The U.S. military's Joint Doctrine considers command "the art of motivating and directing people and organizations into action to accomplish missions."[2] The same document says control is a regulation function that is inherent in command. It allows a commander to delegate authority, standardize requirements, allocate resources, measure performance, and correct deviations.[3] In this light, command is the impetus and control is the means for getting people to accomplish a given mission. Command is perceiving and deciding, where control is communicating the decisions, organizing to carry them out, then monitoring and measuring the performance to feed back to command, which decides whether the performance is on track and adjusts accordingly.[4] It is a loop that is common to any system that aims at a goal. Cybernetics, a term coined by Norbert Weiner in the 1940s, became the study of systems that maintained equilibrium through such an exchange of information with the environment. The entire loop is what we will call the command and control loop.

This command and control loop explains the essence of the doctrine of "centralized control and decentralized execution." The command and control loop is accomplished by a commander—and staff—who specifies the what to subordinates. The subordinates determine the how and the commander measures and adjusts the what based on the results.

This leads to something the military calls "strategy to task" planning. Theoretically, the policy-makers develop an overall strategy for the war that includes military force contributing to the overall goals of foreign policy. This leads to a military strategy that specifies the military objectives and types of forces that will achieve these goals. The military commanders in the theater then develop plans to accomplish these military objectives—plans that include specific tasks for each type of force (land, air, sea, special operations). The theater commanders then delegate these tasks to lower echelon commanders who come up with plans to execute missions that accomplish the tasks. The amount of centralization is therefore related to the level of detail included in the plans at each level.

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[2] JP 3-0, II-17.
[3] Ibid., II-18-19.
[4] Irving B. Holley, Jr. "Command, Control, and Technology." *Defense Analysis* vol. 4, no. 3, (September 1988): 268-9.

But Chapter 2 showed us that, for airpower, the level of detail at a given level varies according to circumstances. For strategic bombing missions, the command and control loop at the headquarters of Army Air Forces included a great deal of information in its specification of the target and even tactics, whereas for close air support only those on the scene knew the target locations. Where the subordinates need to work with others to get the information they need to accomplish a mission, there must be something else involved in this command and control loop.

Command Relationships

The answer is command relationships. Joint Doctrine specifies several command relationships that can be used to define who is in charge. The commander with combatant command authority (COCOM) has complete authority over the troops, to include disciplinary actions, logistics, budgetary responsibility, and the accomplishment of the mission. He can delegate parts of this authority. He may delegate operational control (OPCON) to another commander, allowing that commander to organizing supporting forces and accomplish the mission (without the disciplinary, budgetary, or logistics authority). A commander who has COCOM or OPCON authority may delegate tactical control (TACON) to a commander, allowing the commander to give "local direction and control of movements or maneuvers to accomplish [a] mission."[5] These relationships involve transferring control of units. They do not, of course, relieve the delegating commander of the responsibility to accomplish the mission.

The most common way to develop these relationships is to designate component commanders. The commander of all U.S. forces in a theater of war is called the Joint Task Force Commander or Joint Force Commander (JFC, or CFC for combined when other nations are present as well). The JFC is vested with COCOM of all the forces. He or she is authorized to organize the forces as appropriate; but there will at least be service components to provide forces from each service. Usually there will also be functional components: an air component, a land component, a maritime component, a special operations component. The JFC will then appoint a commander of each of these components: a Joint Forces Air Component Commander (JFACC), a Joint Forces Land Component Commander (JFLCC), etc.[6] While the service components provide the forces, the functional component commanders are the ones to which the JFC will normally give OPCON—they are the ones that determine the missions those forces will accomplish. Figure 1 shows these relationships. It also shows the JFC may organize other subordinate Joint Task Forces for special purposes.

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[5] Joint Publication 0-2, *Unified Action Armed Forces (UNAAF)*, 10 July 2001, III-2.
[6] JP 3-0, II-15-17.

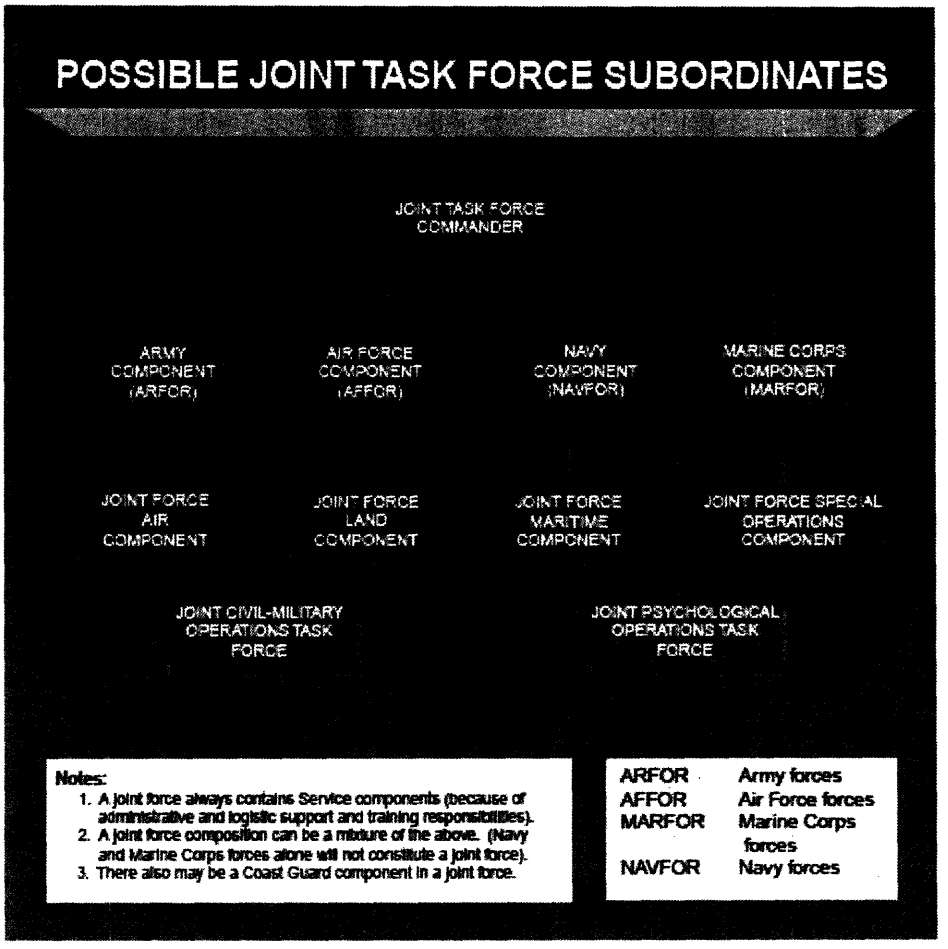

Figure 1: Typical Subordinate Commanders under the JFC. Source: Joint Publication 5-00.2: Joint Task Force Planning Guidance and Procedures, 13 January 1999

The relationship not shown in Figure 1 is that of the JFC's staff to the component commanders. Typically, the JFC will have a staff consisting of six different areas along with some special advisors. The six primary areas are called J-1 through J-6, and each has the responsibility to support the JFC in one particular area, such as intelligence for J-2, operations for J-3, and plans for J-5. Thus, the authority of these staff organizations can sometimes become confused with the authority of the subordinate component commanders.

The COCOM/OPCON/TACON labels most often deal with a superior-subordinate relationship. To varying extents, these relationships give a commander the ability to directly specify how the subordinates are to act. The JFACC does this through an Air Tasking Order (ATO)—it is an "order" that tells the aircrews where and when to fly, what weapons to employ, and how to communicate. Since the job of making sure the aircraft can communicate, can get refueled, and do not run into each other is so important and complicated for large operations, JFACCs have tried to include everything that flies in a single ATO to ensure everything is coordinated. The other services, however, do not relish the prospect

of allowing the JFACC (who is usually an Air Force officer) to command their forces. They have therefore been reluctant to give the JFACC command authority (OPCON or TACON) over specific forces. Everything that flies must be in the ATO; but although this is an "order," not everything in the ATO is technically under the command of the JFACC.

This points out an important difference between the type of commanders who can maintain command and control of land versus air forces. In land combat, the forces under a commander generally fight together and the commander is responsible for maintaining command and control. The commander integrates the subordinate units, each of whom carries out a portion of the mission under the command and control of their respective commanders. Thus the JFLCC develops the land component plan and gives each corps a part of it. The corps commanders develop a plan to accomplish their part of the overall plan and give each division a part in it, and so forth. But in air war, the commanders under the JFACC do not exercise command and control of a portion of the mission. For one thing, aircraft from different organizations will find themselves working together. One mission may demand a mix of fighters and tankers and electronic jammers, while the next mission may demand a mix of fighters and bombers. There are not enough resources to ensure each wing has enough of everything to do every job imaginable.

The main reason lower echelon air commanders cannot command and control airpower is that they do not have the capability to do it. The range and speed of the aircraft are such that keeping track of them and directing them requires sophisticated technology. The Air Force maintains the Theater Air Control System (TACS) for this purpose. The Air Operations Center (AOC) is the "senior element" of the TACS, responsible for ensuring the aircraft follow the constraints developed by the Plans subsystem. The TACS also includes organizations in close contact with ground units to request and coordinate air support for ground forces' activities: the Air Support Operations Center (ASOC) and Tactical Air Control Parties (TACP). There are ground-based radars called Control Reporting Centers (CRCs) and Control Reporting Elements (CREs) to work with other air defense assets to protect friendly airspace from air attack. Finally, there are airborne elements of the TACS to provide information—which we will call intelligence, surveillance, and reconnaissance (ISR)—and on-scene airspace control. These include the Airborne Warning and Control System (AWACS), Joint Synthetic Targeting and Attack Radar (JSTARS), Airborne Battlefield Command and Control Center (ABCCC, which is now decommissioned), and Airborne Forward Air Controllers (FAC-As).[7] The TACS is just the Air Force's portion of the Theater Air to Ground System (TAGS) that includes similar pieces from the Army, Navy, and Marines.

So while ground commanders can delegate authority to increasingly lower-echelon commanders, when the same authority is to be passed for air combat, it must be passed down from the JFACC to

[7] Air Force Policy Directive 13-1, *Theater Air Control System*, 11 May 1995, 1-2.

elements of the TACS. None of these elements are commanders of the assets they control. This is the reason the Air Force doctrine talks about "control" and not "command."

There is another command relationship: that of *support.* A commander can designate one subordinate commander the "supported" and another the "supporting" commander whenever one type of force should aid, complement, protect, or sustain another. In this relationship, the supported commander determines what type of support is necessary, but the supporting commander determines how to provide this support with the forces under his or her command. The supported commander provides general direction of the effort but the supporting commander determines procedures, tactics, forces, and communications to carry it out.[8]

For example, close air support (CAS) is a type of support relationship where air forces are supporting ground forces. The ground commanders determine how much support they need and where, and the JFACC provides the aircraft and the command and control of those aircraft through the ground portion of the TACS.[9]

Leveraging and Depth of Command Relationships

Through these command relationships, the JFC can adapt the hierarchical organization of the forces and arrange them to work together to do whatever the situation requires.[10] This "leveraging" of command relationships is one way the JFC can strike the balance between allowing subordinates the freedom to innovate and maintaining a coherent strategy. But leveraging command relationships to affect specific actions takes significant attention to these relationships. The JFC must create what we will call sufficient "depth" of command relationships so that there is clear unity of effort at all times.

This is because the military is a human organization. Humans create organizations to accomplish complex tasks by dividing the complex tasks into smaller, more specialized tasks. They then develop a subdivision for each specialized task, and the subdivisions routinize these specialized tasks as much as possible. In this way, organizations attempt to replace uncertainty with stable relationships and standard operating procedures.[11] The military services were created to deal with the different environments in which wars would be fought. They then created further subdivisions to develop equipment and train people to accomplish the tasks in those environments. Thus an A-10 pilot and a tank commander are

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[8] Ibid., III-9.

[9] Of course, the Army and Marines each have their own aircraft to support some of their CAS requirements. The Marines, in particular, maintain a robust CAS capability because they consider aircraft to be an integral part of their combined arms doctrine. For this reason, Marine commanders are reluctant to give the JFACC control of Marine sorties, and will only give control of those sorties in excess of what the commander thinks he will need. As we will see, JFACCs have responded by allowing them this leeway and shifting most of the other CAS to Army areas.

[10] JP 3-0, II-6.

[11] James Q. Wilson, *Bureaucracy*, (New York: Basic Books, 1989), 221. This is obviously a very rational view of organizations; there are many organizations that are much more loosely coupled, where goals are not necessarily top-down directed but negotiated. Karl E. Weick, *Sensemaking in Organizations*, (Thousand Oaks, Calif.: Sage, 1995), 70.

trained and equipped to accomplish different tasks. If only all these subdivisions could stay in their lane and remain isolated and pure, the control problem would be more tractable. However, the tasks are often put together to accomplish a single mission.

Sufficient depth of command relationships means that when these different parts come together to accomplish a mission, they will be working toward the same goals. There will still be control by virtue of the fact that everyone knows who is supposed to make the decisions about determining the mission, allocating the resources, and measuring the results. When the parts come together, they not only accomplish something, but that something contributes to the overall results in a meaningful way. Achieving this depth therefore helps to leverage command relationships to achieve both capability and adaptability.

Constraints on Specific Actions and TSTs

There are other, more direct methods commanders use to control military actions—they can put constraints on specific actions, telling the military what actions it can or cannot take. Rules of Engagement (ROEs) are one way that commanders can do this. These rules specify when and in what conditions troops can use force. The President, Secretary of Defense, and commanders use ROEs to impose not only legal but practical and political limitations on the use of force as well.[12] When airpower is involved, another way the JFC or policy-makers can put constraints on specific actions is by withholding the authority to approve targets.

Newer technology gives commanders another option: giving direction during ongoing operations. Instead of letting forces perform their missions in accordance with the pre-planned constraints, they can make decisions during the performance of the missions. The TACS performs a certain amount of this routinely, because air traffic control is a normal part of airpower. But as we will see, during the period of our study air commanders have gotten increasingly involved in directing ongoing missions by specifying the targets while the aircraft are airborne. We will call these targets by several names. Because they emerge in response to battle actions or timely intelligence, they are at first called emerging targets. Then, upon identification, if the JFC makes the determination that a target must be attacked during a certain window of vulnerability (not necessarily immediately), it becomes a time-sensitive target (TST).[13] In Operation Iraqi Freedom, the JFC, Gen. Tommy Franks, specified what types of targets would be

[12] Air Force Operational Tactics, Techniques, and Procedures (AFOTTP) 2-3.2, *Air and Space Operations Center*, 25 October 2002, 219. ROEs have been called "the tether between the SECDEF and the soldier."
[13] *Commander's Handbook for Joint Time-Sensitive Targeting*, United States Joint Forces Command Joint Warfighting Center, 22 March 2002, I-1 – I-3.

considered TSTs. But other emerging targets were considered urgent to the air component, even though they did not fall into any of the TST categories. These were called dynamic targets.[14]

Systems

The word "system" has to qualify as one of the most overused words in the English Language. People use the word whenever they want to refer to a bunch of things that seem to work together, especially if the way they work together is not completely understood. It is therefore deemed appropriate to talk of an economic "system," a political "system," or a distribution "system," even though the speaker would usually be hard-pressed to define what is included in such systems, much less how they work. Still, "systems thinking" and the "systems approach" are becoming accepted as valid academic pursuits as they are shown applicable to a greater variety of problems.

Systems thinkers generally agree that there are valid reasons to group things together when they may not otherwise be seen as a single unit. The classical reductionist analytical approach is to break single units apart into components, analyze the functions of the components, and piece these functions together to ascertain the performance of the whole. The approach has worked well for many of the physical sciences, when there are parts that have a mechanistic performance that obeys rules. It even works for some complex systems—as long as it is the "unorganized complexity" of many somewhat randomly-acting parts and can therefore be analyzed using probabilistic principles. But when the parts interact, it is usually futile to use such linear methods that assume the behavior of the whole is the sum of the behaviors of the parts. These are cases of "organized complexity," commonly found in systems where humans interact.[15] The type of system we are interested in is "a set of interacting components having well-defined (although possibly not well understood) behavior or purpose; the concept is subjective in that what is a system to one person may not appear to be a system to another."[16]

Grouping subsystems together forces us to work with a complex system that would not appear as a system to many; but it allows us to determine whether there are interactions among the subsystems. Complexity theory is a relatively new field that attempts to analyze complex systems as wholes, rather than through a reductionist approach.[17] There are many definitions of a complex system, and a concise definition is not important here. We will assume that the system in question, the CAOS, is a complex system. It is a large-scale collection of components that together have collective, or "emergent," properties. These properties are the things analysts usually look at with respect to airpower: the overall

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[14] Lt Gen T. Michael Moseley, "OIF by the Numbers," CENTAF – Prince Sultan Air Base, Kingdom of Saudi Arabia, 30 April 2003. Available through Commanders Action Group, 9th Air Force, Shaw AFB, S.C.
[15] Ludwig von Bertalanffy, *General Systems Theory: Foundations, Development, Applications*, Revised Edition, (New York: George Braziller, 1969), 18-19, 34-5.
[16] C.L. Magee and O.L. de Weck, "An Attempt at Complex System Classification" Proceedings of the ESD Internal Symposium, (Cambridge, Mass.: Massachusetts Institute of Technology Engineering Systems Division), 220.
[17] Albert-Laszlo Barabasi. *Linked: The New Science of Networks.* (Cambridge, Mass.: Perseus Books, 2002), 371.

characterization of the strategy as "strategic bombing" or "fielded forces," the determination of how "decisive" airpower was in achieving the objectives, and even how unified the effort was toward a single strategy. The components do not always seem to be working together, but are interconnected in ways that are not obvious. Later, we will describe these components and the mechanisms that bind them. The overall behavior of the system cannot be determined from examination of any one of these parts. One would be hard-pressed to tell how effective the CAOS is by examining an officer sitting at his desk in the AOC, or even by watching the aircraft fly the missions. The overall or *emergent* behavior is heavily dependent on the interaction of the parts and the exchange of information (here human interaction facilitated by technology). These characteristics fit most if not all definitions of a complex system.[18]

One key characteristic of organizations as systems is the degree of coupling among the organizational entities. Theorist Karl Weick used educational systems to demonstrate the fact that many organizations do not exhibit the kind of rational behavior we often attribute to them. Even though managers meticulously develop a plan, divide the labor, and specify the roles necessary to achieve their goals, they are often disappointed that the organization does not perform as expected. This is because the organization is, to a greater or lesser extent, loosely coupled. If it were a machine, where each moving part directly affects another and predictably causes some action, the results would be relatively easy to design. But in loosely coupled organizations, although events are responsive to some degree, they also maintain their own identity. That is, although actions by one part of the organization may have some effect on another part, the parts also act somewhat independently.[19] According to Weick, there are actually many advantages to this loose coupling, including localized sensing, adaptation, and the ability to "seal off" a breakdown.[20]

Perrow picked up on this concept and used it to describe the degree of centralization that is appropriate for each system. He proposed linear, tightly coupled systems are best centralized—operators must adhere to strict standards or their output will affect the other parts of the system.[21] Complex, loosely

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[18] Magee and de Weck go on to say that a complex system has a number of inter-relationships that are difficult to describe, manage, or change. The authors were particularly interested in those systems that involved human or social/management interactions. S. Lloyd, "Complex Systems: A Review," Proceedings of the ESD Internal Symposium, (Cambridge, Mass.: Massachusetts Institute of Technology Engineering Systems Division), 182, emphasizes the use of information. Charles Perrow, *Normal Accidents: Living with High-risk Technologies*, (Princeton: Princeton University Press, 1999), 85-6 emphasizes the fact that complex systems will have unfamiliar or unintended feedback loops, many interactions, indirect or inferential information, and will be difficult to understand. Joseph M. Sussman, "Collected Views on Complexity in Systems," Proceedings of the ESD Internal Symposium, (Cambridge, Mass.: Massachusetts Institute of Technology Engineering Systems Division), 453-477 is an excellent summary of 21 different approaches to analyzing complexity.

[19] Karl E. Weick, "Educational Organizations as Loosely Coupled Systems," *Administrative Science Quarterly*, vol. 21, issue 1 (March 1976), 1-3.

[20] Ibid., 6-7.

[21] Perrow, 78. We are not concentrating on defining complex vs. linear interactions as Perrow did. Perrow notes that these terms are not opposites, although his usage seems to denote such a relationship. His purpose is to describe

coupled systems are best decentralized—any attempt to control them centrally may miss the chance to allow operators to innovate and adapt when unexpected or unintended interactions occur. Since the systems are loosely coupled, this local innovation does not significantly affect other parts of the system. However, complex, tightly coupled systems are a problem. Their complexity begs for decentralization to make adjustments when unintended interactions occur; at the same time, because they are tightly coupled, the local innovation allowed by this decentralization greatly affects the other parts of the system—the only cure for this is centralized control. Perrow notes that a system cannot be both centralized and decentralized at the same time, although many have some type of hybrid arrangement that asks operators to perform with autonomy but be responsive to overriding.[22]

Our analysis of centralization versus decentralization must therefore include these factors. We will also pay attention to whether we are dealing with a tightly coupled or a loosely coupled system. In our case, we will subjectively define "loosely coupled" to mean the different parts in the system do not have to work closely together to achieve an outcome. "Tightly coupled" will connote a situation where the parts do have to coordinate closely to be effective or safe.[23]

A representation of the CAOS

The goal of representing this CAOS is to model the behavior of the system with respect to the question of how control is accomplished. We will not attempt to model physical characteristics or even processes. Instead, we will concentrate on finding the interactions among the different components in the system. It will not be a formal, rigorous model that we will use to simulate the system—although perhaps a first step. It will be a representation that helps us find leverage in our quest for the right trade-offs between centralized and decentralized control.

The Complex, Large-scale, Integrated, Open System (CLIOS) framework was developed by Joseph Sussman, a specialist in intelligent transportation systems at MIT, to do precisely that. It starts with a graphical depiction of a system as a collection of subsystems that are acted upon by policy-making organizations in what is called the "policy sphere." The components of these subsystems may be physical products, processes, or even concepts that describe the observable behavior of the subsystem.[24] Later, we will model the influences among these components within the subsystems graphically by connecting

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the degree to which a sequence of events can be understood and predicted based on the perceived interactions in the system. Nonlinear and simple did not seem to apply to these characteristics.

[22] Perrow, 332-4.

[23] Weick (1976), 5 admits that the term "loosely coupled" could apply to many different situations: an excess of resources over demands, a decentralized management style with much delegation of discretion, a relative lack of regulations or coordination, or even the simple fact that no matter what a manager tries, the results do not change.

[24] Here, the CLIOS graphical representation is a level of abstraction above a system dynamics representation. In system dynamics, causal loop diagrams show the effects of changes in one variable on another. But these variables have to be things that can be quantified. We will not attempt to do this here, although it may be an admirable future goal.

those that interact. We will also locate components that operate in multiple subsystems or are influenced by those in the policy sphere. This will help us to find interactions and feedback within and among the subsystems and the larger environment.[25]

We begin our discussion by listing the important characteristics from the previous chapters. These characteristics must be present in the representation if it is to be useful in addressing the issue of control in the decidedly human context that is war.

1. War is, first and foremost, an instrument of policy, and airpower is an instrument of war. There will always be some coercive purpose, some "dialog" with the enemy, without which combat airpower has no meaning and subject to which its actors will remain.
2. Although it is the job of policy to determine the nature of the war, this is not always done in a concise manner. Policy goals may be difficult to translate into military strategy and tactical actions.
3. Tactical actions have strategic consequences that may be out of proportion to their tactical consequences. The Tet Offensive ended in a tactical victory for the U.S. It was also a major strategic loss. Policy-makers have to mitigate these potential consequences somehow.
4. Strategic actions also have tactical consequences. The attempts by Secretary MacNamara and, later, the generals at SAC headquarters to direct many details of airpower employment had the effect, as perceived by the airmen in theater, of lowering their effectiveness. This had the real effect of lowering the airmen's morale and discipline.
5. The CAOS can be various sizes, depending on the conflict. Its focus is generally the entire theater of the war, and can tap resources from all over the globe. Some of these are linked by virtue of their ability to fly from one place to the other; others are linked by their ability to connect in virtual space.
6. Control of airpower is not a system-level characteristic; it is a local characteristic. There may be different levels of centralization at different places in the CAOS simultaneously. There may also be different levels at the same place at different times. And control is an onion; what appears to be decentralization at one level may appear to be micromanagement at another.

[25] Rebecca S. Dodder, Joseph M. Sussman, Joshua B. McConnell, "The Concept of the 'CLIOS Process': Integrating the Study of Physical and Policy Systems using Mexico City as an Example," presented to the MIT (Massachusetts Institute of Technology) Engineering Systems Symposium, Cambridge, Massachusetts, 31 March 2004, 2-5.

7. Individuals in different parts of the CAOS have different agendas. We saw this most vividly in the fights between the services for control of airpower. This is not new. It is well known that, though decisions are often made based on a rational choice among the consequences of competing options, they are at least tempered by the fact that an individual in a given role within a given organization has rules within which his or her choices must fall.[26]

8. Finally, our model should reflect the trend toward using sensor-communications loops to get and use information. Chapter 3 showed that the Air Force has been evolving the doctrine, technology, and organization to rapidly react to information from the battlespace. The system has had to improvise ways to deal with the real-time control that this entails.

The Combat Air Operations System Policy Sphere

So far, our study has not given us the means to graphically represent the structure of the subsystems that make up the CAOS. But we have identified many of the players who can influence the system by setting policy. These players form the "policy sphere."

Obviously, the President of the United States, his Secretary of Defense, and the Joint Chiefs of Staff are important players, and there will be other offices such as the Secretary of State, other cabinet members, and the National Security Advisor involved. Congress also has a definite, constitutional role and also an indirect role as well. After the Goldwater-Nichols Act of 1986, we know that there will be a Joint Forces Commander (JFC) and this person will probably have functional component commanders for the land, sea, air, and others. The JFC will also have service component commanders and functional component commanders, although these may vary among conflicts. He or she may also have smaller task forces under the joint force for accomplishing specialized parts of the mission.[27] There will probably be other countries in a coalition with the U.S., so their forces and governments are important players, and of course, there will be an enemy organization (which could be any type of political entity such as a government or terrorist organization) and military forces.

But our study has also illuminated several other indirect players. The media is one, and the people of the U.S. and coalition countries are another. Based on the concern given to avoidance of collateral damage, we have to say that the people who could potentially support the enemy organization and the non-combatants in the combat zone are important players as well.

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[26] James G. March, *A Primer on Decision Making: How Decisions Happen*, (New York: The Free Press, 1994), 101-102.

[27] Joint Publication 3-0, *Doctrine for Joint Operations*, 10 September 2001, II-6.

The results of this analysis should show these policy sphere players the trade-offs involved with the policies they set. It should identify the areas where they have the option to intervene in the control of combat airpower and show them the consequences of intervening in specific ways.

The Subsystems

With this background, we can develop a way to look at the problem. The historical arguments showed that there are several layers to the argument about centralized control and decentralized execution. They did not show how—or even whether—these layers are related. If they are, it would be premature to solve one problem and make another worse. They did, however, show that these layers affect the control of airpower. The system that employs and controls airpower includes a politico-military strategic layer that is affected by public opinion and the media and other governments. It also includes a theater-level military layer where the different services and components have different ideas about how to manage and use airpower. It includes a layer, built around the TACS, that actively regulates, tracks, directs, and otherwise exchanges information with airpower during operations. And of course, it also includes the actual application of effects by the operations. Since all these influence the control of airpower, the system must consider them in the analysis. We will call them the Strategic, Planning, Adjustment, and Force Application subsystems.

In its simplest form, the CAOS looks like the diagram in Figure 2: the four subsystems in a policy Sphere. Of course, the separation of the CAOS into subsystems is somewhat artificial. In reality, there is a great deal of interaction among the components of each. The rest of the chapter will develop relationships among the components of each subsystem, showing how they interact within and among subsystems.

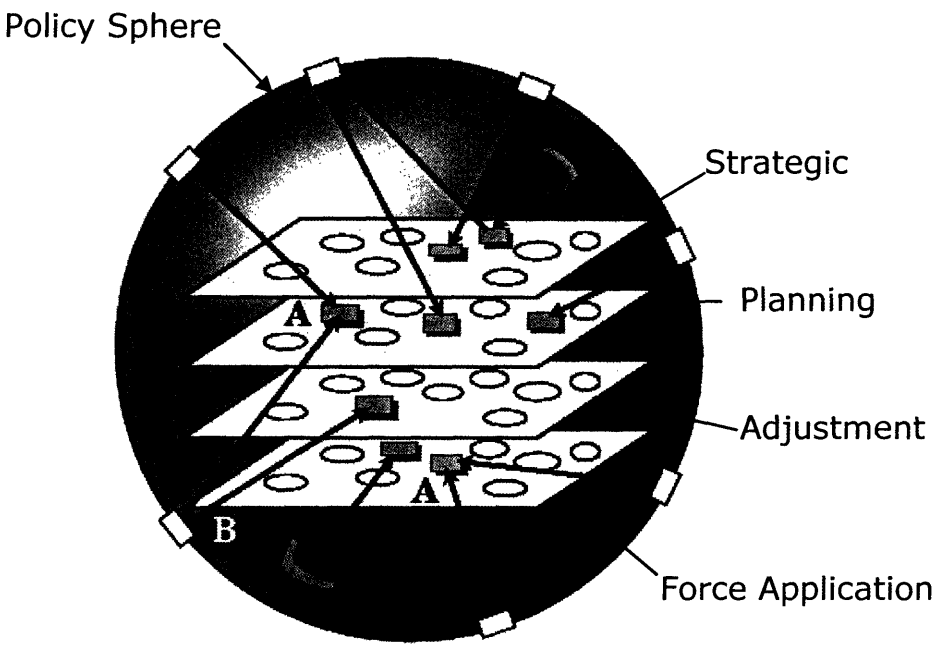

Figure 2: CLIOS diagram of subsystems in Policy Sphere. Source: Dodder, Sussman, and McConnell

To depict the components of the subsystems, we will use the symbology shown in Figure 3. We will build a diagram of each subsystem separately. If a component is common among two or more subsystems, it will be represented by a hexagon. If it is a component that those on the policy sphere can directly affect, it will be represented by a rectangle. Other components not in either category will be represented by circles. Where it is necessary to show another subsystem in a diagram, we will use a diamond. For each subsystem, we will show the relationships among the components by drawing influence arrows showing the influence of one component on another.

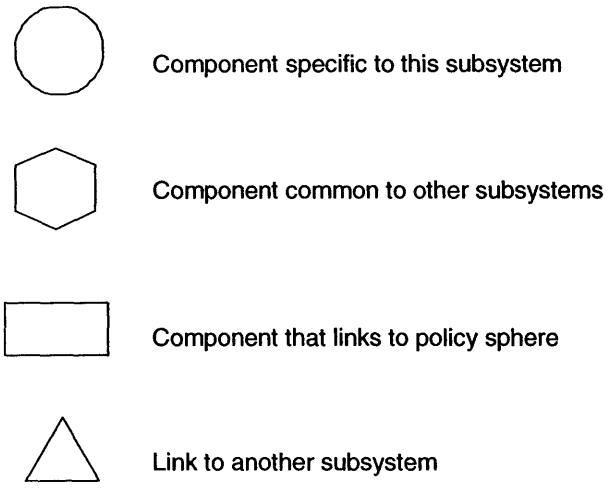

Figure 3: Symbology for Subsystem CLIOS Diagrams

The Strategic Subsystem

The organizations that operate in the system are subject to control by the strategic level, either directly or through feedback loops that indirectly influence their actions. Figure 4 shows a diagram of the Strategic Subsystem.

Policy-makers use military force as part of a grand strategy for achieving strategic objectives. Normally, the overall military strategy is developed by a National Security Council (NSC) composed of at least the President, the Secretary of Defense, the Secretary of State, the Central Intelligence Agency, the National Security Advisor, and the Chairman of the Joint Chiefs of Staff.[28] They also use other instruments of power, such as diplomatic and economic tools, with which we will not deal here. Then the Joint Chiefs of Staff and the JFC develop a plan to use the allowed resources to achieve the strategic objectives within that military strategy.[29] It would be far simpler for the military if it were told to destroy the opposing army, no matter the cost. But the coercive bargaining process brings up restrictions on the military's actions, because the government may have to worry about pressures on coalition support, the support of its own people, and even the solidarity among the branches and political parties of the government as well as the actual objective for which they are using military force.[30]

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[28] Joint Publication 5-0, Doctrine for Planning Joint Operations, 13 April 1995, I-1, II-1.

[29] JP 5-0, I-1-2. There may be an existing plan formed by a "deliberate planning process" that includes many more players during peacetime. This is then transformed into a more specific plan during the crisis. Alternately, the plan may be formed entirely by "crisis action planning," see I-9-10. The process mentioned above deals only with the actions in the crisis.

[30] Daniel L. Byman, Matthew C. Waxman, and Eric Larson, *Air Power as a Coercive Instrument*, (Santa Monica, Calif.: RAND, 1999), 59-67, also comments on a previous draft by Dr. Sheila Widnall, Institute Professor, Massachusetts Institute of Technology and former Secretary of the Air Force.

The degree to which the government has worried about these pressures relative to the strategic goals has played a big part in where, along the spectrum of coercion, the military strategy has fallen in the past. In World War II, when the U.S. had been attacked and allied partners were fighting for their survival, the strategy was near the brute force end of the spectrum. In Vietnam, where the American public arguably lost track of why we were fighting and the U.S. was worried about potential involvement from China and the U.S.S.R., the strategy was much more "calibrated."

As we discussed above, policy-makers can use varying degrees of two basic methods of control. They can give the military objectives and guidance and allocate resources, letting the theater commanders determine the best way to use them; but they can also put constraints on specific actions when these actions might intensify the pressures above. As you can see from Figure 4, the difference is in the directness with which these two routes affect the military actions. When policy-makers simply give objectives and guidance, they are allowing the military's Plans Subsystem considerable leeway to define how the military actions will interpret the guidance and achieve the objectives. Our study will show that this leaves room for standard operating procedures (SOPs) and internal agendas to produce results that may be harmful to the strategy.

In addition, the policy-makers may find themselves under time pressure that disqualifies normal military channels. The military force produces effects on the enemy military and government; but it also inevitably leads to friendly casualties and collateral damage—innocent people sometimes get killed. The Plans Subsystem has provisions for assessing the results so the policy-makers can determine how well the strategy is working. But the news media produces an almost immediate feedback of some of the more spectacular results, and this is often what shapes the perceptions that drive the pressures we discussed above. This information is generally reflective of facts—or at least official debate about facts—so the problem is not necessarily that the media changes the debate. The problem for decision-makers is that the media essentially becomes an amplifier that can shorten decision cycles by raising the gain in one particular feedback loop over another.[31] Thus, we will see that the policy-makers often feel pressure to increase the amount of specific constraints to show they are trying to reverse any adverse results.

[31] Ibid., 68-9.

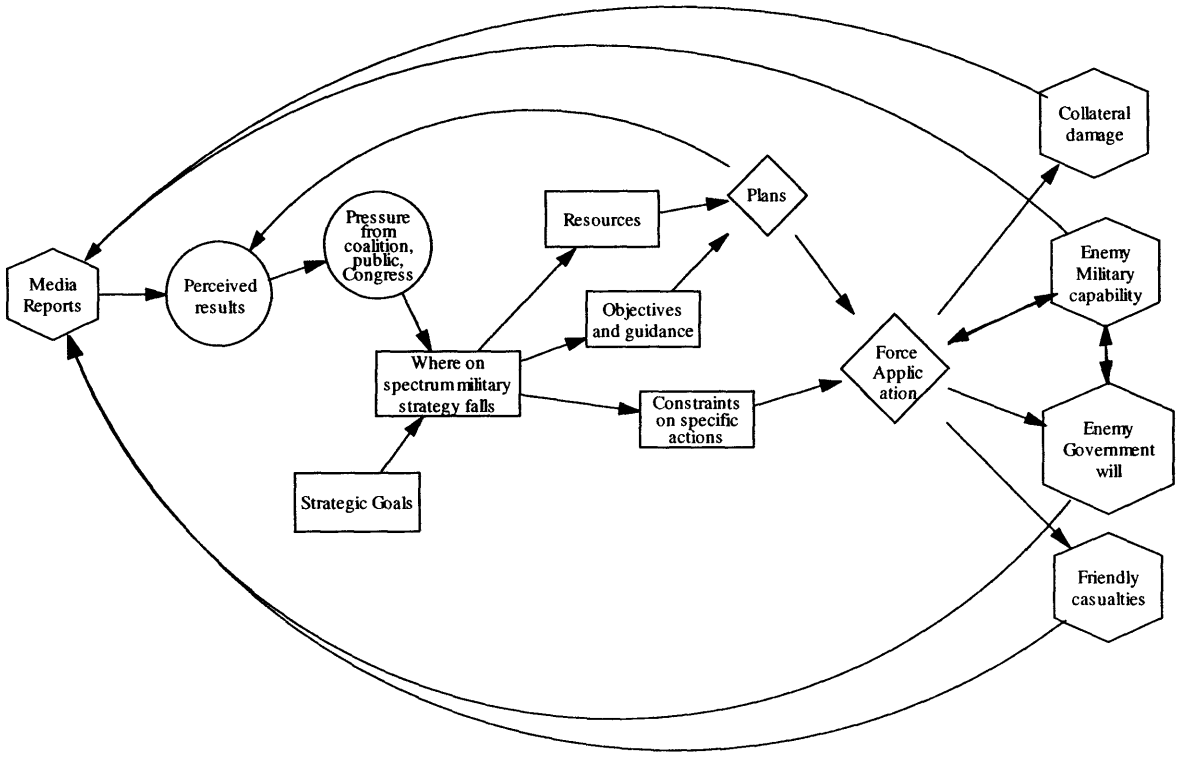

Figure 4: Strategic Subsystem

Plans

The Plans Subsystem is where the military translates the strategy from the Strategic Subsystem into plans for military action. For airpower, this means apportioning the available aircraft to the different tasks, developing target lists, scheduling the missions, and developing the procedures and constraints that allow the TACS to control the flow of aircraft. Figure 5 is a non-CLIOS diagram that shows the current view of the planning process.

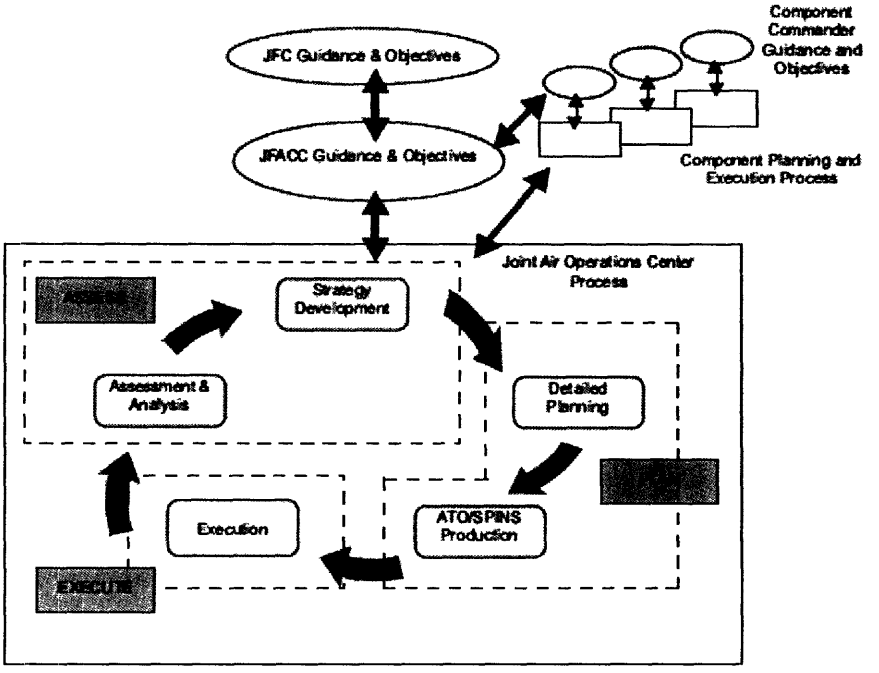

Figure 5: The Aerospace Assessment, Planning, and Execution Process – non-CLIOS representation. Source: Air Force Doctrine Document 2, Organization and Employment of Aerospace Power, 17 February 2000, 74.

The bulk of this process takes place in the AOC, which is organized in divisions that focus on the different parts of the cycle.[32] They usually reside in a single building, although the Air Force is moving towards being able to perform these tasks in a distributed manner as well.[33]

The diagram is not a CLIOS diagram. It depicts a process, not behavior. It does not show the impact of decisions. It will be helpful to understand this process, but at this point we do not have enough information to show how the subsystem behaves with respect to different levels of centralization.

The diagram is based on the "strategy-to-task" methodology. The JFC gives guidance and objectives to the component commanders, who break this down into guidance and objectives for their components.[34] The JFACC's strategy division develops a daily Air Operations Directive that spells out

[32] The AOC is nominally organized into five divisions: Strategy Division; Plans Division; Combat Operations Division; Intelligence, Surveillance, and Reconnaissance Division; and Mobility Division. These five divisions and several supporting/specialty teams are supervised by an AOC Director, who works for the JFACC. See Air Force Instruction 13-1AOC, *Operational Procedures – Aerospace Operations Center*, 1 July 2002, 15-16.
[33] Ibid., 11.
[34] A campaign is a series of operations that together accomplish the strategic and operational objectives for a theater. It is the responsibility of the JFC to develop the campaign plan and objectives using all the joint forces available to

his guidance and breaks the JFC's guidance down into objectives and tasks, which are then further broken down into targets that accomplish those tasks.[35] Each component gives input on the targets they would like attacked, and the JFC convenes a Joint Target Coordination Board (JTCB) to prioritize these and come up with a final list of targets. The JFC can determine who runs this JTCB and what its authority is.[36]

Then the air component takes the list of targets, called a Joint Prioritized Integrated Target List (JPITL), and does some detailed planning to attack the targets. During this process, they also try to determine what other tasks airpower will be called on to perform besides attacking these targets. Some examples could be mobility missions for supply or movement of troops or humanitarian aid. But the planners also try to anticipate the need to react to the enemy as the battle unfolds. The AOC organization includes liaisons to the Army, the Navy, the Marines, and Special Operations. These are the Battlefield Coordination Detachment (BCD), the Naval and Amphibious Liaison Element (NALE), the Marine Liaison Office (MARLO), and the Special Operations Liaison Element (SOLE).[37] Together with these liaisons, the air component planners try to earmark enough missions to support the other components, including CAS. We will see that in recent wars, they have also started allocating missions to attack time-sensitive or dynamic targets. They also plan to send sensors, called Intelligence, Surveillance, and Reconnaissance (ISR), to look for the emerging targets.[38]

The result of the detailed planning is an Air Tasking Order (ATO) that gives the details of the missions that the aircraft will fly. The missions can be extremely detailed, with target locations, times, and munitions; but when the aircraft are tasked to support dynamic targeting, the mission will of course be less detailed. The ATO also contains constraints for the missions, such as ROEs, airspace control instructions, and other special instructions. The air component convenes an ROE board to develop ROEs for air operations to supplement ROEs from the higher levels, refining them for each new phase of

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him and considering the strategic political environment and guidance from the policy-makers, see Joint Publication 3-0, *Doctrine for Joint Operations*, 10 September 2001, III-4 – III-7.

[35] Air Force Operational Tactics, Techniques, and Procedures 2-3.2, *Air and Space Operations Center*, 25 October 02, 17-18.

[36] The Guidance, Apportionment, and Targeting (GAT) process produces a prioritized list of targets and ISR collection priorities that are then approved by the JTCB. The JFC defines who runs the JTCB and what its authority is. AFOTTP 2-3.2, 45-46.

[37] AFOTTP 2-3.2, 5.

[38] *Combat Air Forces Concept of Operations for Time Critical Targeting*, Draft, October 2000 Update. In a process called "Predictive Battlespace Awareness (PBA)," the planners determine where targets are most likely to emerge, due to the terrain and the location of the enemy forces. They then try to arrange sensor coverage (ISR stands for Intelligence, Surveillance, and Reconnaissance) of these areas, with on-call sorties nearby to respond. However, this could loosely cover instances where the ground troops or airborne FACs will be present to designate targets. We will get into these concepts later.

combat.[39] An Airspace Control Order (ACO) gives the procedures for maintaining the flow of aircraft safely.[40]

The people in the AOC then monitor the execution of the ATO and make any changes that occur based on the operations. The sensors from the ISR sorties and any ground troops (including special operations) alert them to emerging opportunities and return pictures or reports of battle damage to the AOC. The people in the AOC then perform "Combat Assessment" to see how the attacks affected the enemy's forces and plans, and whether there are any exploitable opportunities. They also perform "Operational Assessment" to determine how successful the overall campaign has been and whether the strategy should be adjusted.[41]

Figure 6 shows a CLIOS representation of the Plans Subsystem. The next five chapters will show what happens when the strategic decision-makers and the JFC use varying levels of constraints. Constraints from the Strategic Subsystem raise the level of accountability for specific results at the JFC's level, causing him to retain authority for targeting and command and control with his staff. The air component is not empowered—and often not fully exercised to the extent of its capabilities—and does not integrate as well with the other components. The reduced empowerment and the centralized command and control lead to a lack of depth in the command relationships. In addition, constraints on specific actions hamper the use of effects-based operations and strategy-to-task that the air component prefers, often leading them to focus on ongoing missions rather than longer-term strategy. Of course, this focus is also a result of the need and increasing capability to pull information together to react to the enemy as the battle progresses. But the increase in dynamic missions has made it more difficult to assess the results; this in turn makes it more likely the Strategic Subsystem will want to use constraints on specific actions.

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[39] AFOTTP 2-3.2, 36-37. The board is headed by a Strategy Division person, and includes a JAG representative and representatives from other services and countries. The new ROEs have to be approved by the JFACC, the JFC, the SECDEF, and the President.

[40] Actually, the ACO is a daily order that implements an overall Airspace Control Plan (ACP). Both the ACO and ACP specify restricted areas and procedures for control and avoiding conflicts. The ACP also has to provide ways to transition from peace to conflict and back as well. See Joint Publication 3-52, *Doctrine for Joint Airspace Control in the Combat Zone*, 22 July 1995.

[41] AFOTTP 2-3.2, 32-3.

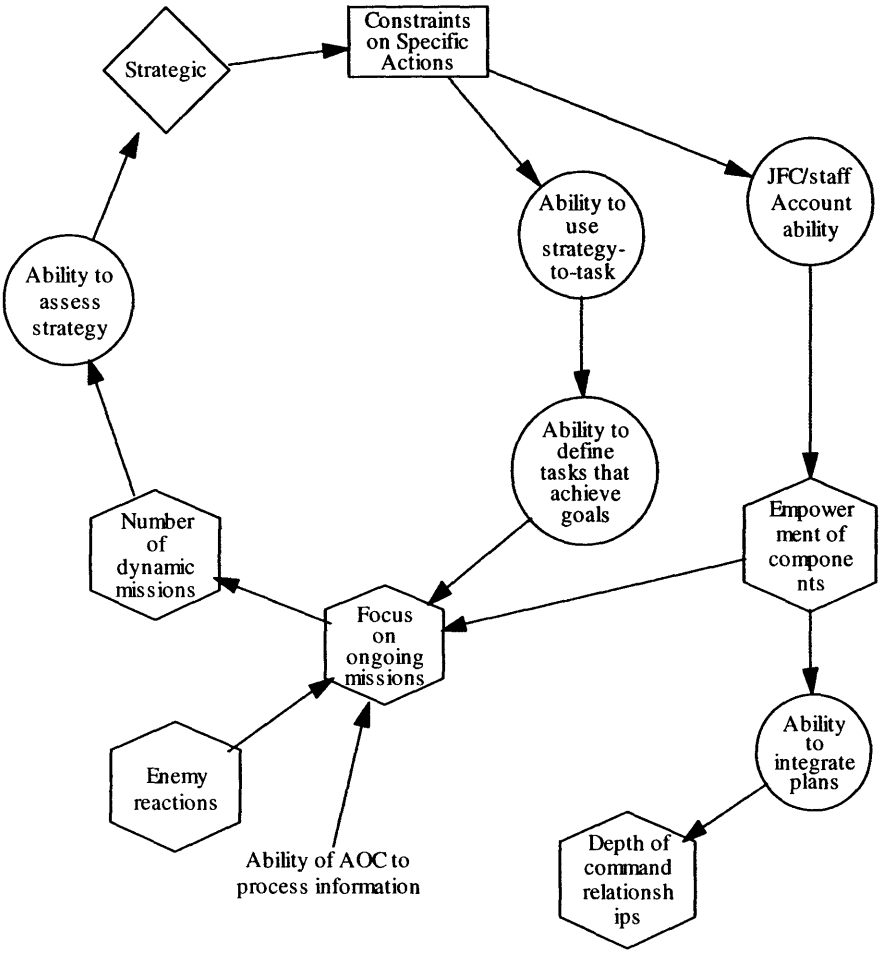

Figure 6: Plans Subsystem

Adjustment

The planning and coordinating occurs simultaneously with the operations. But there is also a need to adjust during the operations. When the aircraft execute the sorties designated in the ATO, many real-time adjustments have to be made, and with thousands of sorties happening at the same time, it takes a sophisticated system to perform this function. This is the TACS that we discussed earlier. Because sensor-communications loops are such an important part of the issue, we will consider the ISR sensors part of this same subsystem. Thus, the Adjustment Subsystem helps ensure the aircraft perform the missions as ordered in the ATO, helps guide the aircraft through the procedural airspace controls, gathers information to help react to the battle, and gathers information to assess the results. Figure 7 depicts the CLIOS diagram for the Adjustment subsystem.

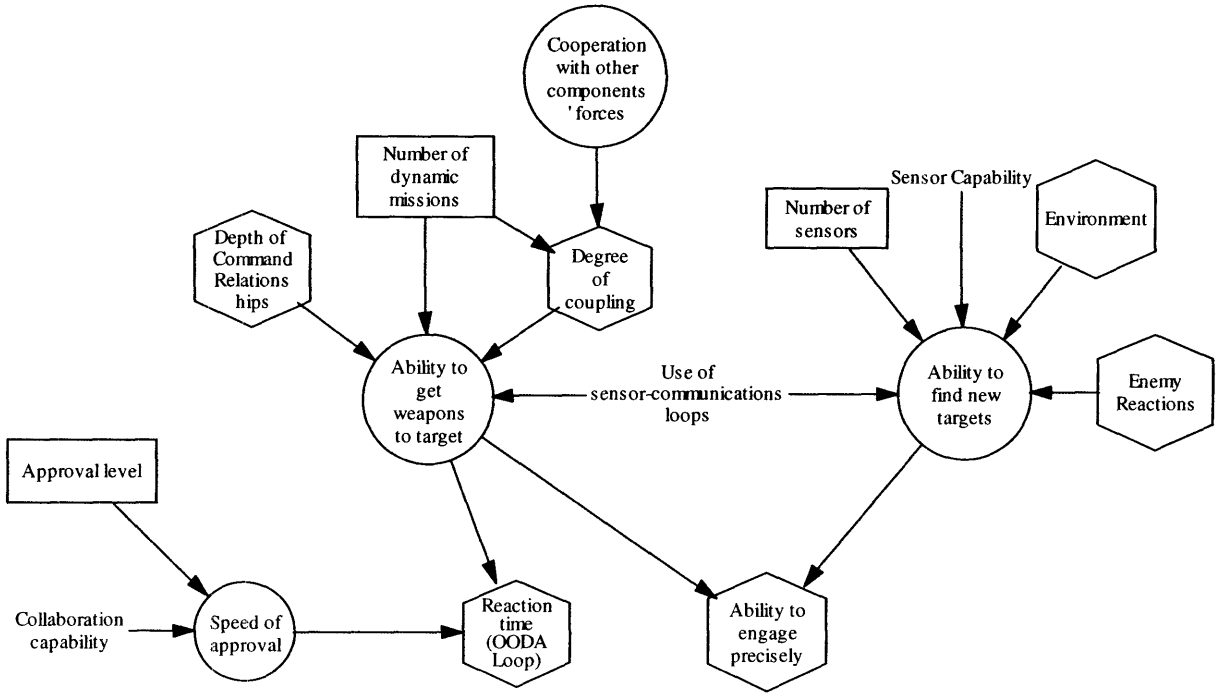

Figure 7: Adjustment Subsystem

The next five chapters will show that the performance of the Adjustment Subsystem is dependent on the depth of the command relationships developed in the Plans Subsystem. Adjustment aims at achieving the balance between getting weapons to targets—including emerging targets—quickly but ensuring these targets contribute to the strategy and do not derail it. The quick part deals with the ability to shorten the Observe, Orient, Decide, Act (OODA) Loop—a command and control paradigm we will cover later. For the latter function, the Adjustment Subsystem coordinates with the decision-makers, as rapidly as possible, and tries to engage the targets as precisely as possible. Thus the two concrete factors the people in this subsystem end up balancing are speed (the OODA Loop) and precision—the two hexagons at the bottom of Figure 7.

To balance these two, they need to find targets, get the weapons to the targets, and get approval to engage the targets. Finding the targets and getting approval to engage have been aided tremendously by technology. The JFC and component commanders do have to make sure the right sensors are available, including humans in contact with the enemy when appropriate. This depends on the environment and the enemy. But sensor and communications technology has increased the ability of sensor-communications loops to find these targets and get the information into the hands of the AOC. Collaboration technology has increased the ability of the people in the AOC to get approval. Of course, it is still much quicker to

get approval when the approval level is close to the AOC than when the JFC or even Secretary of Defense are involved.

But getting the weapons to the target is often complicated. We will see that in some cases, where the situation is loosely coupled, the depth of command relationships does not matter. All that is necessary is to get information on the target and feed it to a GPS-guided weapon. The trouble is that the ease with which this occurs can cause component commanders to think it is not necessary to provide the same depth of command relationships they would normally provide. They may not set up certain command nodes, like the ASOC, because the ground controllers and aircrew can coordinate directly. Then, when the situation becomes more tightly coupled, the people near the action need the resources to be allocated smoothly and automatically. If every request for support triggers an ad hoc solution and an approval chain, this will not happen. It only happens if the command relationships are so deep that there are command nodes at low levels with the situational awareness and the authority to make these decisions quickly and in accordance with pre-planned procedures. It takes more than information sharing to perform this kind of resource allocation among disparate entities—it takes authority and information together with the ability to communicate.

The degree of coupling can be a function of environmental factors or the enemy's reactions, but it can also be influenced by the interaction among dynamic players. When there is a lot of coordination among different components and a lot of dynamic missions looking for new targets, there will be tight coupling. The actions of any one player could drastically affect the actions of the others, because the airspace is crowded and the actions of the aircrews must be coordinated with the actions of the ground troops. The fewer dynamic players and the less coordination, the less the players' actions depend on each other and the looser the coupling. So while on the one hand, having a lot of dynamic missions helps get the weapons to the target, on the other hand it also increases the degree of coupling and makes it harder to do this automatically. This may be a threshold relationship, where it is only difficult above a certain threshold.

Force Application

As we showed in Chapter 2, Air Force doctrine cites "centralized control and decentralized execution" as fundamental to the proper employment of air and space power. No one sitting hundreds or thousands of miles from the battlespace is supposed to tell the person in the cockpit how to fly his or her airplane. Supposedly, doing so could hamper the accomplishment of the current mission and stifle any initiative on the pilot's part for future missions. Yet many tactical actions are now the result of information passed from remote decision-makers. This will become increasingly automatic in the future. So it is important to examine the force application subsystem to see what effects control has on the tactical level.

The planners at the AOC send the ATO to the air bases all over the theater. Here airmen in a Wing Operations Center (WOC) look through the individual missions and do the detailed planning the aircrews will need to fly the missions. They pull out all the applicable target data, procedures, frequencies, and other instructions for each mission assigned to aircraft from the wing. Then they get intelligence about the threats in the area to help plan the routes to and from the target. They do any coordination with tankers, electronic warfare aircraft, or other support, and get the weather reports for the mission time. Finally, the aircrews who will fly the missions come in a couple hours before the takeoff time, get briefed on the mission, study the preparations the others have done for them, and do last minute preparations.[42]

Then the aircrews take off to fly the missions. If they are flying a mission to a pre-planned target, they can fly the mission as planned, guided by the TACS to ensure proper flow through the airspace. But on dynamic missions, aircrews are often dependent on the TACS for information on new targets as well.

The next five chapters will show that the evolution of these sensor-communications loops to perform dynamic missions has in some cases reduced the role of the aircrew in the attack sequence. With GPS-guided munitions like the Joint Direct Attack Munitions (JDAMs), it is often possible for an aircrew to drop a weapon at night or through bad weather based only on coordinates they receive over the radio or datalink. So instead of having to find the target visually and then aim the weapon at the target by maneuvering the aircraft or pointing a laser beam, the aircrew just needs to fly to an area within the weapon's envelope and "pickle." Of course, the dynamic mission puts demands on the aircrew to adjust routes and frequencies and threats without the ability to pre-plan.[43] But much of the job of finding, fixing, targeting, tracking, engaging, and assessing (the "kill chain") is done by people in remote places.

The Force Application CLIOS diagram, Figure 8, shows a resulting tension between the ability to engage targets precisely and the potential for accidents in the CAOS. What this really means is that the types of controls leaders use to ensure precision engagement of targets can also contribute to the potential to cause friendly fire or collateral damage. This is because the very things that increase precision—the use of sensor-communications loops and weapons like JDAMs that take information in digital form—also

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[42] There is very little written about aircrew actions at the wing level. Gen. Chuck Horner relates his experience working in a WOC during Vietnam in Charles Horner, Gen. (retired), USAF, *Every Man a Tiger*, (New York: Berkley Books, 2000), 75-81. Pilots who flew A-10s in Kosovo relate their experience in *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as Told by the Airmen who Fought in Operation Allied Force*, Christopher E. Haave, Col., USAF and Phil M. Haun, Lt Col., USAF, Editors, (Maxwell Air Force Base, Ala.: Air University Press, 2003). I have filled in some of these general actions from my own experience during Desert Shield in 1990.

[43] Pilots have to wade through a staggering amount of procedures and publications to make changes on the fly. In Iraqi Freedom, F-16 pilots reduced this information to a 4-inch thick "Smart Pack" that contained frequencies and procedures for refueling and other vital activities. There were 10-12 pages of frequencies alone. When told to switch to another frequency, the call would be to switch to a color, for brevity and security sake. They would then look up the frequency that corresponded with this color in the "Smart Pack." This is just one example of the hassle involved in performing even seemingly simple tasks "on the fly." Michael Stolley, Lt, USAF, (F-16 wingman during Iraqi Freedom), personal interview with author, 25 March 2004, recording in author's possession.

distribute the tasks performed in the attack sequence or "kill chain." This reduces the role of the strike aircrews (in the attack sequence—it increases their workload in some respects) and makes the interactions more complex, involving distributed teams. The ability of the aircrews to perform information-gathering has also increased this complexity—now many aircraft are sensor platforms as well as strike platforms. At the same time, the increase in the number of dynamic missions means there is more adjustment during the missions. These two factors—more complex interactions made in real time—increase the tendency to drift from global procedures because of the inconvenience these inevitably bring. When the CAOS is loosely coupled, there are often no consequences for this drift; in fact, the convenience of the locally adapted procedures gives perverse incentives to ignore the global procedures. Then, when the CAOS becomes tightly coupled, there is significant potential for accidents. This is based on a theory by Scott Snook called Practical Drift, evidence of which we will see later.

For example, Pilots who had flown in Vietnam and then worked in the TACC during Desert Storm took pains to allow as much freedom at the tactical level as possible. They had grown disillusioned as planners in Saigon levied what the pilots thought were unreasonable constraints on them, until pretty soon they had lost confidence in their leadership and refused in many cases to follow some of the direction they received.[44] But another problem that occurs with a high level of constraints is that the pilots may feel the need to get permission before taking any action, whether it is allowed by the constraints or not. When this occurs, as it did in Kosovo, the pilots lose their ability to innovate and react rapidly to new developments.[45]

The cure for this balance is again found in the depth of command relationships. If the command relationships are sufficiently deep, there are command nodes at a low enough level that they can affect the actions of the aircrew more directly. This does not mean the aircrew are always under the direction of the command nodes. With such depth, the aircrew can be intentionally given discretion to act on their own when there is low risk of collateral damage or friendly fire. Where this discretion is not appropriate, the command node is there in proximity to the force applicators with the authority to direct the action. But this intentional delegation is only possible where there is a commander with the situational awareness to do it. We will see examples where the different actors at the force application level were able to innovate in loosely couple times but lacked a commander who could step in to direct them when the action got intense.

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[44] Jeffrey Feinstein, Lt Col (retired), USAF, interview with author, 25 Mar 04, audio tape in author's possession. Also see Tom Clancy and Charles Horner, Gen. (retired), USAF, *Every Man a Tiger*, (New York: Berkley Books, 2000), 85-87.

[45] See *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as Told by the Airmen who Fought in Operation Allied Force*, Christopher E. Haave, Col., USAF and Phil M. Haun, Lt Col., USAF, Editors, (Maxwell Air Force Base, Ala.: Air University Press, 2003), 148, 207 are two examples where pilots probably did not have to ask permission but did. Phil Haun, Lt Col, USAF, email to author, 11 March 2004, confirmed the pilots felt the need to check because the CAOC had started retaining the authority to give permission to strike.

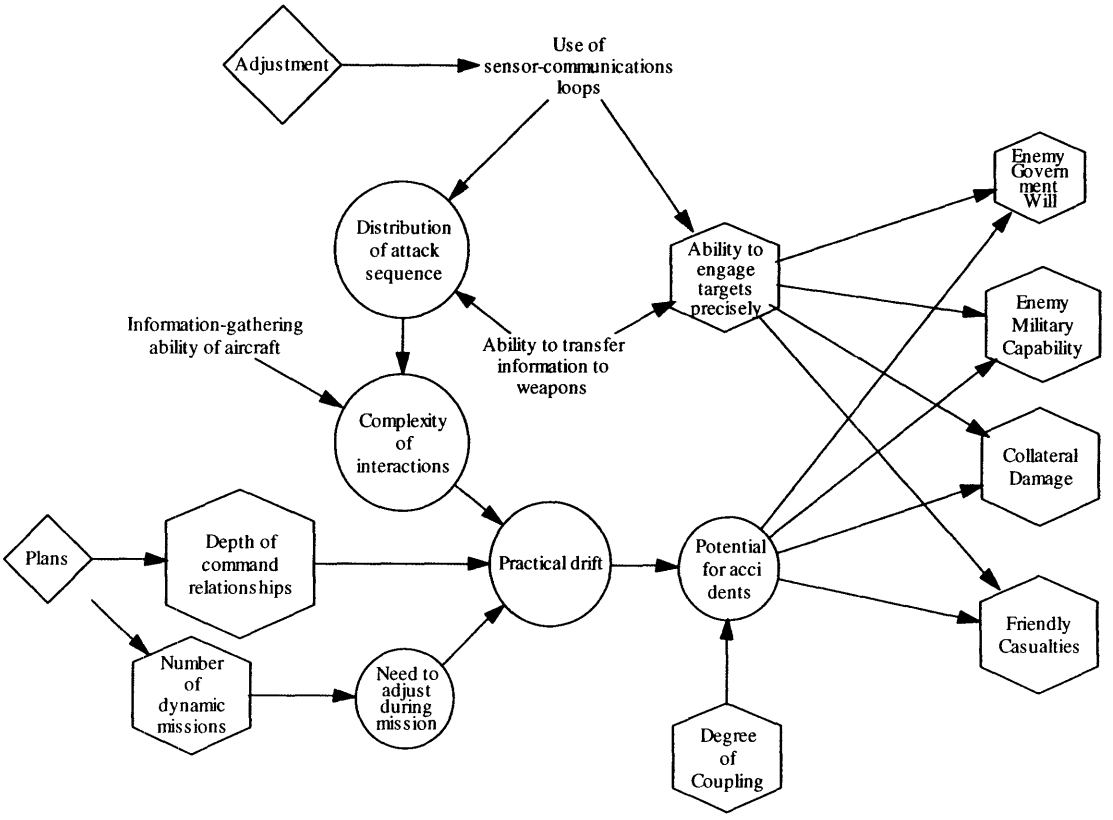

Figure 8: Force Application Subsystem

Conclusions

The CLIOS framework is a method of organizing the information about the behavior of the CAOS so we can see how the different issues interact. This chapter has briefly outlined these issues and presented them in graphical format in the CLIOS diagrams.

At the strategic level, the dominant issue is to what extent the policy-makers should levy constraints on specific actions. To understand the trade-offs involved in centralized and decentralized control, we must start our search here, by analyzing what causes policy-makers to opt for more or less specific constraints. We will also look at the long-term consequences for the CAOS so we can sort out the influences of technology and policy on the evolution of the CAOS. Obviously, the short-term consequences are that, by using specific constraints, policy-makers gain the ability to more directly affect the military actions when they use constraints like ROEs and approval of targets.

However, it appears they may start a chain of events in the other subsystems that affects the degree to which the JFC can empower his component commanders. We will next investigate how command relationships have been formed in the CAOS, paying particular attention to the relationship between the JFC and his air component. If our diagrams are correct, the more the strategic level uses

constraints on specific actions, the less authority the JFC delegates to the air component. In turn, the amount of authority the JFC delegates to the air component in developing the airpower targeting strategy should be an indicator of how well the air component is able to integrate with the other components.

The other consequence of specific constraints on the theater level is that it becomes harder to assess plans and strategy. We will investigate the ability of the air component to get and use information in the AOC, using the technology developments along the way. These developments have made it easier to get and process information from the battlefield in command centers. However, our diagrams suggest this has not made it easier to assess and adjust strategy. Specific constraints lead to a focus on specific (ongoing) actions, and the air component has developed the ability to intervene in these actions more than the ability to assess their results in the aggregate.

This ability to intervene in these actions has also become more important to achieving the overall mission. The politically sensitive missions the air component has been asked to perform require a combination of speed and precision, so we must investigate the way the air component has attempted to achieve this balance. Our diagrams would suggest they have increased the use of sensor-communications loops to find the targets and get the information to the weapons. In the mean time, they have had to develop collaboration to get approval to attack the targets they find emerging on the battlefield.

Finally, we will investigate the effects of these developments on the aircrews and troops who apply force using airpower. We will see how the development of sensor-communications loops and weapons that use digital information has distributed the tasks involved in the attack sequence or "kill chain." Our chapter on system safety will show how the resulting complexity of interactions leaves the door open for "Procedural Drift," which can potentially lead to accidents.

Throughout this investigation, we will see two dominant threads. The first is that the extent to which the players in the CAOS need to and are able to conform to centralized direction depends heavily on the degree of coupling in their area at the time. This explains Chapter 2's conclusion that there have often been different degrees of centralization at the same time in different places or in the same place at different times. The second is that the extent to which the military commanders can establish depth in their command relationships determines their ability to leverage these relationships and strike the balance between precision and flexibility. Defining relationships, instead of specific actions, at all levels gives commanders the ability to delegate authority and still hold people accountable. As the interactions among participants become increasingly complex so that, as Admiral Cebrowsky puts it, you can "no longer talk about one being supported and the other supporting," achieving this depth will mean ensuring there is always someone who is able to integrate the forces because of his or her superior situational awareness and authority.

Chapter 4

The Strategic Level and Control in the Information Age

The creation of strategy resembles Penelope's web—beautiful loomwork by day unraveling at night.

Eliot Cohen, *Supreme Command: Soldiers, Statesmen, and Leadership in Wartime*

The mind of man plans his way, but the Lord directs his steps.

Proverbs 16:9, New American Standard Bible

Air Force aircraft were not involved in the battle in Mogadishu, Somalia on October 3, 1993—Army helicopters were the only airpower available to the Rangers. But although the military commanders involved would have liked more support, including AC-130 Gunships and armor, they did not think they needed it to succeed in picking up two of Mohammed Farah Aidid's lieutenants. The military did not disagree with the overall mission to find and capture Aidid, either—the primary advocate was Admiral Jonathan Howe, the leader of the UN mission that had been unable to bring relief from famine to the area because of the actions of Aidid's thugs. But after 18 Rangers were killed and television news showed pictures of Somalis dragging the dead through the streets, military members disagreed with the Clinton administration's decision to abandon the mission. The Rangers had accomplished their mission—although at a huge cost—and wanted to continue. They wanted to believe their mission had always been important enough to justify the loss of their comrades, so this set-back would not stop them. They felt abandoned by their civilian leadership.[1]

Policy-makers learned a different lesson from Somalia. They learned that the consequences of tactical military actions can affect overall foreign policy. President Clinton's military advisors had convinced him this was a mission they could handle, and now there were embarrassing and disturbing pictures all over the news.[2] It was an experience that arguably shaped the administration's foreign policy, from the decision not to intervene in Rwanda to the decisions not to get involved in ground wars in Bosnia and Kosovo.[3] It was a big factor in the early departure of Secretary of Defense Les Aspin.[4]

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[1] Mark Bowden, *Black Hawk Down: A Story of Modern War*, (New York: Penguin Books, 2000), 337-41, 354-6.
[2] Bowden, 334.
[3] Chester A. Crocker, "The Lessons of Somalia: Not Everything Went Wrong," *Foreign Affairs*, May/June 1995, 7.
[4] Comments on an earlier draft by Dr. Sheila Widnall, Institute Professor, Massachusetts Institute of Technology, former Secretary of the Air Force.

Airpower became the favorite tool for foreign relations. The U.S. found that, in the absence of another superpower and with stealth, precision, and information technology, it could use airpower to make bold statements in areas of less than vital interests without too much risk. Airpower offered policy-makers the potential to avoid the pitfalls of traditional military strategy. Because of the limited aims in these small wars, policy-makers were better able to identify what was undesirable than what was desirable from their military instrument. But U.S. airpower seemed to offer policy-makers the ability to tweak military action within the bounds of a broad policy, rather than letting the military perform according to its standard of SOPs.

The relationship between policy-makers and military commanders did not always fit our preferred command control paradigm of guidance, empowerment, debate, and accountability. In Desert Storm and Iraqi Freedom, the relationship came closest. But in Kosovo, there was no "relationship"—only constraints on actions that could have negative consequences. For the military commanders, avoiding these negative consequences comprised a large portion of their responsibility to "implement strategy." A frustrating exercise, but nevertheless a fact of life.

Although some individuals strove to change this relationship, overall the response was introspective. Policy-makers were giving airpower the chance to prove its worth, giving Air Force leaders fuel for their inter-service budgetary arguments. Airpower did not work as well as its proponents had hoped in all cases, and Air Force leaders found themselves chasing the ability to strike rapidly emerging targets with minimal risk to civilians or Americans. To embrace these technological and political changes, the Air Force went through some changes of its own. Its leaders welcomed the power of information technology and used it to develop the ability to exercise control of airpower at the operational level, in an Air Operations Center (AOC). They crafted new visions from the top that drove research and doctrinal development.

This chapter tells this dual story. It reveals the pressures that drove policy-makers to use constraints on specific military actions instead of turning military strategy over to the military commanders. In the process, it shows the complicated interaction of national security policy, organizational processes, and technological development that produced an evolution of airpower command and control from its inability to achieve unity of effort in Vietnam to a system that many say is managed at too high a level today.

From Vietnam to Desert Storm

As we defined airpower in the previous chapter, it connotes an integrated whole. Yet where we left off in Chapter 2, airpower was anything but an integrated whole. There was no single manager of air resources. It was not a tool that was responsive to policy-makers' strategies. There was very little cooperation among the different services to produce a coherent effort using all their assets.

The 1970s and 80s saw the rise of the fighter generals, with their experience in fighting limited wars in Korea and Vietnam and their need to innovate tactically and materially.[5] Throughout this period, the Air Force, Navy, and Marines refined the precision munitions, sensors, communications and information technology, stealth technology, training, and operational doctrine that would eventually lead to a major victory in the Persian Gulf in 1991. In 1975, the Air Force developed Red Flag, a large-scale exercise that put fighter pilots through their first 10 combat missions in as realistic an environment as possible. Along with the Navy's Top Gun program, this training helped U.S. aircrews develop tactics and proficiency to deal with the heightened air defenses demonstrated in the Vietnam and Yom Kippur Wars. The Air Force added the F-15, F-16, and A-10 to its inventory while the Navy added the F-14 and F-18 and the Marines gained the AV-8 and F-18.

Meanwhile, the services were also working to upgrade their weapons capabilities. In the late 1970s, the Air Force started the Armaments Division at Eglin Air Force Base, Florida to develop non-nuclear munitions. Through the mid-1980s, the Air Force introduced 10 new ground-attack weapons, plus plans for 6 more. These new precision weapons, added to another airframe, the revolutionary F-117 stealth fighter, were to prove a devastating combination in the 1990s.[6]

But these developments were aimed at making the pilots better at accomplishing their missions. The truth is, throughout the 1980s, there was little progress in the control of airpower at the operational level, even though the Air Force began an exercise called Blue Flag in 1977 to practice command and control of large air operations. The Army and Air Force began to collaborate on doctrinal development, but that effort actually crystallized into part of the problem. Both saw that it would take teamwork from the air and land components to defeat the huge threat from the Warsaw pact. Air Force and Army generals agreed to work out details of AirLand Battle doctrine, which foresaw extensive use of tactical airpower and sensors to fight the close battle and the deep battle simultaneously. But another doctrine developed simultaneously in NATO, called Follow-on Forces Attack, proposed to use airpower to strike even deeper, at theater-level targets that would isolate the enemy front-line troops from support and reinforcements. AirLand Battle subjected airpower to the corps commanders' plans, while Follow-on Forces Attack called for controlling airpower at a theater level for the best use of the assets.[7] The argument between the two could have come straight out of World War II, where airmen complained that airpower was being split into "penny packets" under ground commanders.

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[5] Mike Worden, *Rise of the Fighter Generals: The Problem of Air Force Leadership, 1945-1982*, (Maxwell Air Force Base, Ala.: Air University Press, 1998), 237.
[6] Benjamin S. Lambeth, *The Transformation of American Airpower*, (Ithaca, N.Y.: Cornell University Press, 2000), 59-80.
[7] Lambeth, 85-7.

So although the equipment and tactics were well developed by Operation Desert Storm, the command and control arrangements were not. In 1982, the Joint Chiefs of Staff had begun a Joint Doctrine Pilot Program. Through the program, they had sanctioned the concept of the JFACC, which seemed to be the "single air manager" the Air Force had been seeking. However, the Marines and the Air Force significantly disagreed over the authority of the JFACC. The Marines interpreted the position as a coordinating office. They insisted on the 1986 Omnibus Agreement that ensured the Marines could maintain OPCON over sorties they needed for direct support of Marines. They would make excess sorties available to the JFC, the JFACC's boss, and the JFACC would then be a *coordinator*. The Air Force thought the JFACC needed to be a *commander*, with the authority to direct joint air forces to accomplish missions.

Lessons from Desert Storm

This difference was never reconciled before Desert Storm. In fact, because the Navy and Marines were not committed to the JFACC concept, they had not trained for it, and had not purchased equipment necessary to implement it. Even the CENTCOM plan for hostilities in Iraq, OPLAN 1002-90 (which was published one month before Operation Desert Shield began), contained the seeds of ambiguity over the issue.[8]

The 1986 Goldwater-Nichols Amendment helped set the stage for unity of effort in Desert Storm by giving tremendous power to joint commanders. When Desert Shield kicked off in 1990, Gen. Norman Schwartzkopf set up his staff with one air commander to control the use of airpower from all services. The Navy and Marines resisted to some extent, and the Army refused to allow its helicopters to be controlled in this fashion, but the result was still a very well-coordinated effort compared with Vietnam. This unity allowed air planners to coordinate the effects of airpower attacks to take advantage of the advances made in the 70s and 80s.

Desert Storm brought together technology and lessons from the preceding two decades in a startling way. For the first time, the concepts of stealth and precision became part of a single, integrated effort—an operational level strategy versus independent tactical actions. In integrating them for the first time, the airmen that ran the air forces in Desert Storm showed the U.S. that it 1) could be done and 2) needed to be done better. Though most agreed airpower had been largely responsible for a great victory, the U.S. Air Force still took lessons from it and spent the 90s developing its ability to obtain and use information to prosecute war more smoothly at the operational level.

First, Desert Storm taught a lesson about the new security environment. Even before the war, the Air Force had begun sketching a vision for its role in the post-Cold War era. Secretary Donald Rice and

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[8] Thomas C. Hone, Mark D. Mandeles, and Sanford S. Terry, Lt Col, USAF, "Command and Control," Part II, Vol. I, *Gulf War Air Power Survey*, (Washington, U.S. Government Printing Office, 1993), 358-368.

Air Force Chief of Staff Gen. Larry Welch put together a white paper entitled "Global Reach, Global Power," laying out how the Air Force could continue to provide security as the country demobilized its overseas presence.[9] Desert Storm showed that, in the absence of the great power deterrence that characterized the Cold War, the U.S. would be able to engage in warfare on a large scale in protection of its interests. The Air Force had been called on to lead an airpower effort of thousands of sorties per day against a well-equipped enemy in open conventional combat. That had been unheard of in the Cold War.[10]

In this new environment, without the worries about intervention by other superpowers, policy-makers could give the military commanders freedom to accomplish a mission. The military commanders received what they thought were clear and achievable objectives from their strategic-level decision-makers, who then empowered the military to achieve these objectives. President George Bush himself set forth the national objectives within a week of the Iraqi invasion of Kuwait. He called for 1) securing the immediate, unconditional, and complete withdrawal of Iraqi forces from Kuwait; 2) restoring the legitimate government of Kuwait; 3) assuring the security and stability of the Persian Gulf region; and 4) protecting American lives. Military planners embraced these objectives wholeheartedly, citing them in all key briefings of their efforts. The first two obviously called for the dislodgement of the Iraqis from Kuwait. The third was not quite as clear, but was interpreted as a call to reduce the capability of the Iraqi military. The fourth became a moot point when U.S. hostages were released in December 1990.[11] In these objectives, the U.S. military found the basis of a clear military strategy.

But that did not give the military commanders carte blanche to do as they pleased. Desert Storm also taught that in this security environment, there would be coalitions of the willing—willing, at least, for the moment. The Desert Storm coalition consisted of countries like Syria who would otherwise never have considered themselves on the same side as the U.S. To hold this coalition together, the civilian leadership had to manage some details of the war. Despite the clear objectives, the military was called on to do some things it considered militarily insignificant. Namely, it was called on to hunt Scuds.

The "Great Scud Hunt" was the source of considerable friction between the policy-makers and the military commanders in the battle theater. The U.S. forces in theater did not consider the Iraqi Scuds to be a viable threat to the coalition. But they were thinking militarily only. Back in Washington, the policy-makers were taking extreme measures to keep the Israelis out of the war. When the Iraqis

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[9] Ronald Fogleman, "Air Power and National Security," speech to the Defense Forum Foundation, Washington, D.C., 24 January 1997, available at http://www.af.mil/news/speech/readroom2.shtml, accessed 5 December 2003.

[10] It is true that the effort in Vietnam was huge by the end of the war. However, it began slowly and built up to that level. In fact, that's the whole point: in Vietnam, President Johnson thought he had to calibrate the level of violence so it would convince the North Vietnamese the U.S. was serious without causing the Soviets or Chinese to enter the war. In Desert Storm, airpower was calibrated at its maximum effort from the very beginning.

[11] Alexander S. Cochran, et. al., "Part 1: Planning," Vol. 1 of *Gulf War Air Power Survey*, (Washington, U.S. Government Printing Office, 1993), 83-4.

launched the first Scuds into Israel on 18 January 1991, Israel requested the U.S. release its identify-friend-or-foe (IFF) codes so the Israelis could launch a retaliatory strike. The U.S. refused, but had to show that it was doing everything it could to defeat the threat. This included sending Patriot missile batteries to Israel, allowing the Israelis to nominate targets, and launching an all-out effort to find and destroy the mobile launchers in Iraq. But on 19 January, Secretary of Defense Richard Cheney scrubbed the daily flight schedule[12] and discovered the air planners in Riyadh had not stepped up the Scud-hunting efforts. He exploded, and Chairman of the Joint Chiefs of Staff Gen. Colin Powell got the word to the airmen in Saudi Arabia: get serious about Scuds. The resulting Scud Hunt (which included efforts by Special Operations forces on the ground) was ultimately unsuccessful at finding and destroying mobile Scud launchers, but it was successful at suppressing the launches and, more importantly, keeping the Israelis out of the war.[13]

Other incidents reinforced the relationship between tactical actions and political impact. On 13 February 1991, F-117s struck a command and control bunker in the Al Firdos district in the suburbs of Baghdad. Military targeteers had ignored the bunker at first, but recent indications were that the Iraqis had begun using it. But planners did not know the Iraqis were also using the bunker to shelter families of some of its elite. When television news stations ran pictures of Iraqi civilians killed in the attack, military leaders saw that all the precision in the world could not overcome a lack of intimate knowledge of the target. More importantly, if this lack of knowledge led to mistakes, the political stakes were high as leaders would have to take swift and decisive action to win a public relations battle. In this case, that meant severely limiting strikes on Baghdad.[14]

The Air Force also learned space was a valuable medium. Air Force Chief of Staff Gen. Merrill "Tony" McPeak called Desert Storm "the first space war." In Desert Storm, space assets provided warning of missile launches, showed where cloud cover would inhibit air operations, carried long-range communications, and supplied imagery to update maps and aid strike packages, and provided global positioning system (GPS) navigation.[15] But Lt. Gen. Charles Horner, the JFACC in Desert Storm, had found space capabilities difficult to deal with because of security concerns. Horner found that, because space capabilities were so highly classified, the Air Force space operators were afraid of making

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[12] The Air Tasking Order, or ATO.

[13] Michael R. Gordon and Bernard E. Trainor, *The Generals' War: The Inside Story of the Conflict in the Gulf,* (NewYork: Little, Brown and Company, 1995), 227-247.

[14] GWAPS, 68-9. Wayne W. Thompson, "Al Firdos: The Last Two Weeks of Strategic Bombing in Desert Storm," *Air Power History*, Summer 96, 355.

[15] Thomas S. Moorman, Jr., LtGen, USAF, "Space, A New Strategic Frontier." *Airpower Journal*, VI, 1 (Spring 1992), 19-20.

mistakes, so he could not incorporate space information into the command and control processes the way other capabilities could.[16]

After the war, Gen. Horner became the commander of the unified U.S. Space Command, and his primary concern was changing the culture to a more operationally-oriented one. In fact, the next five commanders (including Horner) were all fighter pilots. The Air Force also conducted a Blue Ribbon Panel on space in 1992 as part of the initial analysis of Desert Storm. Under Horner's watch, Space Command established a Space Warfare Center (SWC) at Falcon Air Force Base, Colorado, modeled after the USAF Weapons School in Las Vegas. The SWC began developing tools to enable air component commanders to apply the information from space capabilities to the fight. In 1994, Project Strike II led to the ability to re-target an F-15E to hit a mobile Scud launcher using coordinates derived from space imagery.[17]

The Air Force made even more sweeping organizational changes in the wake of Desert Storm. Recognizing that all aircraft would have to play a role in the new conventional warfighting and deterrence roles, the Air Force restructured the traditional Military Airlift Command (MAC), Tactical Air Command (TAC), and Strategic Air Command (SAC). It re-aligned its bombers and fighters into one Air Combat Command (ACC) and put the assets that get them to the fight—tankers and airlift—into one Air Mobility Command (AMC).[18] The bombers and the fighters would both be ready to work together in conventional strike packages. The tankers would be positioned to support airlift and fighters in the event of a conventional contingency, rather than sitting alert for the nuclear bombers. The Air Force aligned itself more toward the ability to project conventional power worldwide, rather than the ability to support a nuclear strike at a moment's notice.

Integrating with the Clinton Administration

When President Bill Clinton took over as commander in chief, relations between the new administration and the military were tense. In a 2002 article, a retired colonel and former Air Force historian called this a period of "the most open manifestation of defiance and resistance by the American military since the publication of the Newburgh addresses over two centuries earlier, at the close of the American war for independence."[19] Yet in the next eight years, the administration was to grapple with the use of force more than any administration since Vietnam. In the process, it was to shape the U.S. military and its vision for the future.

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[16] Charles A. Horner, Gen. (retired), USAF, interview by author, 29 May 2004, recording in author's possession.
[17] Lambeth, 238-241.
[18] Fogelman, "Airpower and National Security."
[19] Richard H. Kohn, Col (ret) USAF, "The Erosion of Civilian Control of the Military in the United States Today," *Naval War College Review*, Summer, 2002, 10-13.

In 1995, Air Force Secretary Dr. Sheila Widnall and Chief of Staff Gen. Ronald Fogelman realized that the Air Force's vision did not make enough of the information revolution. They began a strategic planning effort by inviting Alvin Toeffler, Carl Sagan, and other scientists and visionaries to tell them what the future held for the Air Force. This led to the Air Force's first vision document, "Global Engagement—A Vision for the 21st Century Air Force."[20]

"Global Engagement" attempted to keep the Air Force in step with the Clinton administration and the Joint Staff while also increasing the Air Force's capabilities. The President's National Security Strategy demanded the military be prepared to participate with diplomatic efforts to enhance the stability of critical regions throughout the world.[21] Accordingly, in 1996 the Joint Chiefs of Staff headed by Chairman Gen. John Shalikashvili had published Joint Vision 2010, a document that described how the U.S. military forces would accomplish this security strategy. The joint forces would have to develop new operational concepts and something called "Information Superiority" to perform all the missions that would be required of them in war and peace. This would allow forces to work together so they could accomplish their objectives without huge numbers.[22]

The Air Force completely agreed. Air Force Vision 2010 pointed out that these new operational concepts required speed, global range, stealth, flexibility, precision, lethality, global/theater situational awareness, and strategic perspective—exactly the things that airpower could deliver better than any other type of force. But in order to really become global, the Air Force would have to become the *Air and Space Force* and, eventually, the *Space and Air Force*. In the mean time, it would have to develop the ability to get its people and machines to the conflict fast. Forces would be packaged in Air Expeditionary Forces that would be ready to deploy together (in fact would practice deploying together) at the drop of a hat. The Air Force would also have to develop the ability to "locate the objective or target, provide responsive command and control, generate the desired effect, assess our level of success, and retain the flexibility to re-engage with precision when required." The document even called for a cultural change: in the future, anyone who was experienced in the employment and doctrine of air and space power would be called an operator (a big step in a service dominated by fighter pilots).[23]

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[20] Fogelman, "Airpower and National Security."
[21] "A National Strategy of Engagement and Enlargement," The White House, February, 1996, available at http://www.fas.org/spp/military/docops/national/1996stra.htm#II, accessed 6 December 2003.
[22] "Joint Vision 2010", Joint Chiefs of Staff, 1996, 16-26. This document said the joint forces would have to develop new operational concepts called "Dominant Maneuver," "Precision Engagement," "Focused Logistics," and Full-spectrum Force Protection" in order to perform all the missions that would be required of them in war and peace. These documents would rely on something called "Information Superiority" that would allow decision-makers to decide whom, where, how, and with what to engage to accomplish security objectives. Instead of massing forces, the military would mass effects by applying the right force in the right place at the right time.
[23] "Air Force Vision 2010 – Global Engagement," HQ USAF, 1996, available at http://www.au.af.mil/au/awc/awcgate/global/nuvis.htm, accessed 9 December 2003.

"Global Engagement" was an ambitious document. There was some controversy in it. The single line about moving to an Air and Space Force and then a Space and Air Force generated heated debate among senior officers.[24] The move to expand the definition of "operator" required a huge cultural change and has still not matured. But the document gave Air Force leaders the impetus to move toward Information Age warfare. It enabled the Air Force to fight for its right to maintain control of space.[25] It justified further work on unmanned aerial vehicles and other sensors for gathering information and getting it back to decision-makers. It also pushed for further work on precision munitions. It pushed for innovation that was in line with civilian and joint force policies, but in a way that expanded Air Force capabilities.

Intervention with Caution--Somalia and Bosnia

A slight detour is in order here. Bosnia is not one of the conflicts that will inform our study of the CAOS. However, it is informative to see how it bridged the gap between the disaster in Somalia and the 1999 war in Kosovo. When Dr. Sheila Widnall arrived in Washington, D.C. in 1993 to take over as Secretary of the Air Force, she spent her first weekend glued to the television. Mixed with the anguish that the rest of Americans felt as they watched the bodies of dead soldiers being dragged through the streets of Mogadishu, Widnall had another observation: "Now we won't go into Bosnia."[26] She correctly predicted that the disaster in Somalia would make the Clinton administration think twice about getting involved elsewhere.

In the end, the U.S. did enter the Bosnian conflict, but warily. The UN Protection Force had been established in Croatia in January 1992. When the Bosnians declared independence from Yugoslavia in March of that year, the Serb military advanced and quickly carved out most of the new state for its own. The U.S. and several European states recognized Bosnia in April, and by June the U.N.'s mission was extended to include protection of humanitarian relief supplies into Sarajevo Airport.[27] Yet in 1995 the Clinton Administration was still deeply divided over what to do about the conflict. President Clinton wanted to provide American leadership to allow the use of force, but at the same time wanted to avoid putting 20,000 Americans on the ground. By August 9, 1995, he decided to intervene.[28]

Airpower under close supervision was the answer. The UN was already using caution in employing NATO airpower to enforce a no-fly zone. The UN and NATO had developed a command and

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[24] Sheila Widnall, former Secretary of the Air Force, interview by author, 2 December 2003, notes in author's possession.

[25] Ibid. Prof Widnall stated that one of her priorities while she was in office was "maintaining Air Force equities," by which she meant holding onto and perhaps expanding the boundaries of the Air Force's responsibilities and, by extension, capabilities.

[26] Widnall interview.

[27] Robert C. Owen, Col, USAF, "The Balkans Air Campaign Study: Part 1," *Airpower Journal*, Summer, 1997, 8.

[28] Ivo H. Daalder, *Getting to Dayton: The Making of America's Bosnia Policy*, (Washington: Brookings Institution Press, 2000), 80. See the next chapter for a good discussion of the interagency process that led to the decision.

control arrangement they called "dual key," meaning both had to agree if any action was taken. If UN peacekeepers on the ground needed support (CAS), the director in the Combined Air Operations Center (CAOC) could authorize it. Offensive strikes required the overall NATO air commander approval. But on the UN side, Secretary-General Boutros Boutros-Ghali was the approval authority for offensive strikes, while Ambassador Yasushi Akashi's approval was required for CAS. This despite the fact that the two sides had already negotiated rules of engagement (ROE) for military action. Repeated requests for CAS were denied, and the first offensive strike in November 1994 was so watered down it had no effect.[29]

By the time the Clinton administration made its diplomatic move to intervene with force, the precedent for tight constraints on airpower had been set. The NATO air commander, Lt. Gen. Mike Ryan, was in charge of planning the air strikes for a campaign called Deliberate Force. Officially, the purpose of the strikes was to protect UN peacekeepers on the ground. In fact, the US took great care to keep Ryan separated from Ambassador Richard Holbrooke, the de facto leader of the diplomatic contact team that was negotiating with Slobodan Milosevic. It would have been inappropriate for the two to cooperate, because that would have made the air strikes a tool for coercion of the Serbs, as opposed to a neutral protection force.[30]

Yet even without intervention from political leaders, Ryan chose to be sensitive to political considerations. He maintained tight control of the strikes. He personally chose every aimpoint and made every decision regarding the weapons to use on a given target.[31] In fact, Ryan was probably more conservative about the political consequences of the air strikes than Holbrooke and his team—Ryan was concerned that the political support for the air strikes would not withstand a significant collateral damage incident; Holbrooke had no such fear.[32] But the close coordination between bombing, actions on the ground, and diplomacy was one key to the success of the effort.

Institutionalizing Command and Control

Bosnia was a small war, but it contributed to the Air Force's understanding of the way airpower fit into the current political environment. It was another example that airpower had to be ready to fit into a carefully choreographed political strategy. Accordingly, the Air Force began to put more effort into being able to control airpower at the operational level of war. A 1996 Air Force Scientific Advisory Board study illuminated the need for improvements in command and control processes and technology.[33]

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[29] Owen, 15-18.
[30] Robert C. Owen, Col, USAF, "The Balkans Air Campaign Study: Part 2," *Airpower Journal*, Fall, 1997, 17.
[31] Owen (Part 2), 9. The aimpoints are called desired mean points of impact, or DMPIs (pronounced "dimpy").
[32] Owen (Part 2), 18.
[33] *History of the Aerospace Command and Control Agency, 1 October 1997-30 September 1998*, Volume 1, p. 30, K401.07-2 v.1, in the USAF Collection, AFHRA.

In response, Air Force leaders started an organization called the Air and Space Command and Control Agency (AC2A) to integrate air and space, eliminate duplication of effort, and modernize command and control. Before this, any organization that needed command and control equipment submitted a budget for it; as a result, there were 67 different command and control systems in the 1997 budget. The agency's job was to drive toward a common operational architecture, while also developing a baseline for the AOC.[34]

But Air Force officials were only beginning to get a handle on the scope of the problem. The 67 systems were those that communicated information from place to place or processed it when it got to its destination. Looking only at those systems, one could imagine a decidedly closed-loop command and control system that automatically processed and disseminated information. But the sensors that pick up data from the battle area were an important part of the real, open-loop system.

These ISR sensors were also evolving. In Desert Storm, the Joint Surveillance Target Attack Radar System (JSTARS) made its debut even before it was a fielded system. The JSTARS program was still in developmental testing when Lt. Gen. Frederick Franks, commander of the U.S. Army VII Corps, observed a demonstration in Europe in the fall of 1990. He was so impressed, he had Gen. Schwartzkopf briefed, and Schwartzkopf got the system deployed to the desert.[35] JSTARS was instrumental in detecting troop movements in the Battle of Khafji and would later be used extensively in Kosovo, Afghanistan, and Iraq. In fact, it was in Kosovo that JSTARS first teamed up with another development in airborne ISR, the unmanned aerial vehicle (UAV).

UAVs had been used for reconnaissance as far back as Vietnam, but had always suffered from the slow delivery of data and inaccurate navigation. The Predator was the first vehicle to incorporate GPS-enhanced navigation and commercial satellite datalinks for control and imagery transmission, so it was released from the bonds of line-of sight operations.[36] It was developed by General Atomics in response to a request for proposals in 1993, and saw combat in the Balkans 17 months after the contract was awarded in January 1994. It was built using off-the-shelf components and acquired using a quick-reaction strategy called the Advanced Concept Technology Demonstration.[37] When Air Force Chief of Staff Gen. Ronald Fogleman saw how important the Predator had become by virtue of its service in Bosnia, he went all-out

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[34] Ibid.,1. The agency's name was changed in September 1998 to the Aerospace Command and Control Agency, versus the Air and Space Command and Control Agency. This is why, although the acronym was originally ASC2A, I use AC2A, since that was the eventual name. The Department of Defense identifies systems by categories called Program Elements, and in response to the 1996 SAB report, the Air Staff had counted 67 such PEs just for C2, p. 30.

[35] Thomas C. Hone, Mark D. Mandeles, and Sanford S. Terry, Lt Col, USAF, "Part II: Command and Control," Vol. 1 of *Gulf War Air Power Survey*, (Washington, 1993), 101-3.

[36] Thomas P. Ehrhard, "Unmanned Aerial Vehicles in the United States Armed Services: A Comparative Study of Weapon System Innovation," (Ph.D. dissertation, Johns Hopkins University, 2001), 227.

[37] Christopher Palmeri, "A Predator that Preys on Hawks," *Business Week Online*, 17 February 2003, available at www.businessweek.com/magazine/content/ 03_07/b3820093_mz017.htm, accessed 9 June 2004.

to make it an Air Force asset, mobilizing support and creating an operational squadron even before the USAF was designated the lead service.[38] Besides this, Air Force generals were becoming more aware of space capabilities.

So the Air Force realized it had to incorporate ISR into its command and control paradigm. Every year, Air Force generals hold a series of meetings called Corona. At the 1997 Corona Fall meetings, the generals pointed out that no one was in charge of ISR sensors, which were becoming integral parts of the command and control process. Instead of creating a new center, the Air Force included this new responsibility into the AC2A, making it the Air Force Command and Control, Intelligence, Surveillance, and Reconnaissance Center (AFC2ISRC).[39]

If ever there was an organization dedicated to developing the capability to employ Van Creveld's "directed telescope," this was it. This agency was responsible for developing the tools and training to create formal feedback loops from sensors to decision-makers to action-takers. With separate, "stove-piped" systems, this was impossible, but if the systems could be made common, or at least interoperable, then these sensor-communication loops could become formal processes. The AFC2ISRC gathered up the inputs from the warfighting commanders and then worked with Electronic Systems Command and Mitre Corporation in Massachusetts to develop the technology into usable capabilities as quickly as possible.[40]

One key to this rapid development was an annual experiment called the Expeditionary Force Experiment (EFX) in 1998. Its purpose was to exploit the Revolution in Military Affairs and demonstrate "emerging Air Force capabilities to deploy and employ decisive aerospace power for the joint force commander through an Aerospace Expeditionary Force."[41] Recognizing the fact that the technology used to command and control airpower was changing faster than the acquisition system could develop new systems and techniques, this yearly event began trying a more flexible method called "spiral development." The first experiment focused on collaborative tools that allowed people to perform distributed operations from multiple locations, and also tried to develop a process for targeting dynamic, "time-critical targets."[42]

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[38] Ehrhard, 230-32.
[39] *History of Aerospace Command and Control Agency*, 19-22. By this time, the AC2A was actually called the Air and Space Command and Control Agency (ASC2A).
[40] Ibid., 9.
[41] "EFX 98 Assessment Report," Executive Summary, internet, https://jefxlink.langley.af.mil/index.asp, accessed 11 December 2003. The report is unclassified, but in order to view it you must get permission from the Air Force Experimentation Office (AFEO).
[42] Ibid.

Kosovo

The changes did not keep up with the pace of world events, however. Within six months of the conclusion of the first EFX, the U.S. found itself fighting a war in Kosovo. The 1999 Kosovo conflict was similar to Bosnia in that political controls were again a huge consideration in airpower employment.

The war in Kosovo was unprecedented in that it was a war for solely humanitarian reasons without a mandate from the UN. Although both Prime Minister Tony Blair and President Clinton also referred to the destabilizing effect of refugee flows, the primary reason for the intervention seems to have been the plight of the Kosovar Albanians.[43] The Kosovo Liberation Army (KLA) and the Serbs had been fighting since 1991, and up until 1999 NATO had been merely trying to get the two sides to stop fighting. But in January, 1999, 45 Kosovar civilians were massacred at Racak. Then the Serbian delegation to the Rambouillet peace conference refused to agree to NATO peace conditions. At the same time, Milosevic switched to a strategy of trying to drain Kosovo of ethnic Albanian supporters of the KLA.[44] This gave NATO a clear choice of sides in the war.

It did not, however, make for a clear choice of military strategy. The U.S. political objectives were to demonstrate NATO's opposition to aggression, deter Milosevic from further attacks, and damage Serbia's capacity to wage war. NATO's political objectives were to stop the killing in Kosovo, end the refugee crisis, and create conditions for political solutions based on the Rambouillet Accords.[45] These are far more nebulous objectives than the Desert Storm coalition had received. They are also best achieved with ground troops. But, with less than vital interests at stake, there was little stomach among the NATO nations for risking the lives of their soldiers.

Furthermore, they did not think they had to. Throughout the 1990s, airpower was involved in applying force in a number of different situations that were short of a full war. The Bosnia conflict was one. The containment of Saddam Hussein with "no-fly zones" was another, as was the effort to coerce Saddam into complying with U.N. inspections in 1998. These were characterized by short, quick applications of airpower to effect a short-term change in the behavior of the opponent. There were no long-term strategies for the accomplishment of strategic objectives. Correspondingly, the system that employed airpower in each was only a fragment of the one that had fought Desert Storm. In Operation

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[43] Although there was no resolution directly authorizing force, there were in fact UN resolutions that gave some legitimacy to NATO's side to the issues. Resolution 1199 of 23 September 1998 demanded a halt to all actions by security forces that affected the civilian population. Resolution 1203 of 24 October 1998 demanded Serb compliance with accords of Belgrade earlier that month. The NATO states probably did not ask for a vote because Russia and China had vowed to veto any such resolution, and this would probably have robbed the movement of the impressive legitimacy that it had despite the lack of explicit direction. Adam Roberts, "Nato's 'Humanitarian War' over Kosovo," *Survival*, vol. 41 no. 3 (Autumn 1999), 105-7.

[44] *The Air War over Serbia: Aerospace Power in Operation Allied Force, Initial Report*, (Washington: Headquarters USAF, 1999), 2-4.

[45] Ibid., 9.

Southern Watch, for example, the day-to-day operations to enforce the no-fly zone were coordinated by a crew of about 500 people in the AOC in Riyadh, Saudi Arabia. But whenever a coordinated attack occurred, as when President Clinton ordered retaliation against Saddam in January 1993 for the attempt on President Bush's life, a larger group would take over. They would plan the actions and get the targets approved while still in the U.S. (at Shaw Air Force Base, S.C.). Then the commander of 9th Air Force would deploy to Riyadh with his hand-picked staff to run the operations during the brief period of increased intensity.[46]

This mentality carried over into the Kosovo war at first. Gen. Wesley Clark's recollection, published later in a book, is that he was mentally prepared to step up from limited attacks to more major attacks and then to a ground invasion of Kosovo and even Serbia if necessary. But in the political arena, there was a desire for a couple days of strikes and then a bombing pause, just like in Bosnia.[47] A shallow reading of the 1995 Bosnia intervention suggested Milosevic was vulnerable to combined bombing and diplomacy. A deeper reading would have reminded everyone that the Dayton Accords had followed a series of sharp reversals on the ground and the bombing had not been against Serbia proper.[48] Yet in August 1998, when military planners presented the North Atlantic Council (NAC) countries with military options for a potential crisis, any options involving ground troops were shelved. President Clinton and Secretary of State Madeleine Albright made public statements that told Milosevic there would be no ground invasion—only bombing from the air.[49]

There was no coherent strategy, no mechanism to link the allowable means to the required ends. We will see later that even the air commander, Lt. Gen. Michael Short, knew he could not stop ground troops from performing ethnic cleansing without troops on the ground. He did think airpower could convince Milosevic to capitulate, but only by going to downtown Belgrade to attack the bases of Milosevic's power. This approach was precluded by the policy-makers as well.

In the absence of a clear mechanism, policy-makers used a target approval process to implement strategy. This was really the only strategy guidance between the strategic level decision-makers and the military. Supreme Allied Commander Europe Gen. Wesley Clark was not involved in any discussions with his Commander in Chief or Secretary of Defense William Cohen.[50] Target approval was done by a

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[46] James Pritchard, Lt Col (retired), USAF email to author, 21 November 2003.
[47] James O. Ellis, Adm, USN, (Commander, Joint Task Force Noble Anvil during Allied Force),"A View from the Top," briefing, 15 October 1999.
[48] Roberts, 110-11.
[49] Andrew L. Stigler, "A Clear Victory for Air Power: NATO's Empty Threat to Invade Kosovo," *International Security*, Vol. 27 No. 3 (Winter 2002/3), 127-8.
[50] Wesley K. Clark, Gen. (ret), USA, *Waging Modern War: Bosnia, Kosovo, and the Future Combat*, (New York: Public Affairs, 2001), 201-2 describes the US target approval process, and 218-20 describes Clark's quest for political guidance, which he got from NATO secretary-general Solana but not from either President Clinton or Secretary of Defense Cohen. He later wonders, on 341: "Wouldn't they have been able to make better decisions,

committee of NATO governments, any one of whom could veto individual targets. The process was slow and sporadic, and the bombing did not produce nearly the effects the airmen thought it could have produced.[51]

But mistakes in the bombing had the potential to destroy NATO's moral high ground. Strategic-level decision-makers found more evidence in Kosovo that tactical actions can have strategic effects. Intelligence officials targeting a Yugoslav arms agency selected the wrong building off overhead imagery. They were unaware that the building they were mistakenly targeting was the Chinese embassy, because the map they were using did not show the correct location of the embassy, which had moved in 1996. These two mistakes combined to produce a diplomatic nightmare when a B-2 precisely bombed its target (which turned out to be the Chinese embassy). This triggered a crisis between Beijing and Washington, caused an international uproar that threatened the coalition's solidarity, disrupted moves to negotiate an end to the conflict, and halted bombing in Belgrade for two weeks.[52]

In retrospect, the approach taken by the policy-makers implies they were more concerned about the NATO alliance than about the ethnic cleansing. They ruled out ground troops and discounted the only other strategy that may have forced quicker capitulation, both in the name of maintaining the NATO alliance. This is not necessarily true. It does show that political pressures at times outweigh "military effectiveness" in policy-makers' decision processes.

In the end, the Air Force learned some hard lessons from the conflict. In Kosovo, airpower had been the U.S.'s only military instrument and it had been found wanting in several respects. Although the strikes on Belgrade seem to have had an effect on Milosevic, the valiant efforts against his army in Kosovo were unable to stop the ethnic cleansing or even destroy the Serb air defenses, because the Serbs were able to disperse and hide. Airpower needed an improved ability to engage fleeting targets in a politically sensitive environment. In Kosovo, this had been done through a process called "Flex Targeting," which made up an unusually large proportion of the total strikes. This brought remote decision-makers in on the execution to a greater degree than ever before. Often, Short's CAOC staff tried to direct aircraft based on real-time intelligence from ISR sensors. Essentially, he was taking extra care to ensure targets met the ROEs protecting civilians before approving the strikes.[53] But this process illuminated the need to enable the tactical level to be able to respond more quickly based on the same information. Although there were cases where this slowed the tactical actions down, there were also

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and have them better implemented, I thought, if they brought the commander into the high-level discussions occasionally?"

[51] United States General Accounting Office (GAO), "Kosovo Air Operations: Need to Maintain Alliance Cohesion Resulted in Doctrinal Departures," Report to Congressional Requesters, GAO-01-784, Washington D.C., July 2001.

[52] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment*, (Santa Monica, Calif.: RAND, 2001), 206-7.

[53] Rebecca Grant, "Reach-Forward," *Air Force Magazine*, Vol. 85, No. 10 (October 2002).

cases where the aircraft were not able to respond quickly enough to strike a target that the CAOD had approved.[54] The official lessons were that the military needed to get better at precision engagement, and to procure common tactical datalinks to tie sensors to shooters and help produce a "common tactical picture."[55]

In fact, these were the things that the Air Force had been working on. So the lessons of Kosovo reinforced the lessons from Bosnia and the other small conflicts in the 90s. Whether Air Force leaders agreed with it or not, this type of warfare was probably here to stay. Airpower would have to use information to conduct precision attacks with low collateral damage in a way that was tailored to political circumstances.

Ascendance of the AOC

Five years after he was the JFACC in Deliberate Force, as Air Force Chief of Staff, Gen. Ryan wrote the next Air Force vision document. Like its predecessor, this document followed directly from the National Security Strategy and Joint Vision 2020. But it went into more details about how the Air Force would use its information. In it, Ryan and Secretary of the Air Force F. Whitten Peters stressed the necessity of getting information to the Air Commander:

> We will strengthen the ability of our commanders to command and control aerospace forces. Their Aerospace Operations Centers will be able to gather and fuse the full range of information, from national to tactical, in real-time, and to rapidly convert that information to knowledge and understanding—to assure decision dominance over adversaries.[56]

Ryan and Peters expanded the targeting process that Fogelman and Widnall had laid out in their document—now the process was to "find, fix, target, track, engage, and assess." This "kill chain" was to be executed (eventually in minutes instead of hours) by an integrated "system of systems." Only now, instead of an *Air and Space Force*, it was an *Aerospace Force*.[57] Put in perspective, this was not a downplay of the significance of space. It was an effort to reinforce the fact that everything worked together, in a "system of systems," with the AOC as the hub of control of the system. Ryan's experience had taught him the AOC was the right place to control airpower. The thing to do was to make it more effective by feeding all the information to it.

Certainly the technology was now available to pull data into the AOC and process it. Numbered air forces, those organizations responsible for controlling Air Force resources in case of a war in a

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[54] Todd harmer, Maj, USAF, "Enhancing the Operational Art: The Influence of the Information Environment on the Command and Control of Airpower," (Master's thesis, School of Advanced Airpower Studies, Maxwell Air Force Base, Alabama, 2000). In one particular case, Short and Clark were watching live Predator video, imploring a pilot to find three tanks they saw moving along a road. The pilot, clearly agitated by the high-level attention, was unable to find the tanks. This pilot was actually Gen Short's son. After the third prodding: "Gen. Short really wants those tanks killed!" the FAC answered back, "[expletives deleted] it Dad, I can't see the [expletive deleted] tanks!"
[55] "Kosovo/Operation Allied Force After Action Report," 50.
[56] Global Vigilance, Reach, and Power: Air Force Vision 2020, HQ USAF, 2000, 3.
[57] Ibid., 6.

particular area of the world, had already begun constructing AOCs. The 9th Air Force, which had fought Desert Storm under Horner, finished one at Prince Sultan Air Base (PSAB) in Saudi Arabia in 2001. This was a brand new facility, built from the ground up for the purpose of running an air war in Southwest Asia.[58] But manning the AOCs in time of war took a lot of manpower, and the drive from the Defense Department was to cut down on this overseas presence. So each numbered Air Force also wanted another facility at its home station to execute what was called "reachback." Because of the incredible leaps in bandwidth available over fibre and satellite technology, much of the analysis work could be done here, leaving the analysts and their equipment at home during a war. The Air Force built a single reachback facility, the Rear Operations Support Center, at Langley Air Force Base, Virginia.

But this centralization put tremendous pressure on the AOC as hub. If all the decision-making was to be accomplished there, it had to be done well. Training the people had long been a concern. The Air Force traditionally had not put emphasis on learning to do the job of controlling airpower—flying the planes was its business. When (then Major) Jack Sexton left the Philippines because of the eruption of Mt. Pinatubo in 1992, he was sent to the 9th Air Force at Shaw Air Force Base, South Carolina, where he became the training officer for the people who had run the air campaign in Desert Storm. One of the first questions he was asked was "What do you do?" Certainly Sexton must have some hobbies or something that would keep him occupied, because the people there were only used in case of war, which left a lot of spare time.[59] They spent almost no time training or refining their trade. It was seen as a dead end job, for those who would soon retire: "Civilian below the zone."

The Air Force attempted to change that, too. In 2000, Ryan announced that the AOC would now be treated as a weapon system. This unprecedented step took a formerly ad hoc arrangement of technology and people and transformed it into a real entity. Now, someone had to figure out how to operate it, standardize the operating procedures, and train people to set it up and maintain it. The EFX (later called JEFX, to enhance the *joint* aspect of airpower) would provide the medium for experimentation. Also in 2000, Ryan started a Senior Mentor program. Based on a similar program in the Army, this program took four retired three-star generals (including Short) and gave them the responsibility for passing on their lessons on how to employ airpower at the operational level of war. They now help mold exercises by planning them and playing key parts, assess the performance of the senior officers in those exercises, and lecture to more junior officers about the operational level of war.[60] They have helped form training courses to teach officers how to run an AOC. Even more importantly, they have been firm advocates of assigning officers from the Air Force's elite training and education

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[58] History, 9AF, FULL CITATION?

[59] Jack Sexton, Col (ret), USAF, interview by author, 3 June 2003, notes in author's possession.

[60] "Air Force Senior Mentor Program and Operational Command," message by same subject from HQ USAF Washington DC/CVA to MAJCOMs, DTG R 230952Z AUG 00.

schools—like the Weapons School at Nellis Air Force Base and the School of Advanced Air and Space Studies at Maxwell Air Force Base—to positions where they will work in an AOC.[61]

The senior mentors worked in concert with a former part of the AC2A. Soon after AC2A was organized, it took on a subordinate organization at Hurlburt Field, Florida. The organization that had been responsible for the Blue Flag exercises was renamed the Air Force Command and Control Training and Innovation Center. In the next six years, this center would undergo two more re-organizations, finally achieving the status of a wing with three groups under its control. In 2004, the 505th Command and Control Wing became responsible for training people, developing formal processes, and testing systems to perform air and space command and control. The wing established a formal training unit, mission qualification classes, and continuation training for those who will work in AOCs. They ran exercises using a mixture of modeling and simulation and live aircraft, and the senior mentors provided experienced critiques of the results. They developed the doctrine documents that describe how command and control is exercised in the CAOC. And they were responsible for testing the equipment and procedures during JEFX and other experiments and operational tests.[62] On paper at least, the Air Force had achieved a formal recognition that command and control at the operational level of war required a cadre of professionals in the field who were competent with formal processes and up-to-date equipment.

A New Administration and the War on Terror

It was during this period that the new George W. Bush administration came to the White House. President Bush won an election by an electoral technicality, receiving more electoral votes but fewer popular votes than Vice President Al Gore in the 2000 election. But in the eyes of the military, he was the Commander-in-Chief. His administration included such heavyweights as Donald Rumsfeld, in his second term as Secretary of Defense, Vice President Dick Cheney, the former Secretary of Defense who had served during Desert Storm, and Secretary of State Colin Powell, the former Chairman of the Joint Chiefs of Staff during Desert Storm. This was a group that was anything but intimidated by the Department of Defense, and immediately went to battle with the military. The 2001 Quadrennial Defense Review demanded transformation, including a reduction in traditional procurement programs like the F-22 and Crusader. Secretary Rumsfeld proved to be a hard-nosed boss who saw it as his personal duty to guarantee civilian control of the military.

So when terrorists attacked the World Trade Center and the Pentagon on 11 September, 2001, the resulting war presented a much different civil-military case than the previous Kosovo War. That it would

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[61] The School of Advanced Air and Space Studies is a master's degree program that takes graduates of the Air Force's professional military education, Air Command and Staff College, and teaches them the art and science of airpower strategy. In 2002, the school began sending its students through an advanced course in command and control taught at Hurlburt Field, Florida.

[62] William Jones, Lt Col, USAF, "505th Command and Control Wing, Wing Mission Brief," briefing to author, Hurlburt Field, Florida, 1 June 2004.

be a war, in the conventional sense, was not at all guaranteed by the terrorists attacks. Bush made the response to the 11 September attacks the central issue of his presidency. At daily National Security Council (NSC) meetings for the next month, the strategic level decision-makers wrestled with how to wage war on an entity as nebulous as the enemy in this war. Throughout, they were very conscious of the image the world had of an America that simply lobbed cruise missiles in response to any attack.[63] Bush made it a point to stress that he knew the war would be long and would entail loss of American lives. There would be American "boots on the ground," not just aircraft and missiles in the air. Nevertheless, the cost would be justified.[64]

But translating this strategic vision into a military strategy was difficult to say the least. The principals had a difficult enough time trying to decide who was the enemy; they could not immediately tackle how to attack that enemy. This was left to the military, and Rumsfeld was not initially happy with the way they handled it. He wanted the military to come up with innovative ways to fight this war that would also spur the transformation he was trying to encourage: "If you're fighting a different kind of war, the war transforms the military."[65] Rumsfeld and the other principals set the conditions for the military strategy by sending in CIA and military special operations teams on the ground to work with the native opposition forces in Afghanistan. They expected the military to figure out the details.

Still, there were some specific actions the Bush administration felt it needed to constrain. To avoid any perception that the war was against the people of Afghanistan or the people of Islam, the military actions had to remain clean and not cause much damage to Afghanistan or its people. The NSC made a decision that all potentially "sensitive" targets were to be cleared by Secretary Rumsfeld himself. This seemingly inane constraint had the effect of severely narrowing the allowable targets by including all infrastructure such as electrical power, roads, and industry. The military also had to get approval to strike any target which could be expected to cause moderate to high collateral damage. The authority for these decisions was eventually delegated to Gen. Tommy Franks, the CENTCOM Commander and JFC, and

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[63] Bob Woodward, *Bush at War*, (New York: Simon and Schuster, 2002). This book amounts to a series of published interviews with the principal players in the Bush administration, as well as some special forces. See pp. 48-9, 61-2, 81-2 for descriptions of wrestling with the scope of the war, 37, 144-5, 175-6 for Bush's view of leading but delegating to the experts.

[64] George W. Bush, "Address to a Joint Session of Congress and the American People," the United States Capitol, Washington, D.C., 20 September 2001, accessed 5 December 2001. Available at http://www.whitehouse.gov/news/releases/2001/09/20010920-8.html, accessed 21 June 2004. "Boots on the ground" is from Woodward 44, 51-2.

[65] Woodward, 43-44, 62-3, 99 describes Bush and Rumsfeld trying to push the military to come up with innovative solutions, the quote is from 135. The quote is Bob Woodward's formulation of Rumsfeld's thoughts about transforming the military while fighting a war.

then later to his staff.[66] This was not like Kosovo, where the strategic level had to approve all targets. However, it was not Desert Storm—the air component was not the one making the plans.

The Bush administration also had a difficult time getting the military and the CIA to work together smoothly. The NSC principals knew that the CIA and military special operations teams needed to work together hand-in-hand to accomplish the mission. In Bob Woodward's published account of his interviews, CIA Director George Tenet thought he was clear that the CIA paramilitary teams would work for Franks. Yet it appears Rumsfeld was not comfortable with the arrangement. He did not command the CIA troops, and wanted his own military troops on the ground.[67] In Franks' memoirs, he also recalls having been given control of CIA assets, including Predator.[68] But workers at CENTCOM knew that, given the unusual nature of this inter-agency arrangement, command authority stopped at the JFC. At the beginning of the war, only Franks could direct the CIA Predator.[69]

So the U.S. military deployed hastily to an unfamiliar area halfway around the world. The air component set up in its brand new facility in Saudi Arabia, and prepared to direct Navy and Air Force aircraft and work with CIA and Special Operations forces on the ground. But Franks spent most of his time in Tampa Bay, Florida. He was able to communicate with his component commanders by VTC and collaborative tools, so he only spent about 25% of the first three months in or around Afghanistan. Franks proposed that communications leaps "permitted us to provide intent and guidance without doing the tactical work of subordinate commanders."[70]

We will see later that the air component officers saw things differently. Commanded by the CFACC, Lt. Gen. Charles Wald, the air component planners felt they got very little strategic guidance but very much detailed direction. CENTCOM staff held the authority to approve targets in planning and during operations. It appears the initial decision by Rumsfeld to hold this authority created a precedent; even when he released that authority, the next in line assumed someone had to hold the authority for sensitive targets. This still meant that a staff officer, thousands of miles and several time zones away, held authority that air officers thought should have been delegated to the air component in theater.[71] This was symptomatic of the fact that policy-makers and military commanders had a difficult time defining a military strategy.

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[66] William M. Arkin, "The Rules of Engagement," *Los Angeles Times*, 21 April, 2002, accessed via latimes.com on 21 April 2002. Also Crowder email, and Bob Woodward, *Bush at War*, (New York: Simon & Schuster, 2002), 166. The exception was if CIA had bin Laden or al Qaeda leadership "in its crosshairs," according to Woodward.
[67] Woodward, 166, 193-4, 247.
[68] Franks, 290.
[69] Brett Knaub, Lt Col, USAF, 20 EBS/DO (worked in CENTCOM/J3 during Operation Enduring Freedom-Afghanistan), email to author, 5 November 2004.
[70] General Tommy Franks, USA, quoted in Thomas E. Ricks, "A War that's Commanded at a Distance," *Washington Post*, 27 December, 2001, A16.
[71] Deptula interview.

In the absence of an operational level strategy, those at the tactical level continued to work on the problems at hand. By the end of October, the ineffectiveness of the bombing campaign led the media to declare the U.S. and the coalition were in trouble. Then the CAOC workers, pilots, and "'boots on the ground" learned how to work together to achieve a devastating effect on the Taliban forces. In fact, the effects were so devastating that they transformed the overall military strategy and even the strategic objectives for the war. Gradually, the object became to support the Northern Alliance in a regime change, where originally the idea had been to coerce the Taliban into giving up its support of al Qaeda. Had there been more time to develop a diplomatic strategy, there were rifts in the Taliban that could have been exploited to achieve this effect without creating a power vacuum. As it was, teaming up with the Northern Alliance proved the only viable means to extricate the coalition from its strategic problems.[72] While higher level decision-makers were focused on tactical actions, these actions were re-defining strategy--not in a way that was incongruent with the overall vision of policy-makers, but in a logical evolution that nevertheless narrowed the options.

Unlike the Kosovo case, the problem in Afghanistan was not the failure of policy-makers and military commanders to work together. It was instead the inability to predict what the war would look like. This was not the case in Iraqi Freedom.

The objectives were clear from the beginning. Back in November of 2001, before Franks was even involved, Bush had told Rumsfeld they would "protect America by removing Saddam Hussein if we have to." Then in December, Rumsfeld sent Franks a two-page order to prepare a plan to remove Saddam, eliminate the threat of weapons of mass destruction (WMD), and choke off Saddam's support of terrorism.[73] Moreover, the U.S. and its coalition had clear conventional means at hand to accomplish these goals. The loss of the use of Turkish soil notwithstanding, the coalition had ample bases within reach of Iraq where it could station its aircraft, position a large invasion force, and set up supply lines and lines of communication. The policy goal of regime change was suited to a large conventional force operation. According to Franks, during December 2001, he and the NSC prodded each other on the details of the overall plan, so that the military strategy seemed to grow from and compliment the grand strategy.[74]

This was a process that would continue throughout the next year and a half. Franks began developing the military strategy and grand strategy concurrently. He and Rumsfeld talked frequently in

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[72] Carl Conetta, "Strange Victory: A Critical Appraisal of Operation Enduring Freedom and the Afghanistan War," Project on Defense Alternatives, Research Monograph #6. Woodward shows the same thing 149, 154, 174-5, 215, 234.

[73] Bob Woodward, *Plan of Attack*, (New York: Simon and Schuster, 2004), 30, 38..

[74] Franks' recollection of the 28 December, 2001 meeting on 347-356 is a good example. Franks proposed diplomatic options to the NSC members, who also probed him with questions about what he would do about the "fortress Baghdad" problem and WMD, each wanting to line up with the other's strategy.

Rumsfeld's office and over dinners—"grinding back-and-forth planning sessions" that both men called "an iterative process."[75] Rumsfeld tried to convey to Franks the subtleties of his concerns by constantly picking at Franks' plans. In his interview-based book on the planning for the Iraq war, Bob Woodward described Woodward as "a dentist's drill that never ceased."[76] Franks started with a sketch of what he called the " 'lines and slices' working matrix." Slices were the pillars that supported Saddam Hussein and his Baathist regime—the "foundations of Iraqi power"—and the essential elements of the Iraqi nation and its people. Lines were the operational tasks that the coalition could perform in the conflict, like "operational fires," "SOF operations," "information ops," and even "civil-military operations."[77] The matrix was a way of breaking down the complex job of strategy into the much simpler job of determining which slices were affected by which lines.

From this, Franks developed the military strategy. Again, it would have the familiar four phases: 1) preparation, 2) shape the battlespace, 3) decisive operations, and 4) post-hostility operations. By February, 2002, he envisioned five fronts in the operation: two simultaneous conventional assaults from Kuwait and turkey, special operations forces occupying the "Scud baskets" of the western desert, information and psychological information to erode the resolve of the Iraqi military, and an "operational fires" front focusing on Baghdad and the Republican Guard.[78]

In both the Afghanistan and Iraq wars, military strategy became more dependent on hitting fleeting or emerging targets. Just as Operation Iraqi Freedom was about to begin, the CIA established surveillance on Saddam Hussein in a hiding place in southern Baghdad. Meeting in the Oval Office, the President, Secretary of Defense, Secretary of State, National Security Advisor, and Chairman of the Joint Chiefs of Staff ordered a last-second change in the war strategy in order to make assets available for this opening strike.[79] "Time-sensitive targets" like this were only a small fraction of the overall number of strikes, although they drew a large amount of attention when they occurred.[80]

But during Iraqi Freedom, Franks got no second-guessing from Washington.[81] He and Rumsfeld had worked through the plans, and evidently Rumsfeld was satisfied.

Conclusions

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[75] Evan Thomas and Martha Brant, "The Education of Tommy Franks," *Newsweek*, 19 May 2003, accessed through Defense News Early Bird, 10 March 2004.
[76] Woodward, *Plan of Attack*, 98.
[77] Franks, 335-40.
[78] Franks, 376-7, sketch on page 396.
[79] Barton Gellman and Dana Priest, "CIA had Fix on Hussein," *Washington Post*, 20 March 2003, A1.
[80] The air component executed 156 "TSTs," which were targets specifically designated as such by Gen. Franks. These included terrorists, leadership targets, and WMD. In addition, there were 686 strikes on other targets, called "dynamic targets," using the same procedures but attacking targets that were not specifically designated TSTs by Gen. Franks. See Lt Gen T. Michael Moseley, "OIF by the Numbers," CENTAF – Prince Sultan Air Base, Kingdom of Saudi Arabia, 30 April 2003, p. 9. Available through Commanders Action Group, 9th Air Force, Shaw AFB, S.C.
[81] Thomas and Brant.

Carl von Clausewitz proposed that "the first, the supreme, the most far-reaching act of judgment that the statesman and commander have to make is to establish by [the nature of their motives and of the situations which give rise to them] the kind of war on which they are embarking; neither mistaking it for, nor trying to turn it into, something that is alien to its nature."[82] This is quite a demanding task, and one that its author claimed should be done in cooperation between the military commander and statesman. The balance to this statement is the recognition, attributed most famously to Helmuth von Moltke, that strategy is altered by tactical realities.[83] More recently, Eliot Cohen put it this way: "The act of waging war leads—in fact, forces—statesmen to alter their objectives and purposes, thereby frustrating those who hope to reduce strategic aims to checklists."[84]

That is why it is important to see Cohen's and Huntington's advice about civil-military relations as complementary and not conflicting. It is vital that policy reign supreme in the development of military strategy. It is also vital that the military strategy adapt itself to the situation. Only a continuing dialog between the policy-makers and the commanders will ensure this balance exists.

The evidence from this chapter supports this proposition.

In Desert Storm, the policy-makers set the objectives and let the military determine the strategy, but still overruled the military at points. There were times, such as the Scud Hunt, where the policy-makers had to step in to make sure important political considerations were addressed. The fact that Cheney stepped in here was in agreement with our preferred command and control theory; in making strategy, there should be a conflict between the political and military considerations and that conflict should be resolved by the policy-makers after careful consideration of the expert advice from the military. In fact, the absence of such conflict could be dangerous. Both Cohen and Huntington warn against forcing the military to insert political considerations on their own, a foul that Cohen says occurred in several cases in Desert Storm.[85] It may have occurred again in Bosnia, where Ryan appeared to take it upon himself to inject political sensitivities into the planning process. In that case, the result was success, so it is difficult to argue.

Instead of taking on this conflict in Allied Force, policy-makers used constraints on specific actions to keep the strategy in check. Absent was the back-and-forth discussion of strategy; in its place was a system for target approval that was supposed to ensure the military actions remained coherent with policy. This did not empower the military to adapt to the changing situations—the ethnic cleansing

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[82] Carl von Clausewitz, *On War*, edited and translated by Michael Howard and Peter Paret, (Princeton: Princeton University Press, 1989), 88.
[83] Moltke said "The demands of strategy grow silent in the face of a tactical victory and adapt themselves to the newly created situation. Strategy is a system of expedients." *Moltke on the Art of War: Selected Writings*, edited and translated by Daniel J. Hughes and Harry Bell, (Novato, Calif.: Presidio Press, 1993), 47.
[84] Eliot A. Cohen, *Supreme Command: Soldiers, Statesmen, and Leadership in Wartime*, (New York: The Free Press, 2002), 196.
[85] Cohen, 195.

continued unchecked. When combined with the conflicts in Bosnia and the No-fly Zone in Iraq, it may also have shaped the way the military thought about controlling airpower in the long term. It did, however, allow the policy-makers to control the nature of the war. The war was slow and ineffectual militarily but the NATO alliance outlasted Milosevic, who capitulated (to some extent) in the end.

The second Bush administration appears to have come down in the middle of the two previous methods. During Enduring Freedom in Afghanistan, the policy-makers held substantive discussions about military strategy with the military commander. That neither was able to precisely define the eventual strategy only reinforces the difficulty of the task. The policy-makers also sought to impose a few seemingly inane constraints on the type of targets that could be attacked. This actually forced the two levels to communicate during the ongoing operations—a practice that was soon ended when Rumsfeld delegated authority for these attacks to Franks. As a way to set a precedent for the amount of care to be taken, this was probably effective. But as we will see, it had far-reaching effects on the ability of the military to leverage command relationships. It does not fit our preferred method of combining a bruising discussion with empowerment and accountability.

By the time Iraqi Freedom started, the Bush administration and Franks had worked through these issues. We saw that the planning was still characterized by an intense debate between Rumsfeld and Franks. But this time there were no constraints that forced the theater commanders to check with Washington about an ongoing operation.

The degree to which policy-makers used constraints on specific actions or empowerment to control the military affected the way airpower was employed in both the long term and the short term.

In the long term, it taught the Air Force leaders lessons that they used to shape innovations in command and control. The small wars in the 1990s reinforced the fact that, now that airpower's stealth and precision made it a low-risk instrument, political leaders would be more willing to use it in situations where the U.S. interests were less than vital.[86] After suffering unexpected casualties in Somalia, the U.S. used airpower as a coercive tool rather than risk ground troops in both Bosnia and Kosovo. In both cases, the employment of airpower was restricted—in one case by the airman in charge and in the other by the political leaders and allied commander. Led by the new generation of fighter pilots who thrived on innovation, the Air Force took similar lessons from Bosnia and Kosovo and kept the pressure on to develop the capability to engage targets anywhere with high precision and low risk of collateral damage—exactly what the policy-makers were asking of it.

The Air Force leaders did this by developing the ability to get and process information from the field as quickly as possible—in the AOC. Desert Storm introduced the need to expand the TACC and

[86] Raymond O'Mara, Maj, USAF, "Stealth, Precision, and the Making of American Foreign Policy," (master's thesis, Air University, June 2002), gives an indepth analysis of this point. See his conclusions, 100-106.

formalize some of the ad hoc processes that had developed under Horner in the Gulf War. The Air Force developed this capability to the point where it built buildings from the ground up for the express purpose of acting as an AOC. It also built a special facility at Langley Air Force Base to act as a "reachback" center. The Air Force reorganized to put emphasis on the integration of command and control and ISR and to train its people to work in command and control positions. There has clearly been a trend toward increasing the ability of the AOC to use sensor-communications loops to make real-time decisions that would otherwise be pre-planned, left to the discretion of the pilots, or prohibited by ROEs.

In the short term, the relative mixture of constraints and empowerment affected the extent to which the military was able to develop depth in its command relationships. The next chapter will show how the type of strategy development and command relationships were affected by the type of constraints used by policy-makers.

Chapter 5

Command Relationships in the CAOS

On 27 July 2004, JEFX 04 was conducting simulations to give the CAOC operators practice prior to the deployment of aircraft. However, the people in the Time-Critical Targeting (TCT) Cell were frustrated. There had been several simulated Scud launches that morning, and the team had been unable to get permission in time to attack any of them before they moved. The TCT Cell team chief went to talk to the senior officer on the Operations Floor of the Combined Air Operations Center (CAOC), who chatted a message to the Combined Forces Air Component Commander (CFACC). In this chat session, he told the CFACC that the air component had been unable to target surface-to-surface missiles even when ground troops had spotted the launchers and strike aircraft were in the area because the coordination with other components and with the Combined Forces Commander (CFC) had taken too long. He suggested the CFC should make the CFACC the "supported commander" for these attacks.[1]

The next day, the CFACC informed them they had received permission to execute the requested change. From then on, launcher sightings were handled using a much abbreviated process, since the CFACC was the "supported commander" for this objective. Interestingly, as we will see later, this mirrors a change in procedures that occurred between Enduring Freedom in Afghanistan and Iraqi Freedom. Between the two, CFC Gen. Franks worked out many kinks in procedures mainly by re-aligning command relationships.

In fact, if we are to determine the impact of technology on the principles of centralized versus decentralized control, we must first realize the impact of other factors. Organizational factors are some of the most prominent. The organizations that make up the U.S. military are, as we have already shown, a disparate bunch. They have different cultures and work under different constraints, both of which shape the way they view the world, especially in terms of command and control.

Part of our definition of control was influencing others to act on command decisions. The CFC does this partly through organizing his components in a way that empowers them to accomplish the right missions. Chapter 2 proposed command relationships have always been one of the factors that determined whether the control of airpower was centralized. The issue for the Air Force (and, earlier, the Army Air Forces) was that there should be a single manager of airpower. Thus, to the Air Force the important thing is not "how" centralized the control of airpower is but "where" it is centralized.

[1] Author's personal notes, JEFX 04, 27 July.

This chapter will examine these issues by looking at the four major conflicts in our period of study. We will examine how command relationships were handled in Desert Storm, Allied Force, Enduring Freedom (including Operation Anaconda), and Iraqi Freedom.

The chapter will show there is a definite link between the way the components performed and the way they were empowered by the C/JFC. Throughout our period of study, the air component was most proactive about developing strategy when it was given the freedom to develop this strategy—to include targeting—at the air component. When the CFC set up organizational processes that took air strategy development out of the air component's hands, the air component became less proactive and coordination among the components suffered. The components kept innovating at the tactical level, but operational strategy suffered. Increased communications technology was no silver bullet for this problem—it took hard work on organizational relationships to solve it.

But command relationships went beyond the ability to plan operations. Ground and air forces from multiple components became integrated to an extent not seen before, and needed to find a way to use the strong points of each. In some cases it was beneficial to ignore global procedures and give as much discretion to those on the scene as possible. In other cases, this discretion meant no one was able to prioritize and allocate resources. The tighter the coupling, the more imperative it was to provide depth—to extend authority to the lowest level so someone on the scene had the ability to allocate resources based on good situational awareness.

Organizations and Command Relationships

In his book *Bureaucracy*, James Wilson proposed that it is nearly impossible for governmental bureaucracies to resolve the tension between trustful delegation and maintaining accountability.[2] Bureaucracies have inherent barriers that are purposefully manipulated in order to help the organization perform its functions. For example, there are organizational cultures, which are distinctive ways of seeing and responding to the environment. Often, as in the military, these cultures are formed by the actions of founders or heroes, whose stories are retold to keep their ethos alive. The culture becomes a mission, helping drive the members to action where they normally would not be inclined to act. It also helps reduce the amount of direction the leaders need to give, and provides a shared framework for analyzing information, reducing distortion of transmitted information.[3]

There have been many attempts to account for the differences among the U.S. military services in terms of origins, function, structure, or culture, and most seem to fall short. In one of the more famous efforts on the subject, Carl Builder tried to give labels to the service cultures.[4] In doing so, he failed to

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[2] James Q. Wilson, *Bureaucracy*, (New York: Basic Books, 1989), 370
[3] Wilson, 109.
[4] Carl H. Builder, *The Masks of War: American Military Styles in Strategy and Analysis*, (Baltimore: Johns Hopkins University Press, 1989).

analyze perhaps the most distinctive of the military services, the Marine Corps. He also suffered from unfortunate timing: he did his analysis before the effects of the Goldwater-Nichols Defense Reorganization Act and the transition to the "Fighter Generals" could be assessed.[5]

But if we disagree with the applicability of the particular labels Builder chose, or even the ability to choose labels, we must admit the services see the world differently. And although they all claim to do what they do in the interest of the national security, they all respond in ways that seem to protect their own assets. The concept of command probably produces the greatest disputes among the organizations in the U.S. military. We saw all but the Air Force resisted the concept of the JFACC—especially the Marines, who insisted on an Omnibus Agreement.

The reason for this is simple: it is one thing for a subordinate unit to submit to the direction of its superior commander; it is quite another to develop a lateral command relationship. Although the Air Force wings may desire a bit more autonomy in the planning of their missions, they generally agree with the concept of centralized control *by an airman.* After all, it is usually an *Air Force* airman. But if the JFACC wants to gain control of the Navy, Marine, and Army aviation, he will have to overcome extreme resistance.

The principle is similar when talking about components, as opposed to services. Air commanders see World War II as the proof that air forces should not be parceled out to ground commanders. The two mediums have spawned vastly different cultures that influence the way their members see command and control. Many scholars have linked this difference to the formative influence of theorists.[6] However, it is likely these theorists' writings were symptomatic as well as formative. The physical constraints of the mediums within which the forces do their work have much to do with the way they view war. Aircraft are relatively unhindered by terrestrial barriers and have the range (with refueling) and speed to go almost anywhere in a theater of war. The main concern of airmen is then ensuring the resources are prioritized on the most important objectives. Tying scarce resources like electronic warfare aircraft or ISR assets to an area risks not having them in the areas where they are needed. Only a theater-level view can overcome this. Ground forces, on the other hand, are subject to the terrestrial barriers. Because of these constraints, ground commanders must try to gain advantage by maneuvering in conjunction with firepower. The two are inseparable. The ground commander needs to be assured that he can place firepower and the other effects of airpower where and when they are needed.

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[5] Although many would point to the F-22 as another sign that the Air Force is continuing its marriage to the technology of the airplane, that would ignore the devotion to C4ISR that Gen. Jumper has shown.

[6] Kenneth Allard says the U.S. Army was influenced mostly by Jomini and Clausewitz, who emphasized the dominance of the decisive battle; while the Air Force was influenced by the writings of Douhet and Mitchell, both of whom emphasized the ability of air weapons to bypass ground combat and directly win wars. C. Kenneth Allard, Lt Col, USA, *Command, Control, and the Common Defense*, (New Haven, Conn.: Yale University Press, 1990), 11.

The different viewpoints of the services and components make it difficult to take full advantage of the technology that is available today. The same thing happened in the business world. In the 1980s, the infusion of information technology enabled bureaucratic rigidity, not decentralized decision-making. It was not until organizations started crossing the oceans and cultures that the full potential of networking was realized. Corporations had to learn to depend on a complex web of strategic alliances, subcontracting, and decentralized decision-making enabled by computer networks.[7] They are learning to outsource parts of their value chains to others who are more capable of performing a certain task.[8] In the same way, the ground, air, and special operations components and even the CIA have had to come to depend on one another in the recent wars. In some cases, it is acceptable, even necessary, for these forces to do whatever it takes to accomplish a mission. In others, it is important for them to adhere to global procedures. The command relationships have to be deep enough that there is some type of command presence with the situational awareness and communications capability to strike this balance.

So there are two problems integrating ground and air forces. The first is allocating the resources so the broader theater objectives—one of which is working with ground forces—are all supported in priority order. The second is determining how to leverage command relationships so interacting components can take full advantage of the capabilities when they need it most. These are both issues of command relationships.

Desert Storm

Chapter 4 made the claim that developing a policy that leads clearly and simply to a military strategy that leads clearly and simply to tactical actions that achieve the policy is not an easy task. In fact, it is not a serial task—policy and military action often interact to change each other as a conflict goes on. In a conflict where the strategic objectives are nebulous, this is most obvious. But even where those objectives seem clearer, strategy development is rarely straight forward. The chapter claimed the objectives in Desert Storm were clear and easily adaptable to military strategy. Yet in the beginning, it was not clear how to translate these into actions.

That is why, when Gen. Norman Schwarzkopf received a briefing from Air Force Col. John Warden on August 10, 1990, he was pleased. Saddam Hussein had taken Kuwait in three days, deployed the world's fourth largest army immediately across the border from Saudi Arabia, and held American hostages in Baghdad. Schwarzkopf had been meeting with President Bush, and saw that the president was concerned that the U.S. would have no viable options to back up the strong objectives Bush had set for them. Now Warden was in Schwarzkopf's office laying out in detail how airpower could defeat the Iraqi dictator in six days without sending American troops in on the ground. One of Warden's officers

[7] Manuel Castells, *The Rise of the Network Society*, 2nd ed., (Malden, Mass.: Blackwell, 2000, 177-8

[8] Based on Michael Porter's concept of the value chain, Prof. Stuart Madnick of MIT calls this "interlinking value chains."

recounted Schwarzkopf proclaiming "You've renewed my confidence in the U.S. Air Force."[9] Indeed, Warden's Checkmate office had shown remarkable initiative in coming up with a plan, piecing together strategic objectives from speeches by President Bush and other officials, at a time when everyone was in motion reacting to the surprise invasion of Kuwait.[10]

But the fact that the strategy had been developed by a single office in a single service and was briefed to the key players one by one created a conflict of its own. On 11 August, Warden briefed Chairman of the Joint Chiefs of Staff Gen. Colin Powell, who questioned the premise that airpower by itself would yield a satisfactory outcome. Although on the whole Powell was pleased with the effort, Harvey remembers him saying, "Your strategic air campaign cuts out the guts and heart, but what about his hands...I want to leave smoking tanks as kilometer posts all the way to Baghdad!"[11]

However, this was nothing compared with the reception the Checkmate team got from Lt Gen. Charles Horner in Riyadh, Saudi Arabia nine days later. On 6 August, Schwarzkopf had put Horner in charge of the forces in Saudi Arabia while Schwarzkopf went back to the United States to do the high-level coordination. From that moment until the briefing on 20 August, Horner had been consumed with getting forces into theater and establishing a working relationship with the Saudis.[12] An advance copy of Warden's briefing only served to make Horner more wary of the efforts going on in Washington.[13] The briefing by Warden and three others flopped. Horner accepted the plan as a starting point, but had serious questions about many of the targets and especially the overall concept of winning with air alone. He asked three of Warden's deputies to stay and help him plan, but extended no such invitation to Warden.[14]

Five days later, the plan was part of a larger CENTCOM plan. On 25 August, Schwarzkopf briefed Powell on a four-phase plan to eject Iraqi forces from Kuwait. The first phase was remarkably similar to the Instant Thunder plan—only without the intent to win the entire war through the strategic air attacks. The second phase was to gain air superiority over Kuwait, the third phase would prepare the battlefield by reducing Iraqi ground forces, and the final phase was a ground offensive into Kuwait.[15]

With this unprecedented opportunity for the air component, Horner built his organization around the adapted Instant Thunder plan. He established a top secret division, later called the "Black Hole,"

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[9] Ben Harvey, Lt Col, USAF, Memo for Record, 10 Aug 1990, CHP-7 in the USAF collection, AFHRA.
[10] Richard T. Reynolds, Col., USAF, *Heart of the Storm: the Genesis of the Air Campaign against Iraq*, Vol. 1, (Maxwell Air Force Base, Alab.: Air University Press, 1995), 53.
[11] Ben Harvey, Lt Col, USAF, Memo for Record, 11 Aug 1990, CHP-7 in the Desert Story collection, AFHRA.
[12] Tom Clancy with Chuck Horner, Gen. (retired), USAF, *Every Man a Tiger*, (New York: Berkley Books, 2000), 185, 190-233.
[13] David Deptula, Lt Col, USAF, SAF/OSX (Chief of Iraq/MAP Cell in Operation Desert Storm), transcript of interview with Lt Col Suzanne B. Gehri, Lt Col Edward C. Mann, and Lt Col Richard T. Reynolds, 23 May 1991, 33, K239.0472-82, Desert Story Collection, AFHRA (hereafter referred to as "Deptula 23 May 91 Desert Story Interview").
[14] Ibid., 47.
[15] Briefing, "Offensive Campaign: Desert Storm," HQ, Central Command, 24 August 1990, NA 208, GWAPS collection, AFHRA.

under Brig. Gen. Buster Glosson, and set the group to work developing the targeting strategy from Instant Thunder into an operations plan for war. There was no doctrinal basis for this organizational design—doctrine at the time specified only a Tactical Air Control Center (TACC) with four divisions: the Combat Operations and Enemy Situation Correlation Divisions for today's war, and the Combat Plans and Combat Intelligence Divisions for tomorrow's war.[16] There was no provision for developing strategy. Yet Horner set up this ad hoc organization and gave it tremendous authority within the overall air component. Later, on 5 December of that year, he formally reorganized CENTAF around the new division. The Black Hole became the Iraq Cell in the new Campaign Plans Division, while the Combat Operations Planning Division, which had built a plan for the defense of Saudi Arabia, became the Kuwaiti Cell (KTO Cell, which stands for Kuwaiti theater of Operations Cell). At the same time, Horner expanded Glosson's role by giving him command of the provisional air wing that included all Air Force fighters in theater.[17]

During most of Desert Storm, the Black Hole planners, who were now the Iraq Cell planners, had broad authority and minimal direction. Lt. Col. David Deptula, one of the three officers who had come with Warden back in August, became the principle planner. He described it as a "planner's dream" in that there were very few externally imposed constraints and limitations. "The principle guiding element was mission effectiveness...and accomplishing the objectives—which, in fact, we developed!"[18] Working in a top secret area where only a small group of people could enter, Deptula developed a document called the Master Attack Plan (MAP) that conveyed the air strategy as a list of attacks by specific weapons systems against specific targets at designated times. Glosson attended a meeting with Schwarzkopf each evening to explain the MAP and get Schwarzkopf's guidance. Glosson brought the guidance back informally and gave it to Deptula verbally. Then Deptula made any changes to the next day's missions or the following day's MAP. He also wrote an Air Guidance Letter to convey guidance (officially from Horner) to the other divisions about details that were not in the MAP.[19]

To determine what targets best accomplished the objectives, Black Hole planners reached out to establish contacts with other agencies. Warden continued to support them with Checkmate's extensive contacts at the NSC, the CIA, the Air Force Intelligence shop and the Defense Intelligence Agency in

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[16] Thomas C. Hone, Mark D. Mandeles, and Sanford S. Terry, Lt Col, USAF, "Command and Control," Part II, Vol. I, *Gulf War Air Power Survey*, (Washington, U.S. Government Printing Office, 1993), 131-133.
[17] Ibid., 185-9.
[18] David Deptula, Maj Gen, USAF, interview with author, 22 April 2004, recording in author's possession (hereafter known as "Deptula personal interview").
[19] David Deptula, Lt Col, USAF, SAF/OSX (Chief of Iraq/MAP Cell in Campaign Plans during Desert Storm), transcript of interview with Richard Reynolds, Lt Col, USAF and Edward Mann, Lt Col, USAF, 10 December 1991, 53-58, K239.0477-83, Desert Story Collection, AFHRA (hereafter referred to as "Deptula 10 Dec 91 Desert Story Interview").

Washington.[20] Secretary of the Air Force Donald Rice helped get information from U.S. and foreign contractors to analyze the target systems in Iraq.[21] Glosson had close ties with Admiral Joseph McConnell, the Intelligence director on the Joint Staff. But this was really an instance where those in theater were calling back to use the expertise and contacts of those in Washington—"Reachback."[22] The Black Hole reached out to pull all the information in and assemble it into a "big picture," the entirety of which was only visible in their top secret working area.

With this amount of ownership over the information, Deptula was able to create an extremely intricate plan. As he put it, the MAP was the "operational level 'blueprint' which tied the strategic level objectives to tactical level execution."[23] Normally, targeteers would apply weapons to a prioritized list of targets, destroying as many targets as possible with the available weapons. But this inevitably meant some lower-priority targets would not be attacked. Deptula and Warden saw the enemy as a system, and thought the best way to disable the system was to create effects across all target categories simultaneously. In Deptula's mind, it was better to achieve effects short of destruction on all the targets than to destroy some and not touch others. Failing to attack some of the lower-priority targets could nullify the effects of completely destroying the higher-priority targets. So he spread the scarce resources like F-117 stealth fighters across many targets, using only one or two per target instead of enough to guarantee destruction in the conventional sense. Still, the stealth and accuracy of these planes and their precision munitions made them very effective when used in this manner..[24] It was the first explicit use of "effects-based operations."

During the initial phase of the war, this detailed planning method seems to have been acceptable to most of the participants. The ground commanders were not concerned with the areas deep in Iraq. The attacks on Baghdad, while potentially helpful by disconnecting the Iraqi troops from their command and control, were out of their purview. Even the Scud Hunt, while politically sensitive, had little bearing on when the ground invasion could be undertaken.

But conflict gradually brewed. The JFACC was a new and untested concept of command. Now, not only had Schwarzkopf named a JFACC, but he had given that JFACC a large part in determining the war strategy. For the first three phases of the war, the air component was the only component fighting in

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[20] Deptula personal interview.
[21] Donald B. Rice, Secretary of the Air Force, transcript of interview with Lt Col Richard Reynolds, USAF, Lt Col Suzanne Gehri, USAF, and Lt Col Edward Mann, USAF, 11 Dec 91, TF5-1-52, Desert Story Collection, AFHRA, 5-6.
[22] Deptula Desert Story briefing, 25 and Deptula personal interview.
[23] David Deptula, Maj Gen, USAF, "Reflections on Desert Storm: The Air Campaign Planning Process," briefing, Version 8, dated 20 October 1998 (hereafter known as "Deptula 1998 briefing"). This is actually an updated version of the graphics Deptula used for the 1991 briefing referred to as Deptula Desert Story briefing.
[24] Deptula Desert Story briefing, 11, 14-16.

enemy territory, and the view of the enemy as a system worked just fine. But the ground commanders did not see the enemy this way.

As is normally the case in a conventional conflict, the ground commanders had been given separate areas of responsibility. During the planning for the land offensives, Schwarzkopf's staff tried unsuccessfully to buck this trend and integrate the services in a single attack. Graduates of the U.S. Army's School of Advanced Military Studies, nicknamed Jedi Knights, initially tried to use the Marines as a breaching force in advance of the Army attack. Schwarzkopf backed Marine Lt. Gen. Walter Boomer in shooting the idea down. He also rejected the next idea, to use the Marines in a "fixing attack" to give the Army a cover for its "left hook." The Marines were to be given their own area of operations and left to come up with their own plan of attack.[25]

Therefore, Marine air was destined to be focused on a geographical area instead of the enemy as a whole. The Marines already disagreed with the concept of the JFACC; now they had justification to demand control of their aircraft. Since Marines do not have much heavy artillery, they rely on—and are considered very good at—the cooperation of ground and air power. They deploy troops in a Marine Air Ground Task Force, complete with command and control systems and consider their air forces inseparable from their ground forces. Schwarzkopf's assignment of an area of operations made the Marines responsible for "shaping" this area so the eventual attack would be successful. Combined with the Omnibus Agreement, this was enough for Maj. Gen. Royal Moore, Boomer's air commander, to try and justify holding Marine air forces back from the JFACC.

Now Horner had to make a decision. As the plan was written, it was the JFACC's job to prepare the entire battlefield, and the air component wanted to use airpower in an integrated effort to do this. But the Marines' viewpoint was focused on the upcoming ground battles, not the air battles. Handing sorties over to the JFACC made the Marines nervous they would not be able to use them for CAS in the ground battles.[26] They began withholding more and more sorties from the targeting process. In the end, the air component planners realized the smart thing to do was to let the Marines perform any of the shaping that

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[25] Michael R. Gordon and Bernard E. Trainor, Gen (retired), USMC, *The Generals' War: The Inside Story of the Conflict in the Gulf*, (New York: Little, Brown, and Company, 1995), 159-63.

[26] After the war, in an article in the Marine Corps Gazette, one Marine major described why. Horner had always planned on executing the different phases of the air war as simultaneously as possible—the different phases were merely a way to convey them to a ground-centric JFC. The Marines took the phases literally. When it appeared the air campaign was entering Phase III—preparing the battlefield—but some Marine air was still being used to strike Iraq, the Marines grew wary that they would not get the use of their air even in the impending attack.. William R. Cronin, Maj, USMC, "C3I During the Air War in South Kuwait," *Marine Corps Gazette*, vol. 76, no. 3 (March 1992), 34.

had to be done in the Marines' area of operations.[27] Air Force and Navy aircraft could fly the remaining sorties elsewhere. This was possible because there was no shortage of non-Marine aircraft.

But the Army had some of the same concerns. As the air campaign progressed, Army commanders also became impatient for the air component to focus on the Iraqi units immediately across from them. On 9 February, 1991, Secretary of Defense Richard Cheney and Chairman of the Joint Chiefs of Staff Gen. Colin Powell met with Schwarzkopf and the component commanders. The subject was the date to begin the ground war. Deptula attended, and wrote in a memo afterward that he found it frustrating to hear Army colonels asking "When will we get 'our' air?"[28] With the ground war approaching, ground commanders were requesting the air component help them shape the battlefields for which they would be responsible. When they perceived the air component was not filling all the requests, they got upset.

But Horner was following orders from Schwarzkopf. Schwarzkopf had not designated a Land Component Commander; he basically fulfilled that role himself, so he had final say on where the air resources would be used. He chose to use the pre-planned sorties mainly on the Republican Guard units, even though this was not the way his ground commanders wanted it. The trouble was that the Army commanders were not privy to the meetings between Schwarzkopf, Horner, and Glosson on these matters. Horner remembers Schwarzkopf settling the matter one evening by telling air and ground commanders alike, "Guys, it's all mine, and I will put it where it needs to be put!"[29]

The JFC finally decided to lend some formal organization as the solution to this problem. He put his deputy, Gen Cal Waller, in charge of the target nomination process. Waller took all the target nominations from the corps commanders and prioritized them, and this was the list toward which the air component planned. Put in perspective, Horner claimed he was comfortable with the arrangement, because now instead of five or six lists, he got one—and it had a certain legitimacy about it.[30]

Horner thought the point was moot—he believed the best way to support the ground commanders was to create the ability to adjust the missions in real time. His planners were not concerned about the targets the ground commanders were nominating because they had made provisions to attack those targets in addition to the pre-planned targets. They sent interdiction missions to 30-nautical-mile-square

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[27] Corder interview, 24-9. Schwarzkopf himself weighed in to assure the JFACC would still be valid but the Marines would retain maximum flexibility for shaping the battlefield in their sector, Message, Personal Letter for Lt Gen Boomer, info Lt Gen Horner, Subject: Marine Aviation (U), 011330z Feb 91, Current Operations Log entry, TF4-11-199 in GWAPS Collection, AFHRA.

[28] David Deptula, Lt Col, USAF, memorandum for record, subject: "Feedback from SECDEF/CJCS Meeting with CINC and Component Commanders," 9 Feb 91, CHP-5A in Desert Story Collection, AFHRA.

[29] Horner Desert Story interview, 26, 55; Clancy and Horner, 451, 471-4.

[30] Horner Desert Story interview, 56-7.

"killboxes" to attack the fielded forces there.[31] Essentially, as with armed reconnaissance missions, the pilots became the sensors, decision-makers, and executors—a cockpit fusion cell. Later, when pilots had trouble finding the targets in the high threat environment, the aircrews came up with a concept called the "Killer Scout" that we will address later.

When the ground war started, the planners also made provisions to have aircraft available for the real-time CAS requests that they knew would emerge. Horner had crafted a concept he called "Push CAS," where a steady stream of aircraft would fly to the battle areas. If the ground troops needed them, they performed CAS. If not, when replacements came, they went to a pre-assigned target. The difference between interdiction and CAS was whether the mission occurred within a designated area close to the ground troops. The boundary to this zone was the Fire Support Coordination Line (FSCL). Aircrew flying short of the FSCL had to be under the control of the ground troops; those long of the FSCL were sent to kill boxes.[32]

But there was sufficient depth in the command relationships to handle this allocation. It was ABCCC's job to route aircraft to the appropriate place and make decisions to re-direct the aircraft as necessary. An Air Support Operations Center (ASOC) filtered the requests from ground troops to prioritize them.

Notice the difference between the solutions in relation to the degree of coupling of the situations. When strikes were long of the FSCL, air and ground forces did not have to coordinate. The friendly troops were well clear, and the targets were not of urgent importance—they would affect the friendly troops later rather than sooner. These are loosely coupled situations, and Horner did not care whether the targets were pre-planned and provided by the ground troops or found by the Killer Scouts (although he thought the latter more effective if not efficient). But for the tightly coupled operations in the vicinity of friendly ground troops, the disparate forces needed a way to re-allocate resources. The ABCCC and ASOC were decision-makers in constant communications with those on the scene. Obviously, they could only mediate conflicts based on priorities and information received over the radio. They did not have access to a good picture of the battlefield, so their situational awareness was limited.[33]

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[31] "Concept of Operations for Command and Control of TACAIR in Support of Land Forces," 22 Feb 91, attachment 2, i-v, K239.0472-51, Desert Story Collection, AFHRA. (Secret) Information extracted is unclassified. Hereafter referred to as "CONOPS for C2 of TACAIR."

[32] Conops for C2 of TACAIR, 4, 7

[33] The Army used this arrangement to its advantage. The Army liaison officers onboard the ABCCC had access to the Army target list, which was usually different than the list the TACC had put out containing Schwarzkopf's guidance. They also received "pop-up" targets from Army commanders. The ABCCC crew made many decisions about which targets to strike, so the Army priorities often got two chances to influence the operations. After Action Report, 8th Air Support Operations Group, "Operations Desert Shield/Storm," 9, TF4-12-230, GWAPS Task Force IV Collection, AFHRA (hereafter known as "8 ASOG AAR"). This caused problems for the people in the TACC, who did not know what targets had been hit. Battle damage from these attacks was supposed to be relayed by the strike aircraft and Killer Scouts to the ABCCC, who would then pass it to the TACC. But poor communications and

Schwarzkopf and Horner were free to establish these relationships because the policy-makers had imposed relatively few specific constraints. Schwarzkopf was free to give Horner significant authority to develop strategy, and Horner was in turn free to release authority to his TACS. Horner also coordinated well with the land component. It is true ground commanders were not happy with their inability to influence the targeting, but their dispute was with their land component commander—Schwarzkopf. The air component set up Killbox Interdiction and Push CAS to support the ground commanders' immediate needs.

Allied Force

Chapter 3 proposed that, during the 1990s, the U.S. government had developed a pattern of using airpower to deliver short, hard knocks that had been relatively successful in containing, deterring, or even compelling adversaries in Bosnia and Iraq. So when the U.S. detected intransigence from the Serbs in 1999, they sought to deliver the same type of treatment that had been successful before.

Thus, on 24 March 1999 when the war started, there were no plans for a sustained effort to accomplish strategic objectives. There was instead a target development and approval process. Where in Desert Storm Schwarzkopf had initially let the Black Hole develop the targets, supported by informal contacts in Washington, now Gen. Wesley Clark's staff directed the process and the intelligence network was formalized. Clark gave guidance to set the intelligence community in motion to obtain information on appropriate targets. Then the Joint Analysis Center (JAC) at RAF Molesworth in England validated the targets and posted the materials (messages, imagery, etc.) on its servers. The Navy (for Tomahawk missiles) and Air Force planners took the information and created target folders that were then visible on a secure network worldwide. They also created special "POTUS" slides for President Clinton, outlining the target and the options for attacking it along with projected collateral damage estimates.[34]

This process was possible because of the development of web technology. On 3 March 1994, the Department of Defense had brought online a separate backbone router system to handle transmission of classified data. This system, the Secret Internet Protocol Router Network (SIPRNET), used the same protocols as the unclassified Internet and quickly became the preferred method of transmitting classified data among U.S. organizations.[35] Target folders could now be shared among all the participants in this process—all the U.S. participants, that is.

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a heavy workload meant the TACC often did not get information on the targets or the results of these strikes. Hone, Mandeles, and Terry, 318. The end result was that the Army BDA analysts could not verify that targets had been hit, despite the fact that they had the opportunity to influence the targets real-time.

[34] James Schneider, Myron Hura, Gary McLeod, "Command and Control and Battle Management: Experiences from the Air War Over Serbia (AWOS) (U)," progress report briefing, RAND AB-404-1-AF, 9 June 2000, 12. (Secret/Noforn) Information extracted is unclassified.

[35] "Secret Internet Protocol Router Network," Federation of American Scientists, n.p., online, Internet, available at http://www.fas.org/irp/program/disseminate/siprnet.htm, accessed 20 September 2004.

Yet as formal as this process seems, it was the informal part of the process that caused the most headaches in the air component. Each day, Clark would convene video teleconferences (VTCs) to disseminate guidance and discuss issues. Because President Clinton wanted to have the ultimate approval authority for each target, Clark was held to a high level of accountability for the specific targets being attacked. So Clark used these VTCs to discuss the status of individual targets whenever that was necessary. That sometimes meant adding or deleting targets that were on the ATO for the next day.[36] For the air component, this was a problem, because each change affected many other missions because of the tanker and other support required. In addition, these changes were never documented in writing—the memories of the VTC participants were the only record. Air planners came to refer to these VTCs as the "1000 kilometer screwdriver."[37] Airpower analysts have pointed out the end result was that the focus of the air component became the prosecution of targets instead of the creation of effects to accomplish goals and objectives.[38]

This strategy debate soon devolved into an argument between Clark and his CFACC (for Combined Forces Air Component Commander), Lt. Gen. Michael Short. In the absence of ground troops, Short thought the way to get Milosevic to stop the ethnic cleansing and remove his 3rd Army from Kosovo was to hit him at home in Belgrade. He realized that without putting troops on the ground, NATO would not be able to cause enough damage to the Serb forces to cause them to go home.[39] But when Milosevic intensified his ethnic cleansing efforts after March 31, expelling over 400,000 people in a week, Clark saw the chance to step up attacks in Kosovo.[40] He did not yet have permission to increase the attacks in Serbia. Short knew that the USAF had neither the equipment nor the techniques for hunting down the Serb forces that were free to disperse and hide because they were not subject to an opposing ground force. U.S. Air Force A-10s, in theater for rescue efforts, tried to innovate but were extremely limited until the last two weeks of the war when a KLA attack forced the Serbs to mass in defense.[41] Short knew he could

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[36] "Command and Control and Battle Management," 18. Also Clark, 201-2.
[37] "Analysis of the Effectiveness/Efficiency of the Combined Air Operations Center," Vol. 2, Section 2, Focus Area 4:Command and Control, *Air War Over Serbia: Aerospace Power in Operation Allied Force*, 12 July 2000, 16-17. (Secret/Noforn) Information extracted is unclassified.
[38] "Command and Control and Battle Management," 19. Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment*, (Santa Monica, Calif.: RAND, 2001), 21 calls it a "continuously evolving coercive operation featuring piecemeal attacks against unsystematically approved targets, not an integrated effort aimed from the outset at achieving predetermined and identifiable operational effects."
[39] John A. Tirpak, "Short's View of the Air Campaign," *Air Force Magazine*, Vol. 82, No. 9 (September 1999), available at http://www.afa.org/magazine/watch/0999watch.html, accessed 10 December 2003.
[40] For refugee numbers, see the slides "Daily Refugee Flow" and "Total Refugee Flow" from the May 13, 1999, NATO briefings, n.p., internet, http://www.nato.int/pictures/1999/990513/b990513d.gif and e.gif.
[41] Dana Priest and Peter Finn, "NATO Gives Air Support to Kosovo Guerrillas," Washington Post, 2 June 1999, A1. Gary Crowder, Col, USAF, 505 CCW/CV (Deputy C-3 in Allied Force) interview with author, 28 July 2004, notes in author's possession,

not "win" using these methods. Clark knew he could not "win" without them.[42] Milosevic's strategy of ethnic cleansing gave NATO the opportunity to stay on high ground, as long as NATO was seen to be trying to do something about it.

It added up to an odd situation for the air component. Just like in Desert Storm, they were the only component fighting in enemy territory. But this time, they were not allowed to develop the strategy themselves. They could not develop a systemic view of the enemy and then dismantle that system in order to achieve strategic objectives.

So the air component had to look for ways to do a job for which they had not prepared. The long campaign against the Serb army was unexpected, as was the difficulty finding and destroying mobile surface-to-air missiles (SAMs) that the Serbs would not use in order to keep hidden. But here they were in a 78-day conflict, the Serbs were refusing to radiate with their mobile threat radars, and the Serb army was the most wanted—and least restricted—target set. They had to take action. The quest to hit moving targets was, in the beginning, an attempt to take the fight to the Serb army in the daytime.[43]

In April, Short established a "Flex Targeting Cell," that was really two cells in one. The Integrated Air Defense System (IADS) Targeting Cell, under the C-2 (Deputy for Intelligence) attempted to fuse intelligence to find and destroy the elusive threat SAMs. The Fielded Forces Attack Cell, under the C-3 (Deputy for Operations) attempted to find and destroy the Serb forces that were carrying out the ethnic cleansing campaign. On April 14, the planners finally established a "Kosovo Engagement Zone" (KEZ) to allow the attacking aircraft to engage targets of opportunity. The KEZ was similar to "killboxes" that had been used in the past (including Desert Storm) to destroy armies in the field. Only now the army was not in the field but hiding in amongst the civilians and under camouflage. Suddenly, A-10s that had been brought to the war for the sole purpose of conducting search and rescue had a new mission—they were the Forward Air Controllers (FAC-A, for "airborne").[44]

In this way, constraints from the strategic level determined the amount of authority the air component could exercise in developing strategy. The constraints from the strategic level were that 1) there would be no ground troops, and 2) the policy-makers would control the target approval process. This led Clark to put the emphasis on attacking Serb ground troops with airpower and to take a personal interest in the fixed target selection. The result was that the air missions were overwhelmingly geared toward fleeting targets (due to their ability to hide and not mass for the defense)—IADS and fielded

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[42] Crowder interview.
[43] Crowder interview.
[44] "Command and Control and Battle Management," 36, 30 and Crowder interview.

forces. There were a total of 23,300 strike missions in Allied Force, directed at 7600 aimpoints associated with fixed targets and 3400 flex targets.[45]

With little empowerment and their focus narrowed to ongoing operations, the air component did not develop very deep command relationships. We will see that the CAOC became the defacto approval authority for the emerging targets that the FAC-As found in Kosovo. The pilots had to call back through AWACS or ABCCC, who in most cases functioned as radio relays for the CAOC.

But by using such constraints, the policy-makers had also transformed the war into a loosely coupled situation. There was no need to integrate air and ground forces. Air attacks were not allowed unless approved at a high level. The only time the situations became tightly coupled was when the aircrew tried to attack Serbs in the vicinity of civilians. The restrictions from the CAOC were developed to avoid these situations. Of course, these were the very times when the force was most needed to stop ethnic cleansing. If outlasting Milosevic was more important than stopping the ethnic cleansing, then the transformation to a loosely coupled situation was appropriate. If not, the constraints on ground forces and targets were a mistake.

Enduring Freedom

The Bush administration was determined to give the military more say in the way it fought. As we saw in Chapter 3, the NSC staff had numerous discussions with CENTCOM Commander Gen. Tommy Franks to come up with the strategy in the war. It was a difficult task. Secretary of Defense Donald Rumsfeld kept pushing Franks to come up with innovative options, but was frequently disappointed.[46] But in fairness to Franks, no one really knew exactly what to do or how to do it. In the beginning, the NSC staff thought only about exploiting cracks in the Taliban to cause them to break up. There was no formal call for actually helping the Northern Alliance overthrow the Taliban—there was too much risk in that.[47] It was not until later that this shift occurred.

So it is no surprise that the overall military strategy was the subject of controversy. In Franks' memoirs, he recalls crafting a four phase plan: 1) set conditions and build forces to provide the national command authority credible military options, 2) conduct initial combat operations and continue to set conditions for follow-on operations, 3) conduct decisive combat operations in Afghanistan, continue to build coalition, and conduct operations AOR wide, and 4) establish capability of coalition partners to prevent the re-emergence of terrorism and provide support for humanitarian assistance efforts.[48] He and

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[45] "Kosovo/Operation Allied Force After Action Report," Report to Congress by the Department of Defense, 31 January 2000, 87.
[46] Bob Woodward, *Bush at War*, (New York: Simon & Schuster, 2002), 99, 129, 135.
[47] Carl Conetta, "Strange Victory: A Critical Appraisal of Operation Enduring Freedom and the Afghanistan War," Project on Defense Alternatives, Research Monograph #6. Woodward's interviews show the progression on 149, 154, 174-5, 215, 234, 264-7.
[48] Franks, 270-72.

his staff had discussed the options to accomplish these phases, and decided that there were also four: 1) a massive TLAM strike, 2) an air campaign consisting of a TLAM strike followed by B-2 strikes, 3) the same air campaign followed by special operations support to the Northern Alliance, and 4) option three followed by a large deployment of conventional American ground forces. As Franks recalls it, his position was "First we see what the Northern Alliance, with our help, can do. Then we use larger formations if we have to."[49] Combining the phases with the options, in retrospect it seems clear that the CENTCOM commander meant to use the air campaign and SOF/Northern Alliance options for Phase 2, and American forces for Phase 3.

Air component officers differed with this viewpoint—they were trying to be decisive from the beginning, on 7 October 2001. When CENTCOM sent out an order for Phase II on 1 November, the air component responded vigorously that the plan was flawed. Their comments claimed the order misrepresented what was going on and did not include a method to achieve any objectives in Phase II. They pointed out that the C/JFACC had the preponderance of assets carrying out the strikes and was the only one with the command and control systems to control them. Their position was that Franks should make the C/JFACC the supported commander for the phase and concentrate on fighting what was turning out to be a decisive, conventional war for control of Afghanistan. The failure to do so had resulted in disjointed operations, such as some special operations teams going in "without the training and equipment to effectively orchestrate the air support that they required."[50] In fact, as we will see later, the marrying of airpower with the Afghanistan opposition fighters through U.S. special operations liaisons on the ground turned the tide, allowing the coalition to completely wrest control of the country from the Taliban. Yet this was only Phase 2B in the CENTCOM order.[51] Of course, the war was not over when the Taliban was overthrown. However, less than two years later in Iraq, Franks would recommend President Bush call an end to "Decisive Combat" after the Ba'ath Regime was removed from power, even though the same tasks remained there.[52]

The point is that the strategy was anything but clear in the beginning, and Franks did not want to delegate the task of writing that strategy to his air component. The winning strategy evolved as the special operations forces began linking airpower with the Afghanistan opposition forces. The situation sounds similar to the one in Allied Force, except that in Enduring Freedom, unlike in Allied Force, the air component was ready to fight a sustained war. The complete organization was ready to work.

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[49] Franks, 259-61.
[50] Message, 011241Z NOV 01, USCINCCENT to COMUSARCENT et. al., SUBJ/CFC ORDER 002, PHASE II CONTINUED OPERATIONS (S/REL GCTF), and "Centaf Edits," (S/REL GCTF) in Task Force Enduring Look (TFEL) Collection, AFHRA, 11. Extracted material is unclassified.
[51] Ibid. Opinion on the victory comes from Anthony Davis, "How the Afghan war was won," *Jane's Intelligence Review*, February 2002, 6-7.
[52] Franks, 523-4.

It was therefore a source of frustration to the officers in the air component that they were given little authority to develop strategy. Now Brig. Gen. Deptula, the planner from Desert Storm who was given the freedom to develop the MAP using effects-based planning, became the CAOC Director in Afghanistan. He was appalled that CENTCOM essentially issued targets to its air component, taking much of the planning out of the air component's hands.[53] F-16 pilot Maj. David Hathaway was in a similar position to the one Deptula had filled in Desert Storm, but found that his job as Deputy Chief of Strategy involved little strategy development. He felt the CENTCOM J-2 (Deputy for intelligence) was trying to force the air component to follow its strategy by releasing only a select few targets at a time.[54]

In fact, CENTCOM workers were struggling with the target development as well. Lt. Col. Brett Knaub, an Air Force officer working for Air Force Maj. Gen. Gene Renuart, Franks' Chief of Operations (J-3), crafted guidance each day that Franks would sign and brief to the component commanders during a daily VTC. The purpose of the guidance was to prioritize objectives for the next four days, but it also delved into specific targets. In fact, CENTCOM maintained the entire target list (joint integrated prioritized target list, or JIPTL) and decided which of the targets would be hit when. The air component still put together a MAP (now called MAAP for master air attack plan), but it was based on explicit direction from Tampa Bay.[55]

The fact that CENTCOM was the one to collect all target nominations, determine the priority of each, and decide what effort was to be apportioned to each was not lost on Deptula. He remembered the point in Desert Storm where this had occurred in response to ground commanders' perceptions that they were not getting "their" air. It seemed a misguided attempt to satisfy all players—one that, in his opinion, had failed in Kosovo and seemed to promise only the "suboptimization" of airpower.[56] Others pointed out that mixing guidance with such specific targeting details made the guidance too "complex."[57]

There are several possible reasons this occurred. It appears to be partly due to the ROEs. As mentioned in Chapter 3, the NSC staff had developed a category of "sensitive" targets for which the military had to seek approval. The military also had to seek approval to hit any targets which could be expected to cause moderate to high collateral damage. In Afghanistan, unlike in Kosovo, these strategic-level decision-makers did not hold the entire target approval process at their level. The restrictions were probably designed to ensure that proper diligence was used in avoiding excessive damage. And the

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[53] Deptula personal interview.
[54] David Hathaway, Lt Col, USAF, 20 FW/SE (Chief of Air Campaign Strategy for USCENTAF from June 2001 through September 2003) interview with author, 24 March 2004, notes in author's possession.
[55] Brett Knaub, Lt Col, USAF, 20 EBS/DO (worked in CENTCOM/J3 during Operation Enduring Freedom-Afghanistan), email to author, 22 September 2004.
[56] Deptula personal interview.
[57] Gary Crowder, Col, USAF, 505 CCW/CV (basically a Senior Offensive Duty Officer in Afghanistan between 7 October-28 November 2001), email to author, 22 September 2004. As we will see later, then Lt Col Crowder played a big part in development of CAOC tools and operations during OEF.

authority was delegated to Franks soon after the war started. But the precedent had been set: targeting was to be watched carefully by the highest levels.[58] Thus, it was predictable that Franks' staff would be heavily involved in the targeting.

An unusual command structure also contributed to the consolidation of decision authority at CENTCOM. Remember, Franks thought "decisive operations" would not occur until later. But the war became decisive early, and the U.S.-led coalition had no land component in this largely conventional war. Although much has been made of the unprecedented cooperation between special operations troops and airpower facilitated by sensors and precision weapons, the fact remains that the airpower was still largely in support of conventional troops on the ground. One analyst called it a "surprisingly orthodox air-ground theater campaign in which heavy fire support decided a contest between two land forces."[59] When the air effort is in support of the ground effort, normally the air component is made the supporting component and the ground component is the supported component. This was not possible, because the ground had no representation. The troops were the anti-Taliban forces, who had little firepower and thus relied on the U.S.-led coalition's airpower. But they were not under Franks' command—he could only coordinate with them. The special forces troops were his means to do that.

But the special operations forces also contributed to the unfamiliarity of the command structure. There were two Joint Special Operations Task Forces—one in the northern part of the country and one in the southern part.[60] Although these forces eventually all had tactical controllers, they did not have the command and control capability that conventional forces bring with them. They did not have an ASOC with the ability to see the ATO and determine which sorties were available so they could prioritize. They could not allocate resources, they could only call for and provide terminal control for them. So the air component was the component providing the bulk of the force and the ability to command and control that force, but they were not in contact with the ground forces except through the special forces troops.

The CIA was another wrinkle in the command structure. We saw earlier that the CIA had agreed to work for Franks, but that the authority to command and control the CIA Predators stopped here. The unusual nature of this arrangement and the discomfort it caused at the top led CENTCOM to hold authority to coordinate with the CIA at the staff level in Tampa Bay, Florida.

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[58] Knaub lent credibility to this line of reasoning with his assertion that the strict ROEs were the major cause of the extremely centralized process, 22 September and 5 November emails.

[59] Stephen Biddle, "Afghanistan and the Future of Warfare: Implications for Army and Defense Policy," (Monograph #ISBN 1-58487-107-5, Strategic Studies Institute, U.S. Army War College, November 2002), 6, available at http://www.carlisle.army.mil/usassi/welcome.htm.

[60] Marcel Benoit, Capt, USAF, Jason Miller, Maj, USAF, and Steve Gregg, Maj, USAF, 19 SOS (Benoit was an EWO on AC-130H Gunships during OEF-Afghanistan, Miller was a pilot on AC-130H Gunships during OEF-Afghanistan, and Gregg was a pilot on MH-53J Pave Low helicopters during OEF-Afghanistan), personal interview, 28 May 2004, recording in author's possession.

Another possible reason CENTCOM kept decision authority at its headquarters is that the war was small and Franks did in fact have substantial technology to keep track of events. The first night's strikes were aimed at only 31 targets, using 50 Tomahawk missiles, 15 heavy bombers, and 25 attack fighters along with support aircraft.[61] During the first three months, there were rarely more than a dozen aircraft over Afghanistan at any given time, so people could watch the action on a map-like display projected on a wall in the CAOC. The Global Command and Control System (GCCS) had an application called the Common Operating Picture that showed a digital map of all aircraft (among other things) fused together from different sensors.[62]

The available sensors were also much improved. The combination of Air Force and CIA Predators, Global Hawk, JSTARS, U-2, RC-135, and satellites meant that the force had multi-spectral sensors with some pretty good endurance. The fact that the Defense Department had purchased all the commercial satellite bandwidth in the region on 12 September meant they could pass the information back immediately.[63] But it was the addition of ground troops that made the real difference. The CAOC and CENTCOM got unprecedented volumes of HUMINT because of the special operations troops operating with the Afghanistan opposition.[64]

The result of all this was that a great deal of the responsibility for the plans in the first months of the Afghanistan war fell to the CENTCOM planners. There were strict ROEs that led to a high level of accountability for targeting. Franks thought the initial stages would just be a period of setting conditions for U.S. troops to come in and win the war. When the Northern Alliance became surprisingly successful, Franks had no way to control the planning of this ground war from CENTCOM. He had an air component, but they were technically in support of this ground force, so he probably saw it as inappropriate to let them take over strategy. The special forces were divided and did not have the command and control capability to perform the role. The CIA forces were joined with the military only at Franks' level. So all lines led back to CENTCOM in Tampa Bay, Florida. Franks felt he had the ability to handle this situation, given the technology and the size of the war.

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[61] Marvin Leibstone, "War against Terrorism and the Art of Restraint," *Military Technology*, November 2001, 19.
[62] Throughout the 1990s, the Defense Information Systems Agency (DISA) had been working toward a Global Command and Control System (GCCS), using resources from the agency's Defense Information Systems Network. Like the WWMCCS before it, GCCS was supposed to be a White House-to-foxhole system incorporating off-the-shelf technologies as they became available. David E. Pearson, *The World Wide Military Command and Control System: Evolution and Effectiveness*, (Maxwell Air Force Base, Ala.: Air University Press, 2000), 339-40.
[63] Robert K. Ackerman, "Operation Enduring Freedom Redefines Warfare," *Signal*, Vol. 57, No. 1 (September 2002), 3-4.
[64] David Deptula, Maj. Gen., USAF, Director, OEF Combined Air Operations Center, "Operation Enduring Freedom—Highlights, Challenges, and Potential Implications: Some Observations from the First 60 Days," briefing received by email from Maj Stephen Murray, 24 March 2004. (Hereafter known as "Deptula OEF Brief"). (Secret) Extracted material is unclassified.

But interaction between the different components of Franks' force appears to have been poor, despite the increased communications capability. Interestingly, people from different services who served at the same location seemed to develop a team attitude that sometimes overshadowed ties to fellow service members at other locations. Even as an Air Force officer, Knaub related that he found it difficult to defend some of the air component's actions to his CENTCOM coworkers at times.[65] Planners at CENTCOM thought the planners at the air component were following their own prioritites, not CENTCOM's. When Franks learned three leadership targets had not been attacked in the first round, he sent a message to Wald: "In the future pay attention to my priorities—priorities based on the needs of the joint team, not the desire of a single service."[66] But CENTAF planners insist that no sorties or targets issued by CENTCOM were ignored or changed, except for weather or maintenance.[67] Similarly, Deptula briefed that there was "seamless" and "unprecedented" cooperation among different services within the CAOC.[68] But as we saw earlier, the air planners thought CENTCOM was trying to do their job for them. They also thought they had very little insight into what was happening on the ground in Afghanistan. Officers in the CAOC overwhelmingly said that they were not able to receive information on where the special operations forces were or what their plans were in time to develop plans to help them—despite the fact that there was a special operations liaison in the CAOC.[69] A few days before the battle of Mazar-i-Sharif, Knaub found out there had been no planning for CAS in support of the anticipated Northern Alliance offensive. Although this is normally the job of planners at the CAOC, Knaub and other officers at CENTCOM took up the task and developed some phase lines to aid the controllers in calling for CAS.[70] It was not a job that Knaub wanted to take on—it was an important job he felt was being ignored because of a lack of coordination among the component planners. Yet with what we have seen, it seems almost inevitable that this type of coordination would have been done at his level, given that CENTCOM was the only level that could coordinate with all the different players. This turned out to be a foreboding incident.

Operation Anaconda presented a graphic illustration of the potential problems that can result from the lack of integration among the components. The 17-day operation, starting 2 March 2002, was an attempt to surround and destroy remnants of al Qaeda who had escaped to the Shah-i-Kot region over the previous months. By this time, there was a Combined Forces Land Component, commanded by the CFLCC, Lt. Gen. Paul Mikolashek. On 12 December 2001, Mikolashek had created a forward command post in Karshi Khanabad, Uzbekistan, under the command of Maj. Gen. Franklin Hagenbeck.

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[65] Knaub email.
[66] Tommy Franks, Gen (retired), USA, quoted in Franks, 288.
[67] Comments on an earlier draft by David A. Deptula, Maj Gen, USAF, HQ PACAF/DO, email to author, 3 April 2005.
[68] Deptula OEF brief.
[69] Mark Cline, Lt Col, USAF, (MAAP Chief in Operation Enduring Freedom and Operation Iraqi Freedom), telephone interview with author, 11 November 2003, notes in author's possession, Crowder interview.
[70] Knaub 22 September 04 email.

Hagenbeck's 10th Mountain Division was supposed to provide force protection for some special forces there. But when al Qaeda leaders escaped after the battle for Tora Bora, Mikolashek put Hagenbeck in charge of planning and leading Operation Anaconda, designating him Commander, Combined Joint Task Force-Mountain (CJTF-Mountain) several days before the fight began.[71] This meant a drastic change of responsibilities for Hagenbeck and his staff.

The CAOS at this time did not have the depth in its command relationships to handle the switch from a tightly coupled to a loosely coupled situation. Hagenbeck had not deployed with an ASOC or a Tactical Air Control Party (TACP). Up to this point, the air support had been low volumes of time-sensitive targeting directed by the special forces. It was loosely coupled, so the lack of on-scene command presence was not fatal. In Anaconda there would be a requirement for classic support of troops in contact with the enemy. The control system and the ROEs were not set up to handle this.[72] Hagenbeck also did not have control over many of the special operations troops under CJTF-Mountain. He admitted later that the designation of CJTF was "more in name than reality."[73]

But Hagenbeck did not reach out for support from other components in the planning because he did not know he had a problem. Neither he nor Mikolashek's staff were familiar with the way the ROEs in this war shaped its character. Instead of linear control measures like the FSCL and phase lines with which the conventional Army was familiar, the battlespace control measures in Anaconda were a veritable "jigsaw puzzle" of areas of varying restrictions.[74] The ROEs stated that bombs could be dropped in one of three ways: with CENTCOM's approval, in a Joint Special Operations Area, or through the defensive reactions of ground controllers. In Anaconda, the forces would have to rely almost entirely on the third type, so the only requests that could be filled were those from ground controllers who were under fire.[75] Even though Hagenbeck knew he would get plenty of air support, he did not realize that it would all clash in a small area under desperate circumstances.

Worse, the air component was not advised of the plan for Anaconda until late in the game. Working level coordination between the air and land components did not start until 20 February, and it was 22 February before any flag officers in the air component learned of it. The 28-page operations order published on 20 February had six lines of guidance for the CFACC.[76] If there was to be any coordination, it would have to be done on the fly.

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[71] Elaine Grossman, "Army Analyst Blames Afghan Battle Failings on Bad Command Set-up," *Inside the Pentagon*, 29 July 2004, 1.
[72] Letter to the editors, Neuenswander, Col, USAF, "JCAS in Afghanistan: It's not all Bad News," Field Artillery, May-June 2003, available at http://www.findarticles.com/p/articles/mi_m0IAU/is_3_8/ai_103194043.
[73] Grossman, 1.
[74] Task Force Enduring Look, Operation Anaconda: An Air Power Perspective, (Washington: HQ USAF, 15 January 2004), 38-9. (Secret) Extracted Information is unclassified.
[75] Ibid., 32-3.
[76] Ibid., 29.

The air component was not ready to coordinate with the newly established task force. Inside the CAOC, the Army liaison—Battlefield Coordination Detachment (BCD)—had not been involved in the largely special operations-oriented fight to this point (recall that when they should have been, Knaub had stepped in to do the CAS coordination). We have already seen that the air component was not involved in development of the plans from the beginning, instead reacting to detailed guidance from CENTCOM. They were in a following mode, not a leadership mode. Shortly before the operation started, Air Force controllers at Hagenbeck's headquarters attempted to put together an ad hoc group of 15 controllers as a stand-in for the ASOC.

But it was too little, too late. There were more enemy than expected in the Shah-i-Kot Valley, and they did not retreat as expected. Hagenbeck was forced to issue an emergency appeal for air and naval fires and logistical assistance.[77] As we will see later, the ground troops were heroic, the airmen that responded were heroic, and the effort was successful. But we will also see that many of the actions were unnecessarily hazardous. Proper CAS coordination was lacking. There were no pre-planned aids to get aircraft in and out of the area efficiently and help the aircraft in finding targets. The ground commander had not coordinated through his liaisons at the air component to create initial points (IPs) that complemented the ground scheme of maneuver until it was too late.[78]

Enduring Freedom was another example of the trade-offs involved with control by constraints. There is evidence the NSC, especially Rumsfeld, tried to empower the military commanders to develop a strategy for the war. But the strategy was anything but clear. In contrast, it was very clear that targeting was to be given careful consideration and that the strategy was to include cooperation among the conventional military, special operations, and the CIA. These things were given high-level attention. The result was that all lines of authority met at CENTCOM headquarters in Tampa Bay. The air component was not empowered and there was little depth to the command relationships. This was fine in the beginning, when the players were loosely coupled. It was dangerous during Anaconda, when they were more tightly coupled. We will revisit the dangers in not having depth in times of tight coupling later. If the command relationships are truly deep, there will be a command presence with the authority to allow exploitation of opportunities during loosely coupled times, but the ability to tightly control procedures during tightly coupled times.

Iraqi Freedom

Between Operation Anaconda and the beginning of Operation Iraqi Freedom, the various players in CENTCOM put forth some hard work on the relationships among them. Analysts called Anaconda a

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[77] Grossman, 1.

[78] John M. Jansen, Lt Col, USMC, et. al., "JCAS in Afghanistan: Fixing the Tower of Babel," *Field Artillery*, March-April 2003, 24, 25-9.

"wakeup call" to establish common procedures for air operations.[79] Planners in Iraqi Freedom all commented that a major factor in their success was that many of them had worked together in Afghanistan, and most had practiced together for almost a year before combat began in March of 2003.[80] Air Force Lt. Gen. T. Michael Moseley, the CFACC during Operation Anaconda and future CFACC in Iraqi Freedom, worked with Gen. Franks to iron out the Command and Control relationships for developing air strategy and for executing air operations, especially TSTs.

The process for developing a military strategy for the Iraq war became a very joint process. Franks had worked with the NSC to define clear objectives and a strategy that included a much more obvious mechanism for victory—at least for the overthrow of the regime. He was prodded and debated by Secretary Rumsfeld, but in the end the plan was his. His five-front plan integrated land, sea, air, and special operations forces, defining the part that each would play in relation to the others. This was a "strategy-to-task" effort.

So each component got its part to plan, and then they sat down together to plan the integration. Now "strategy" for the components became a job of working with CENTCOM and the other components to make sure the objectives fit the capabilities and of breaking the objectives down into a list of tasks that each component would be called on to accomplish in conjunction with the others. When put together, all the air tasks comprised the air campaign plan. It was a job that Air Force Lt. Col. Hathaway, Moseley's Chief of Air Campaign Strategy, remembers as a tedious, time-consuming, but inherently joint process—not glamorous but definitely effective.[81]

One of the most joint of these tasks was to work with SOF to suppress Scud attacks from the western desert. Although the Great Scud Hunt in Desert Storm had sufficed to satisfy the strategic level at the time, the word was out that it had been unable to find and destroy the mobile Scuds. This time, the coalition would have to be militarily effective as well as politically effective. When President Bush asked Gen. Franks what the forces were going to do about the Scud threat, the Air Force got the responsibility to come up with a plan. Brig. Gen. Dan Leaf, who had been a wing commander during Allied Force, headed a "Kill Chain Task Force" designed to figure out how to find and engage the mobile Scuds before they could threaten the coalition. Leaf held live-fly rehearsals at Nellis Air Force Base, Nevada in October and December of 2002 and January of 2003 to smooth the working relationships which had begun in Afghanistan. By the time Iraqi Freedom started, the air component had a well-oiled machine to do time-

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[79] Sandra I. Erwin, "Air Wars Demand More Inter-service Coordination," *National Defense*, September 2003, 22.
[80] Karl Wingenbach, Lt Col, USA, TRADOC FC and John P. Andreasen, Lt Col (retired), USA, (both worked in the BCD in Enduring Freedom and Iraqi Freedom), interview with author, 21 May 2004, notes in author's possession, Cline interview.
[81] David Hathaway, Lt Col, USAF, 20 FW/SE (Chief of Air Campaign Strategy for USCENTAF from June 2001 through September 2003), email to author, 29 September 2004.

sensitive targeting.[82] They also had developed a plan to find the Scuds. They had studied the launch patterns in Desert Storm and laid out possible maximum and minimum ranges for the various missiles. They had observed the transportation system in western Iraq to identify "launch baskets," hide sites, and well as storage and maintenance locations where the SOF and other ISR assets could focus. Then they developed a plan to keep these areas under scrutiny using dedicated ISR assets and any fighter aircraft who had ISR capabilities.[83] But despite the planning, the targets were obviously not known until the operation began, so most of these missions were targeted in real time.

Of course, none of this could have been done immediately without air superiority. But in parallel with the planning effort, Saddam Hussein made it possible to gain air superiority in advance. Coalition aircraft patrolling southern Iraq in support of the U.N. resolutions from Desert Storm came under increased attacks starting in the summer of June 2002. Their response, designated Operation Southern Focus, was to increase the scope of attacks on Iraqi air defense and command and control capabilities. Although, as Lt. Gen. Moseley put it, these responses were made within existing ROEs and "never expanded attacks beyond what (were) necessary, proportional and authorized by the (commander in chief) in self-defense," they nevertheless dismantled a good portion of the Iraqis' air defense.[84] This made it possible for Moseley to concentrate on his other tasks.

During this same period, the components and CENTCOM worked hard on the air-to-ground targeting process. It was one of the things Moseley and Franks concentrated on before Iraqi Freedom. The resulting process called for the air component to run the Joint Guidance, Apportionment, and Targeting (JGAT) process that assembled all target requests and made recommendations to Franks about the guidance for the next couple days. CENTCOM still held a targeting VTC (called a Combined Targeting Coordination Board, CTCB), but it was an approval authority now—not a target development authority. Knaub, who still worked at CENTCOM, described it as a "more traditional (read USAF doctrinal) approach to the command and control relationship between CENTCOM and CENTAF."[85] In fact, during Enduring Freedom the CENTCOM intelligence shop had developed a way to feed CENTAF only the targets CENTCOM thought would satisfy the objectives. In September of 2002, at a conference at Camp Doha, Kuwait, the two camps met to hash out the differences, and the air component strategists were given the authority to develop enough targets so they could pick and choose those that best fit the air

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[82] Gary Backes, Lt Col, USAF, 705 TRS Chief of AOC Tactics and Innovation, interview with author, 27 May 2004, recording in author's possession.

[83] Briefing, "CTBM CONOPS and Execution Development, July 2002-29 January 2003," received from Kevin Glenn, Lt Col, USAF 30 IS/CC (Combat Operations ISR Cell Chief during Iraqi Freedom). (SECRET/ORCON REL USA GBR AUS) Extracted information is unclassified.

[84] T. Michael Moseley, Lt. Gen., USAF, quoted in Jason L. Haag, SSgt, USAF, "OIF Veterans Discuss Lessons Learned," Air Force Print News, 31 July 2003, available at http://www.af.mil/news/story.asp?storyID=123005347, accessed 1 October 2004.

[85] Knaub 5 November 04 email.

and space power strategy, including the ability to change targets during execution. It was a huge shift in Hathaway's eyes.[86]

The shift was evidence of a change of influence on Franks. Where in Afghanistan, Franks had relied mostly on the J-staff that worked with him in Tampa Bay, he now started deferring more to his component commanders.[87] And on this J-staff, Knaub perceived a shift from Franks' reliance on intelligence (J-2) to more confidence in operations (J-3). The move to put Moseley in charge of the JGAT process ran counter to the way things had been done in Afghanistan. In Afghanistan, Franks' intelligence staff, led by Army Brig. Gen. Jeff Kimmons, had been able to introduce targets almost at will. Now CENTCOM had to submit targets to its air component to be prioritized against the inputs of the components. The operations staff, led by Air Force Maj. Gen. Gene Renuart, had pushed for the move. When Kimmons' intelligence people tried to introduce targets directly anyway, Renuart came up with a special category of target called the Joint Critical Target—something that was not a TST but was critical and had to be interjected too late for the normal targeting cycle. Renuart kept the number of these targets down by requiring the intelligence staff clear them through him personally.[88]

Another sign that Franks was shifting more of the authority to his component commanders is the fact that he named Moseley the Space Coordination Authority for Iraqi Freedom. Franks could have kept this authority himself. Instead, two days before the war began, he gave the job to Moseley.[89] This allowed an unprecedented amount of cooperation between space and aircraft operators in Moseley's CAOC.

The shift carried over into ongoing operations as well. The CENTCOM "TST Cell" had been in the intelligence area, although run by Renuart, during Enduring Freedom. Between the two wars, Renuart pushed to get it moved out onto the operations floor and to make it more of a monitoring function. After Anaconda, intelligence people pushed for a Joint Fires Cell that would coordinate air and artillery fires

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[86] David Hathaway, Lt Col, USAF, 20 FW/SE (Chief of Air Campaign Strategy from June 2001 through September 2003), email to author, 21 March 2005. Hathaway related that CENTCOM got the idea the air component just wanted to blow everything up during Enduring Freedom, when the air strategists continuously pled for more targets. The air components strategists thought there would be a master target list that included some restricted and some prohibited targets. On the contrary, CENTCOM created separate restricted and prohibited lists, then gave the air component a smaller master target list that was CENTCOM's estimate of the best targets for the objective. At the September 2002 conference, the air planners pointed out they could theoretically destroy the entire planned master target list for Iraq on the first day. By the time Iraqi Freedom started, Hathaway had the leeway to develop a viable air and space power strategy with the available targets.

[87] Ibid.

[88] Knaub 22 September 04 email and 5 November 04 email. Briefing, "OIF Targeting CONOPS Update," 11 April 2003, file "030411_OIF_Targeting_CONOPS.pdf" in TFEL database, AFHRA. (SECRET//REL MCFI) Extracted information is unclassified.

[89] Elizabeth Rees, "Naming CFACC the Space coordination Authority in Iraq Proved Vital," *Inside the Air Force*, 5 September, 2003, 1.

right there on Franks' staff. Operations people fought against the idea, but lost. However, again Renuart made sure it was established out on the operations floor where he could oversee it.[90]

These changes led to a lot more buy-in from the air component than in Afghanistan. The opinions of the officers who had worked in the air component were that CENTCOM had been too involved in the details during Enduring Freedom, but that the relationship had been fixed by Iraqi Freedom.[91] In Afghanistan, officers high up in the air component claimed CENTCOM had not given any guidance, even though CENTCOM workers claimed they had given it daily; in Iraq, the air component leadership had a direct hand in crafting this guidance.[92] The difference was in the rank of the officers involved in coordinating the guidance, which probably indicates the guidance in Iraqi Freedom was less detail-oriented than that in Afghanistan.

The changes also seem to have empowered the component commanders and improved their relationships. This was the first war where the CFC established clear components (other than himself) for each medium of the fight: a land component, an air component, a maritime component, and a special operations component. But the air and land components realized they had not done a great job of coordinating during Operation Anaconda in Afghanistan. This poor showing seems to have been the impetus for establishment of a new liaison between the two: the Air Component Coordinating Element (ACCE).[93] These were teams of 6-10 Air Force people set up with ground elements at seven places throughout the theater. They were under Moseley's command, but were to work face-to-face with "Surface Commanders" to enhance the communication between that commander and the CFACC.[94] The most prominent of these was headed by Maj. Gen. Daniel Leaf, who worked in the headquarters of the Combined Forces Land Component Commander (CFLCC)—Moseley's ground counterpart, Lt. Gen. David McKiernan. This increased the collaboration between the two components early in the planning, and helped make adjustments, such as moving the FSCL, during the fighting as well.[95]

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[90] Knaub 5 November 04 email

[91] In Horner personal interview, the general expressed a very strong opinion that Desert Storm and Iraqi Freedom had been done well from the standpoint of JFC-JFACC interaction, whereas Kosovo and Enduring Freedom had been done very badly. Crowder and Deptula personal interviews also related that during Enduring Freedom they had seen no guidance from CENTCOM until late November; instead, CENTCOM had intervened in tactical events. In Hathaway personal interview, Hathaway stressed that, as we discussed above, CENTCOM had been trying to specify the targets during Enduring Freedom and were surprised to find during Iraqi Freedom that the air component had an effects-based methodology for targeting.

[92] Knaub 22 September 04 email.

[93] Amy Butler, "As A-10 Shines in Iraq War, Officials Look to JSF for Future CAS Role," *Inside the Air Force*, 23 May 2003, 1.

[94] "Air Component Coordination Element (ACCE) Concept of Operations (CONOPS)," USCENTAF, 13 November 2002, file "030329_CFSOCC-ACCE CONOPS_Mar 03 final.doc" in Task Force Enduring Look database, AFHRA.

[95] Tim Ripley, "Close Air Support: Closing the Gap," *Jane's Defence Weekly*, 2 July 2003, accessed via Current Defense News Early Bird, http://ebird.afis.osd.mil.

As Horner had done in Desert Storm, Moseley conceded that the Marines would use their aircraft primarily to shape the battlefield in their area. In fact, during the fall of 2002 he had prepared for this by convening a conference with top Marine generals to work out the command and control of Marine airpower. Without any formal written agreements, the generals worked out an arrangement that allowed the Marine air commander to tell the air component how many sorties the 1 MEF needed. The planners in the CAOC then allocated these sorties, arranged all the support for them, and sent it back out in the ATO. To make it work, Moseley insisted the Marines provide some of their best officers to serve as MARLO, one of whom became the CAS planner for the entire theater.[96] It was another example of working out relationships prior to the conflict to make the electronic collaboration run more smoothly during the conflict.

The relationships made it much easier to handle changes that came up. So when Franks called Moseley to tell him the ground invasion had to be moved up to 20 March, Moseley responded that the air component could support them with CAS, rather than moving its big effort, which was not scheduled to start until 21 March.[97] This meant the mischaracterized "shock and awe" airstrikes would not be the opening act of the war.[98] Moseley and Lt. Gen. David McKiernan, the Land Component Commander, also had personal contact, resulting in great trust between them that the air component would be there to support the land component's rapid push to Baghdad.[99]

Support for the land component in its invasion from the South was in fact the largest of the tasks for the air component. Through the first 21 days of Iraqi Freedom, over 15,000 of the 20,000 total sorties were dedicated to supporting the land component. This was actually two separate attacks. The U.S. Army's V Corps, under Army Lt. Gen. William Wallace, moved up the middle of Iraq west of the Euphrates while the U.S. Marines' 1 MEF, under Marine Lt. Gen. James Conway, moved up the coast toward Basra to secure the oil fields before heading to Baghdad. The Marines' Direct Air Support Center

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[96] T. Michael Moseley, Lt Gen, USAF, transcript of interview with Rebecca Grant, 1 May 2003, Prince Sultan Air Base, Saudi Arabia, Task Force Enduring Look Database, AFHRA. (Secret) Extracted information is unclassified.
[97] Franks, 439.
[98] The term "shock and awe" came from a book written about the potential of capitalizing on the techniques behind the planning and execution of Desert Storm, particularly the effects-based aspects of the Desert Storm air campaign. The book is entitled "Shock & Awe: Achieving Rapid Dominance," was written by Harlan Ullman and Jim Wade, and published in 1996—both confidants of the SECDEF and likely where the Office of the secretary of Defense picked up the term. When the press got a hold of the term it became a sound bite—however it is important to recognize that shock and awe as described in the book was NOT executed during the opening of OIF. In deciding how to accomplish the job of attacking Baghdad and the Republican Guard, the air component had come up with an aggressive but deliberate plan. But Hathaway recalls guidance came from Secretary Rumsfeld and President Bush that they were to do it more aggressively and with fewer ground forces—the idea was to allow the ground forces to move rapidly to Baghdad to preclude undesirable events like oil fires. Thus, the term "shock and awe" seemed appropriate to describe the act of knocking the regime off guard and never letting them catch up. Hathaway email.
[99] T. Michael Moseley, Gen, USAF, HQ USAF/CV, interview with Air University students, Maxwell Air Force Base, Ala., 4 February 2004, notes in author's possession.

(DASC) and DASC-A(irborne) handled the flow of air support into the 1 MEF sector while the V Corps ASOC handled the flow of air support into the Army's sector.

In a "lessons learned" conference after Iraqi Freedom, air component people pointed out that there had been a difference in the way the Army and the Marines directed the air support. Because of the speed of the attack, the FSCL was often pushed far out ahead of the ground troops. The Army handled all missions short of this FSCL as CAS, and required them to be controlled by the ASOC or a TACP designated by the ASOC. The Marines, on the other hand, chose to create another line called the Battlefield Coordination Line (BCL), which was closer to the ground troops than the FSCL. The Marine DASC opened up kill boxes further out than this BCL—so as a result, air support going into the Marines' sector had a greater chance of being sent to an open kill box than that going to the Army sector. To the aircrew, the difference in flexibility was so stark that pilots regularly requested to be sent to work with the DASC rather than the ASOC.[100]

The difference should have been predictable. The Marines were operating under their doctrine of "centralized command and decentralized control." Since they had de facto command of most of the air in their sector (due to the arrangement with Moseley), they were able to delegate the decisions on the details of the missions by letting the pilots operate freely in kill boxes as opposed to directing them through TACPs.[101] The Army, on the other hand, was trying to integrate air support with its artillery, which is longer-ranged than that of the Marines. Wallace called this "corps shaping," the effort to create detailed effects in his area and then synchronize the corps' maneuvers with its fires. To do this, Wallace had to be able to carefully choose the targets to attack and the weapons with which to attack them.[102]

The difference is in the degree of coupling the two services saw in these operations. To the Marines, beyond the BCL the efforts of the ground and air forces were not tightly coupled, and did not need to be closely managed. They preferred to decentralize the authority to find targets there and get as many aircraft through as possible. To the Army, the efforts of the ground and air forces were tightly coupled all the way out to the FSCL, because the corps' ability to maneuver depended on the fire support.

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[100] Briefing, "Task Force Enduring Look Lessons Learned," slide 48, from file "LLConf.pdf," Task Force Enduring Look database, AFHRA.

[101] Credit for this insight goes to Lt Col Dave Wilkinson, a Marine S-3 pilot who was a fellow at MIT while I was trying to earn my PhD. Email, Dave Wilkonson, Lt Col, USMC, 29 October 2005.

[102] Briefing, William S. Wallace, Lt Gen, USA, Commander, Combined Arms Center (Commander of Vth Corps in Operation Iraqi Freedom), "Joint Fires in OIF: What Worked for the Vth (US) Corps," 12 March 2004, received in digital format from USAF Air to Ground Operations School. Slide 12 claims the Iraqi 11 Div was at 84% strength before OIF, 81% after KI shaping, and 63% after corps shaping. The Medina RG Division, 96% before the war, was reduced only to 92% by KI, but to 29% by corps shaping. The Hammurabi Division went from 97% before to 73% after KI to 23% after corps shaping.

Aircrews were more closely managed, so Wallace had more visibility into the targeting, but aircrews related it took longer to perform a mission in the Army's sector than in the Marines' sector.[103]

In Iraqi Freedom, we have seen that all the players benefited from the "practice" of Enduring Freedom. The constraints from the strategic level had been eased. Franks shifted authority from his staff to the component commanders, such as giving the air component more authority in the targeting process. The component commanders had more clearly defined command relationships. They in turn were able to create depth in the command relationships by delegating authority downward. There were differences in the way the services controlled airpower, but they were suited to the situation and there was authority at a low enough level that the aircrews were able to adjust to each situation, despite the fact they had preferences for one over the other. In fact, the differences in the way airpower was handled from one sector to the other showed the flexibility that comes from having depth in command relationships.

Conclusions

This chapter has shown us the effect of the different ways policy-makers control airpower as an instrument of policy. In Desert Storm and Iraqi Freedom, where the military strategy was the result of debate between the strategic and operational levels, the CFC was able to empower the component commanders to take responsibility for planning their portion of the strategy. In Enduring Freedom, this same debate took place, but resulted in constraints that affected the ability of the CFC to pass authority downward. In Allied Force, there was no debate about strategy, and the constraints from the strategic level created paralysis at the operational level.

In those cases where the component commanders were empowered, they created command relationships that allowed them to pass authority even lower. Elements of the TACS were able to make decisions about allocating resources on the scene, so that in the tightly coupled situations there were strict global procedures and in the loosely coupled situations there was more discretion. As Wallace put it:

> "In fact, it is completely conceivable that we might put some of our artillery and attack aviation under the control of the CFACC [Coalition Forces Air Component Commander] for a specific task and purpose. For example, we might want to execute a surgical strike that requires the synergy of simultaneous attacks by, say, ATACMS, Army attack aviation and Air Force F-16s. We would put them under one commander for the attack and on the ATO. It doesn't matter who actually owns the munitions or aircraft as long as we whack the bad guys."[104]

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[103] Lessons learned from above, but also Richard Coe, Maj, USAF, AF/XORC (F-15E WSO during Operation Enduring Freedom and Operation Iraqi Freedom), telephone interview with author, 24 January 2005, recording in author's possession. It is difficult to tell which method was more "effective" because the data on the rate of destruction do not exist.

[104] Hollis.

The thing they were not able to do is to give these lower levels of authority the situational awareness to truly interlink the value chains of the components. The forces at the scene of battle were still following procedures based on supported and supporting relationships. But throughout the period of our study, airpower's roles showed a subtle change. The shift to hitting emerging targets rapidly and with great precision was accompanied by a concurrent shift toward acknowledging that airpower has the potential to affect the situation on the ground in areas that are remote from friendly forces. The Scud Hunt, the hunt for Serb forces in Kosovo, and time-sensitive targeting in Enduring Freedom and Iraqi Freedom all called on the air component to find ways to deliver precision firepower against enemy forces that did not necessarily fit typical mission molds like CAS or interdiction. In fact, the attempt to rapidly hit emerging targets became a process that could span the spectrum of missions from CAS to strategic attack.[105] It is often hard to put a name on a particular mission. This problem only grows more severe as the war grows less conventional and airpower is increasingly called on to do whatever fits the current situation: ISR, supply, humanitarian aid, or show of force.

The end result is a blurring of the lines that determine what type of control is appropriate in a given situation. Traditionally, joint doctrine has used geographical area to stipulate the difference between CAS and interdiction. It becomes harder to determine who is "supported" and who is "supporting."

In fact, it could change during the battle. It was almost a year later that the U.S. decided to launch an offensive on Fallujah for the first time since the war. Insurgents had basically taken control of the city and two weeks earlier they had burned some American contractors alive in their automobile. On the first night, 4 April 2004, an AC-130U Gunship crew was tasked to escort some Marines into the city. The Marines were moving slowly, so the Gunship crew did some reconnaissance ahead of them. When they returned, they saw shots being fired at a small group of 4-5 Marines that was trying to set up a defensive position. The Gunship was able to see about 60 people moving into positions behind houses about 150 meters away. They asked the Marines for clearance to fire, but the Marines were not confident they knew enough to give that clearance. The one acting as controller, callsign "Woody," started calling up his chain to get clearance. While waiting for this clearance, Woody started going through the nine-line brief to ensure they were ready to engage when the call came. About halfway through the brief, the

[105] David A. Deptula, Maj Gen, USAF, and Sigfred J. Dahl, Lt Col, USAF, "Transforming Joint Air-Ground Operations for 21st Century Battlespace," *Field Artillery*, July-August 2003, pages 23-5. Deptula called for a new mission area called Battlefield Air Operations (BAO).

enemy started firing rocket-propelled grenades (RPG) at the Marines, and immediately Woody called "cleared to fire, cleared to fire!"[106]

When the Gunship started firing, the enemy split into two groups. The Gunship crew fired at one group with the infrared sensor directing the 25 mm gun and fired at the other group with the television directing the 40 mm Bofors cannon. Woody was only able to see one group of enemy but both streams of fire, so he attempted to direct both guns toward the enemy he could see. The Gunship kept firing at both groups. When the Gunship's fire forced both groups to converge and then retreat, the Marines were very appreciative. After that night, Marines gave AC-130 Gunships immediate clearance to fire at their own discretion.[107]

To recognize the need to shift discretion from the ground troops to the aircrew, there would have to be a command presence with total situational awareness. This may not be possible right now, because it requires the ability to put together the information from both places to form a bigger picture of the world. The next chapter will look at the efforts of the CAOS to do this.

[106] Jason Goldberg, Capt, USAF, Joseph Valentino, 2 Lt, USAF, and Don Frazee, MSgt, USAF, (AC-130U copilot, EWO, and sensor operator in Operation Iraqi Freedom), personal interview with author, 1 June 2004, recording in author's possession.
[107] Ibid.

Chapter 6

The "Centre" of the CAOS

The history of command can thus be understood in terms of a race between the demand for information and the ability of command systems to meet it. That race is eternal; it takes place within every military (and, indeed, nonmilitary) organization, at all levels and at all times.

- Martin Van Creveld, *Command in War*

Wisdom is better than strength.
Nevertheless the poor man's wisdom is despised,
And his words are not heard

- Ecclesiastes 9:18 (NKJV)

The ability to put together information from various places to form a bigger picture of the world—that is what we said commanders need in order to make their decisions. The reason some analysts say centralized control is the way of the future is that commanders will be able to obtain perfect information. Let us look at the efforts to do this in the CAOC.

During a distinguished visitor tour at JEFX 04, guests got a briefing from every division in the Nellis Air Force Base CAOC. Each time, the major or lieutenant colonel giving the brief tried to show how they were incorporating the new initiatives. Each one included a short explanation of how machine-to-machine interfaces were changing the way they did their jobs. To the Strategy Division, machine-to-machine meant no re-keying of information from one plan to another. Information from the CFC or CFACC guidance was passed directly into the applicable areas of the sub-plans. To the Plans Division, machine-to-machine meant the information from the Joint Targeting Toolkit (JTT) was automatically transformed into the Master Air Attack Plan (MAAP) by the MAAP Toolkit. In the Combat Operations Division, machine-to-machine meant their databases would automatically be updated with the status of some of the aircraft via Link 16.

If we are to determine what effect technology is having on the CAOS, we must assess the ability of the people in the AOC (and elsewhere) to assemble information and make decisions. Air Force officials have put a lot of emphasis on developing this capability, to the point of calling the AOC a "weapon system."

The AOC has become similar to what Bruno Latour called a "centre of calculation." In his book *Science in Action*, Latour described the way scientists do "science." He said the scientist makes sense of the world by bringing it into the laboratory to manipulate it. The scientist takes samples from those in the field and tries to make them mobile, stable, and combinable enough to transport them to a place where he

can combine them with other types of samples to create a meaningful representation of the world. In this way, the scientist is able to "act at a distance, that is to do things in the centres that sometimes make it possible to dominate spatially as well as chronologically the periphery."[1] But Latour insisted if you want to understand science, it is not the thought process of the scientist, isolated in his or her office, that you need to study. It is what Latour called the "logistics of immutable mobiles," or the way the scientist gathers those samples and assembles them into a representation of the world to solve a problem.[2]

In this chapter, we will examine the way the people in the AOC did this. They acted on the "periphery" by turning plans into actions. Then they brought information about the battlespace back and attempted to assess what was happening so they could revise the plans. This is the purpose of Van Creveld's "directed telescope." The actions in this feedback loop became more automated as the information they dealt with became more digital. Still, assessing the aggregate results has been a weakness of the CAOS—just determining what happened was difficult, not to mention measuring results and comparing them to somewhat subjective goals.

But along the way, the AOC found this directed telescope was also useful for making command decisions about ongoing missions. This did not entail assessing the results before changing plans—merely reacting to the enemy whenever the opportunity arose. It required a simpler physical representation of the world—"where am I, where are my buddies, where is the enemy?"[3] Gains in ISR, information, and telecommunications technology along with new organizational procedures led to the shrinking of the time-sensitive targeting cycle. However, the information comes in from many sensor-communications loops and cannot be combined into one graphic picture. So they cannot be sent to those who do not have access to SIPRNET. Only those in a "centre" can view all the information on adjacent machines or applications.

Desert Storm

The air component in Desert Storm, led by the first ever JFACC, Lt. Gen. Charles Horner, became responsible for accomplishing some significant objectives. Warden's Instant Thunder had been such a powerful idea that it influenced Schwarzkopf to grant significant strategy-making authority to the air component. This prospect in turn influenced Horner to make the Black Hole an important part of the TACC, adding a longer range planning capability to it. Before Desert Storm, there had been nothing like the AOC of today. The TACS was directed by the Combat Operations Division in the TACC, which was housed in a portable, "inflatable bubble" shelter, the AN/TSQ-92. As its name implies, it was concerned with "tactical air control." Then, on Christmas Eve of 1990, after Horner's reorganization of the air

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[1] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society*, (Cambridge, Mass.: Harvard University Press, 1987), 232.
[2] Latour, 237.
[3] Robert Leonard, *The Principles of War for the Information Age*, (Novato, Calif.: Presidio Press, 2000), 36.

component, the Combat Operations Division, led by Lt Col Bill Keenan, moved from the bubble to the basement of the Royal Saudi Air Force Headquarters with the Black Hole and the rest of the TACC.[4] The authority that Schwarzkopf had delegated to the air component carried with it increased accountability that could only be maintained through a beefed-up organization.

But although the Black Hole was incorporated into the TACC, it was not well integrated. We can see this by looking at the process of creating the daily Master Attack Plan (MAP) and Air Tasking Order (ATO). Lt. Col. David Deptula was the principal planner responsible for the MAP. He used markers, pens, and pencils to mark the target locations on charts, one of which still hangs in his office today. But this graphic representation did not tell the whole story. It could not show timing and weapons. Deptula consulted pilots from different aircraft who helped him put together the types of "packages," or groups of aircraft, that would attack each target and which weapons they would use. Then he adjusted the timing so each would occur in the right sequence. When the MAP was complete, Deptula handed it off as a hard copy document to others who created target planning worksheets for each target on the MAP. This step added another level of detail and put the packages in a standard format that the ATO planners were used to dealing with. Finally, these target planning worksheets went to officers who set up the tankers and other support and then gave them to technicians to put them into the ATO, to be disseminated to the aircrews.[5]

This was the first point at which the information was input to a system that could distribute it electronically. It was the ATO planners' job to put the information from the target planning sheets into a system called the Computer Assisted Force Management System (CAFMS).[6] A CAFMS terminal was a desktop computer with a 12-inch monitor and dot matrix printer. The user manipulated data in templates: one for creating a new record, one for editing or purging an existing record, one for listing the results of a query. When a technician entered data, CAFMS stored it locally. One CAFMS system had up to eleven remote terminals which could share a database. But the air component needed five of these systems, with 60-65 local workstations and 47 remotes, to reach all the wings and elements of the Tactical Air Control System (TACS). It was February before software engineers created software patches to allow these five

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[4] Bill Keenan, Lt Col (retired), USAF, formerly 507 TACC/DO and Chief of Combat Ops in Desert Storm, interview with author, 26 March 2004, recording in author's possession.

[5] David Deptula, Lt Col, USAF, transcript of briefing to Richard Davis, 20 November 1991, TF-5-1-53, Desert Story Collection, AFHRA (hereafter known as "Deptula Desert Story briefing"), 19-20. (Secret) Extracted information is unclassified.

[6] David Deptula, Lt Col, USAF, SAF/OSX (Chief of Iraq/MAP Cell in Campaign Plans during Desert Storm), transcript of interview with Richard Reynolds, Lt Col, USAF, Edward Mann, Lt Col, USAF, and Suzanne Gehri, Lt Col, USAF, 22-23 May 1991, K239.0472-82, Desert Story Collection, AFHRA (hereafter referred to as "Deptula Desert Story interview"). (Secret) Extracted information is unclassified.

systems to use a common database.[7] But even then, the full ATO was visible only when all data was entered, and then only on the CAFMS terminals. To be useful, it had to be printed out in hard copy.

There was therefore no shared representation of the air strategy—no graphic picture of the way all the missions fit together to accomplish the objectives. The MAP and the corresponding brief to Schwarzkopf each night were Deptula's and Glosson's representation, but those outside the Black Hole were not familiar enough with the planning to share that awareness.

So when combat started, Horner's new TACC found it difficult to accomplish the complete control loop. Deptula's effects-based method required a fine level of adjustment to ensure the attacks remained integrated. Ideally, the planners would have continually adjusted the attacks based on the effects that actually occurred. They would have taken Horner's and Schwarzkopf's guidance and used it to filter through target nominations and battle damage assessments from the intelligence shops to determine what to target each day. Then they could have looked at all the available assets and orchestrated a coherent plan where each attack fed off its relative timing with the others.[8] The MAP would have been the result of all this processing.

But the existing technology and processes did not support such an elegant plan. The intelligence organizations were accustomed to using imagery to determine damage, not effects. They were also reluctant to release preliminary estimates before final analysis. The intelligence product that Deptula needed to form a new plan based on today's results arrived three days later. He needed it now.[9]

So he and the other planners started improvising. They spent a lot of time on the Combat Operations floor trying to listen to what was going on, so they would know what had gone as planned and what had changed. They had cockpit video from the attack aircraft carried in on C-21 aircraft and watched hours of film to determine whether the aircraft had struck their targets. As the war went on, they learned that the precision weapons were accurate enough to skip this step for some weapon systems. But just as importantly, they watched television news. If CNN showed the lights out in Baghdad, it did not matter how much damage had been done to the electrical targets. The effect was achieved.[10] Deptula's information did not come over datalink in a systematic way. It came from the informal links he was able to assemble from the sources within his reach.

Similarly, turning the assessments into operations was not an easy process either. Prior to the beginning of combat, the Black Hole had produced the MAPs and the ATOs for the first two days of the war. Horner did not want them to go beyond day two, because he knew that things would change and the

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[7] John Paul Hyde, Johann W. Pfeiffer, and Toby C. Logan, "CAFMS Goes to War," in Alan D. Campen, Editor, *The First Information War: The Story of Communications, Computers, and Intelligence in the Persian Gulf War*, (Fairfax, Va.: AFCEA International Press, 1992), 38-46.
[8] Deptula Desert Story briefing and Deptula personal interview.
[9] Ibid.
[10] Ibid.

TACC would have to react. He wanted the TACC to "learn to do chaos war."[11] However, since the Black Hole worked in a top secret area, many in the rest of the TACC had never seen a MAP before day two of the war. When the time came to assemble the third day's ATO on day two of the war, the rest of the TACC got baptized by fire when they were unable to translate the MAP into a working ATO in time. Maj. Gen. John Corder, whom Horner had charged with running the TACC after the reorganization, recalls telling them to send it out when it was 4 hours late and only 30-40% complete. He relied on the TACC Change process to handle the rest.[12]

Handling the changes was Keenan's job. He had 124 people, only a handful of whom were regular 9th Air Force staff. Most of the rest had not been formally trained in their jobs. But he was most concerned that they be current in their weapon system, so he rotated people in for weeks at a time. A notebook on the Combat Operations floor kept records of the standard operating procedures they used, but their experience from Desert Shield constituted the biggest source of expertise. They knew how to make changes: there was a change form that needed to be filled out and signed by Keenan, Col. James Crigger, Jr. (the Director of Operations), or Col. Al Doman (the Director of Combat Operations).[13] But there were many changes; if a target had been hit a day early, because of increased priority, the next Day's ATO would need to change. If a tanker or other support asset had maintenance problems, a whole chain reaction of changes would result. There were so many changes, unless it was an unusual request Keenan's people knew he would sign the change form after the change was already made—Combat Operations people did what they needed to do to make things work smoothly.[14]

They were hard-pressed to affect ongoing missions, however. They could not even really tell where all the aircraft were at any given time. The AWACS had a datalink called TActical Digital Information Link (TADIL) B that allowed them to link to each other. But TADIL B could only handle 100 targets at a time—too few for the TACC to show the whole picture. There was no software available to tie multiple TADIL B units together, so technicians slowed the update rate instead. Because of the slow update rate (in minutes), there was rarely a current picture.[15] Those in Combat Operations knew and accepted it.[16] It was so unusual to have an up-to-date picture from all the AWACS that when this did occur, on 20 February, there was a special entry in the current operations log: "An amazing even has just

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[11] Charles Horner, Lt Gen, USAF, transcript of interview with Perry Jamieson, Richard Davis, and Barry Barlow, 4 March 1992, HQ 9th Air Force, Shaw Air Force Base, SC, 13-14, K239.0472-94, Desert Story Collection, AFHRA (hereafter known as "Horner Desert Story interview"). (Secret) Extracted information is unclassified.
[12] John Corder, Maj Gen, USAF, transcript of interview with GWAPS Kurt Guthe et. al., 18 May 1992, 5-8, 14, TF5-7-124, v.30, GWAPS collection, AFHRA.
[13] Keenan personal interview. Notes, Barton, TSgt, USAF, 5 in TACC NCO Log, TF6-46-482, AFHRA.
[15] Tom Ruimerman, Link 16 System Program Office, interview with author, 5 May 2004, notes in author's possession.
[16] Keenan interview.

occurred: we were able to talk secure, direct to all four AWACS, simultaneously...we also had an air picture from coast to coast at the same time. Unheard of."[17]

Yet, as we will see, the TACC was drawn into the business of directing ongoing missions, especially during the Scud Hunt. There was no way for the aircraft to find the elusive targets on their own. They needed someone with sensor-communications loops to find the targets and direct them there.

The TACC people developed a "change cell." Lt. Col. Phil Tritschler had been an F-4G electronic warfare officer until his unit was closed down one year before Iraq invaded Kuwait. So when he received a call at Nellis Air Force Base to be the "Chief of Combat Operations," he gladly accepted the chance to get close to the action. Upon his arrival ten days before the war, Tritschler found that Keenan was the CCO and had requested an augmentee to "handle stuff" as it came up. In the front of the Combat Ops floor, immediately behind Horner's front row of seats, in the middle of a U-shaped section where Keenan sat, was a small group of tables. Tritschler co-opted these tables for the purpose of planning missions to hit emerging targets during the day.[18]

Most of Tritschler's job was to re-direct aircraft that had not yet taken off. When a target of opportunity popped up (such as a sighting of a mobile surface-to-air missile), Tritschler tried to identify aircraft that had not yet taken off who could accomplish the mission. But CAFMS was "a nightmare." It was not possible to go into CAFMS and determine which assets were available to re-task. So Tritschler gathered the fighter duty officers, support duty officers (for tankers and jammers), and intelligence officers around the change table. They laid a chart on the change table, plotted the location of the target, plotted the targets that potential aircraft were scheduled to attack (along with the type of weapons they would carry), then set up support aircraft and attempted to plan the mission.[19] The team translated a bunch of information from several sources into a single analog, graphic illustration on a chart.

In Desert Storm, Horner's air component was given the opportunity to play a large part in the complete control loop, from developing strategy to assessing and changing it. Horner re-organized the air component around this capability. But the logistics involved in getting and using the information to perform the entire loop were lacking. The Black Hole was unable to share its representation of the strategy, the MAP. They also found it difficult to obtain the information they needed to assess and adjust the strategy. In the meantime, those in the rest of the TACC had to adjust the day's operations without a good handle on the overall strategy. They were also called on to obtain and use information to directly

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[17] CENTAF TACC/CC/DO Current Ops Log, Vol. 2 of 2, 1030Z, 20 Feb 1991, NA-215, GWAPS collection, AFHRA. (Secret) Information extracted is unclassified.
[18] Phil Tritschler, Lt Col (retired), USAF, (Deputy CCO in Desert Storm), telephone interview with author, 24 September 2004, recording in author's possession. Keenan interview.
[19] Tritschler interview.

alter the ongoing missions during the Scud Hunt. Yet they were not able to get real-time information and turn it into actions.

Allied Force

Between 1991 and 1999, information technology and telecommunications technology both experienced huge innovations. It was during this period that the web took off—in October of 1994, the World Wide Web Consortium was established to develop web standards. 1994 was also the year that the Department of Defense established its Secure Internet Protocol Router Network (SIPRNET). We saw that the first Predator flew in Bosnia in 1995, and then in 1996 Secretary Widnall and Gen. Fogleman wrote their Air Force Vision 2010, incorporating ideas about information and space. Then in 1997, the Air Force founded its Aerospace Command and Control Agency, began the Expeditionary Force Exercise, and acknowledged the importance of ISR by incorporating it with command and control into C4ISR. By the time NATO decided to intervene in Kosovo, the world was a different place than it had been in 1991.

The technology available to the air component was also evolving. Contingency Theater Air Planning System (CTAPS) was a UNIX-based bundle of applications that was developed to try and create a "system of systems" that would allow the air planners to share data among themselves. The Air Force hoped this would eliminate the problem in Desert Storm where the Black Hole "dumped" the MAP on the ATO planners and they had to scramble to catch up.

Throughout this period, the organization of the AOC changed as well. The earliest construct for AOC organization was a model adopted in joint doctrine in 1994.[20] Despite the Desert Storm experience, it only specified a Plans Division and an Operations Division. There was no strategy or campaign plans division, and intelligence was a "horizontal" division that was split between plans and operations.[21] By 1998, Air Force doctrine included its own concept of the organization of an AOC. This concept included a Strategy Division to plan for future operations and assess current and past operations—closely resembling Horner's TACC after the reorganization.[22]

But as we have seen, the air component was not prepared or directed to exercise any such long-range strategy function at the beginning of Operation Allied Force. The planners have related high-level decision-makers' expectations of a short war affected all levels of preparation.[23] The organization was

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[20] Joint Publication 3-56.1, *Command and Control for Joint Air Operations*, 14 November 1994, C-3.
[21] Parker W. Northrup III, Lt. Col., USAF, "The Air Operations Center as a Weapons System: Thinking at the Operational Level of War," (Master's thesis, Air University, June 2003), 36.
[22] Air Force Instruction 13-1AOC, Volume 3, *Operational Procedures—Aerospace Operations Center*, 1 June 1998. Northrup, 37-39.
[23] Gary Crowder, Col, USAF, interview with author, 28 July 2004, notes in author's possession. Michael Rollison, Lt Col, USAF, interview with author, 28 July 2004, notes in author's possession. Crowder was the deputy C-3 and Rollison was the MAAP chief for Operation Allied force. Both recalled there was the expectation from very high up

not even set up to prosecute a sustained campaign. Lt. Gen. Michael Short had a Combined Air Operations Center (CAOC) at Vicenza, Italy, but it was not organized along doctrinal lines. Because this was a NATO organization, Short's organization was organized completely around a staff type organization, with C-X designations—C-2 for intelligence, C-3 for operations, C-5 for plans, etc. Unlike the USAF doctrinal version of the AOC at the time, the NATO version did not include a capability to do long-range strategy development. It was concentrated more on the day-to-day planning and the staff functions of getting forces to the theater and supporting them. In the USAF doctrinal AOC at the time, the CFACC was to have a separate staff to perform these staff functions, while the AOC people concentrated on running the combat operations.[24]

The air component did not have a mature process in place to plan, assess the plans, and turn the assessments into future plans. This can be seen through the eyes of those who had to try and put together an assessment of the actions of the air component. At first, there were only three people, who remained in Germany, designated to assess the results of the strikes. It was not until April 17 that three analysts from Germany deployed to Vicenza under Col Allen Peck, Short's C-5 (Deputy for Plans).[25]

According to these assessors, by that time the tools and processes had developed along divergent lines. NATO and U.S. planners used different, incompatible information systems. U.S. planners used CTAPS to put together the ATO, while other NATO nations used a system called Integrated Command and Control. But the U.S. used only a portion of CTAPS' capabilities, because they were used to processes for low level-of-effort wars like Deliberate Force and Deny Flight. At the beginning of Allied Force, the expectation was for much the same type of war. Many of the planners were unfamiliar or uncomfortable with all the UNIX-based applications in CTAPS and their products, and were unable to make the transition to a full use of CTAPS in the high-intensity war that developed. Even the ATO was (and still is) produced in a message format that was readable only by special parsers.[26] So as the war dragged on, the planners developed their own Microsoft Excel Spreadsheets, Word documents, and other tools to perform their own functions. Many were incompatible.

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that the war would only last three days. This agrees with James Ellis, Admiral, USN (Commander, Joint Task Force Noble Anvil during Allied Force), "A View From the Top," briefing, 15 October 1999.

[24] "Analysis of the Effectiveness/Efficiency of the Combined Air Operations Center," Vol. 2, Section 2, Focus Area 4:Command and Control, *Air War Over Serbia: Aerospace Power in Operation Allied Force*, 12 July 2000, 10. (Secret/Noforn) Information extracted is unclassified.

[25] Richard F. Bird, "CAOC Mission Assessment Trip Report (U)," 6 July 1999, 3, Vol. 2, Section 2, Focus Area 4: Command and Control, *Air War Over Serbia: Aerospace Power in Operation Allied Force*, 12 July 2000.

[26] "Analysis of the Effectiveness/Efficiency of the Combined Air Operations Center," 26. Also Jim Bradshaw, Lt Col (retired), USAF, interview with author, 25 March 2004 recording in author's possession. Bradshaw was in 9thAF from 92-96, and is now a contractor working on the technology in the AOC. He was part of a 3-man team who went to Saudi Arabia to help stand up the CAOC at Prince Sultan Air Base and then helped get it ready for Operation Iraqi Freedom.

These electronic incompatibilities were amplified by physical access problems. The assessors were located in a separate building that did not even have SIPRNET access until the end of the war. They were able to put together the products that guided the planning effort of the air component only by establishing personal relationships with the other cells in the CAOC. With these relationships, the assessors gained an understanding of the processes and inside access to the important products from each cell. They then took the information, converted much of it to Access format for manipulation, and created Power Point briefings to Short. The briefings showed him how many missions had been flown and aborted and why, what objectives the missions had been trying to accomplish, and the BDA status for each target.[27] This enormous task was the digital equivalent of collecting everyone's yellow stickies to create napkin-sketches of the progress of the entire air campaign.

The assessors had better sources of intelligence than in Desert Storm. Mission reports and, later, edited clips of gun camera video were available over SIPRNET. But the Joint Analysis Center (JAC) in Molesworth, England was responsible for performing all BDA assessment and was required to confirm every kill with two sources. In the end, BDA still was not timely enough to be useful in the time-constrained planning cycle.[28]

As we discussed previously, much of the attention in Kosovo turned to attacking fleeting targets. Lt. Gen. Short brought in Col. Ed Boyle, the commander of the Air Operations Group in Germany at the time, and a tiger team to figure out how to do the job. They came up with a "cell" that actually had three parts: an ISR cell, an IADS team located with the ISR cell in a Secret Compartmented Information Facility (SCIF), and a Fielded Forces team on the combat operations floor.[29] Their duties were actually rather different.

The IADS team worked in a secret fusion center. The team used signals intelligence when it was available and then attempted to send other platforms like the U-2 or Predator to verify the position of the threats with electro-optics, infrared, or synthetic aperture radar. There was always a possibility the Serbs would park the threat vehicles in an area where a strike against it could cause collateral damage. It was a cat-and-mouse game to find and attack the threats before the Serbs could move them.[30] But the very nature of the mission dictated it was not appropriate to have the strike aircraft loiter in the area to find the

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[27] "CAOC Mission Assessment Trip Report," 4-6.
[28] "Command and Control and Battle Management," 39.
[29] Andrew L. Caldera, Lt Commander, USN, Asst. Intel Officer for Battle Group Staff (Flex Targeting Cell Operations Officer in Allied Force), oral history interview summary sheet, AWOS stand-alone database, AFHRA. James Schneider, Myron Hura, Gary McLeod, "Command and Control and Battle Management: Experiences from the Air War Over Serbia (AWOS) (U)," progress report briefing, RAND AB-404-1-AF, 9 June 2000, 36. Also "Seamless Integration of Intelligence, Surveillance, and Reconnaissance is Critical to Rapid Target Destruction (U)," Vol. 2, Section 2, Focus Area 4: Command and Control, *Air War Over Serbia: Aerospace Power in Operation Allied Force*, 12 July 2000, 417. (Secret/NOFORN). Information extracted is unclassified. Hereafter referred to as "Seamless Integration of ISR".
[30] Caldera interview. (Secret) Information extracted is unclassified.

threats. This left the job to the scarce ISR aircraft. The IADS team found it difficult to cover the entire Kosovo and Serbia area with two slow-moving Predators and one U-2. Both U-2 and Predator imagery was sent back to RAF Molesworth to the Joint Analysis Center and then via transoceanic cable to the U.S. At Beale Air Force Base, California, analysts examined the data to cull useful information from it.[31] But it took a lot of trial and error before the IADS team was able to get the analysts to give them the information they needed in the format they needed, and getting the information sometimes took hours.[32]

The Fielded Forces Team did not have nearly the information processing capability that the IADS Team had. Sitting with the C-3 Operations people, they used the same information the other operations people did—the common operating picture (COP) to show updated positions of the aircraft and a graphic version of Deptula's MAP, now called the Master Air Attack Plan (MAAP).[33] Just the mere fact that they were able to see datalink information on the COP was a huge difference from Desert Storm. But the Flex Targeters were often were responsible for ensuring the ROEs were followed properly, including whether a target was valid. This ultimately entailed getting the information over the radio through several relays.

The picture in Allied Force is therefore one of only modest improvement. The technology to allow people from remote locations to view information existed in the form of web technology, so many different organizations were involved in the targeting process. This gave high-level decision-makers visibility into the details of the operations, forcing them to start choosing whether they should exercise this ability or not. But although there were information systems like CTAPS, they were not tailored for this type of war, and were therefore not used as designed. People in the CAOC had to devise their own procedures and information tools, making it difficult to assemble a picture of what was going on in the aggregate. The air component got deeper into the business of directing real-time operations, a function which now included the ability to get real-time information that many of the aircrews did not have. However, the resources that made this possible were scarce, so most of the time the only way for the Fielded Forces Cell to become involved in these ongoing operations was to receive the information over the radio from the aircrews. This was a function that would take on even more significance in the next conflict.

Enduring Freedom

In previous chapters, we discussed the fact that Gen. Tommy Franks and his CENTCOM staff were involved in the operational details of the war in Afghanistan. There were strict ROEs and complex command relationships that led Gen. Tommy Franks' staff at Headquarters CENTCOM in Tampa Bay,

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[31] Seamless Integration of ISR, 413, Robert E. Monroe, Maj, USAF, "A New Age of Armed Reconnaissance: A New Role for Predator (U)," (Master's thesis, Air University, April 2000), 8.
[32] Caldera interview. (Secret) Information extracted is unclassified.
[33] Crowder interview.

Florida to exercise their authority in some of the operational details. They developed the targets that the air component was to attack, and then held approval authority for many of the emerging targets.

They exercised this approval authority by monitoring ongoing missions from a fusion cell in a secure facility at Franks' headquarters. This fusion cell was basically CENTCOM's own "TST cell," manned by intelligence and operations experts, including Air Force Lt. Col. Brett Knaub. He had been involved in the initial setup of this cell, which was CENTCOM's link to sensor information like Predator video. Knaub's job was to monitor the intelligence analysis during missions and determine when there was a valid target, based on guidance from his boss, Maj. Gen. Renuart (the J-3, or Operations Chief). He then had to notify the appropriate decision maker, which was usually Renuart, although earlier on it could have been Franks.[34] The operation of this cell to direct ongoing operations was one of the things that contributed to the lack of empowerment at the air component.

The air component operated out of the new facility at Prince Sultan Air Base in Saudi Arabia. During JEFX 00, Gen. John Jumper, who was ACC commander at the time, had pushed to develop an AOC with a network that allowed coalition forces to work on the computers side-by-side with U.S. forces. When CENTAF people saw the plans, they wanted the same for the facility they were to build at PSAB. So CENTAF people sat down with Andy MacBrien, the Mitre lead engineer for the JEFX AOC. They showed him a Power Point presentation with 150 systems—that was the system design for the new CAOC. MacBrien pulled out his JEFX designs and tried to make the new facility similar. Although Gen. Ryan had declared the AOC a weapon system at the end of JEFX 00, there still was no configuration control, so this became the defacto standard.[35]

Between these two facilities, workers at Knaub's level kept up a steady stream of communications. Knaub kept up daily contact with officers at the air component. Majors Mark Altobelli and Mark Cline were in charge of developing the MAAP. One of the two talked to Knaub for hours each day ironing out the details of how to translate the guidance into plans for the air attacks.[36] They then developed a Microsoft Power Point brief for the JFACC, Lt. Gen. Charles Wald. This showed graphically what the air strikes would attempt to achieve for the next day. The MAAP still represented the link between the operational strategy and the tactical missions; but now the planners could portray it in a much more understandable, graphic way.

Cline and Altobelli had much improved technology to aid them in their tasks. In fact, the information technology involved had cut some formerly human tasks out of the process. CAFMS and

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[34] Knaub email.

[35] Andy MacBrien, Mitre Corporation, AOC lead engineer, telephone interview, 1 February 2005, notes in author's possession.

[36] Knaub email and Mark Cline, Lt Col, USAF, telephone interview with author, 11 November 2003, notes in author's possession.

even CTAPS had been so difficult to use that technicians had been specially trained to enter the information into the machines. But in EFX 98, 99, and 2000, the Air Force had certified the Theater Battle Management Core Systems (TBMCS), and the planners were using the new technology.[37] TBMCS was a group of applications that were designed to be interoperable and to fulfill the functions in the AOC. These applications retrieved information from databases that updated and were updated by the Global Command and Control System (GCCS). One of the applications was a MAAP Toolkit, a Windows-based program that allowed the planners to enter the information in familiar dialogue boxes. When they had entered the information, the MAAP toolkit automatically produced the MAAP brief and then transferred the information to the ATO.[38]

Planners said that these briefing slides represented their view of the world. Because it was a graphic picture of the ongoing operations, the MAAP brief was a favorite tool to show even the Combat Operations people what was occurring on a given day. But it was also a way to learn how the operations applied to the objectives to be accomplished, because it tied all the missions to those objectives.[39] In fact, this brief was so popular that a version of it got faxed out even to the air wings. It was much easier to understand than the ATO, which was sent out in a confusing message format.

The MAAP was only a "map" of ongoing operations—but Combat Operations people also had improved capability to see what was actually happening as well. At the time, Air Force doctrine showed ISR was the job of a "specialty team" that was to coordinate with all the divisions. However, the doctrine was being re-written to create a separate division for ISR, in recognition of the fact that the JFACC needs information but also has the job of providing information to the JFC and the other components.[40] Wald chose to organize a separate division for ISR, although it was housed in a separate building.[41] The Defense Department had arranged to buy up all the satellite communications bandwidth available for the

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[37] "EFX 98 Assessment Report," Executive Summary, internet, https://jefxlink.langley.af.mil/index.asp, accessed 11 December 2003. The report is unclassified, but in order to view it you must get permission from the Air Force Experimentation Office (AFEO).

[38] Cline interview.

[39] Deptula personal interview and Crowder interview.

[40] Air Force Doctrine Document 2, *Organization and Employment of Aerospace Power*, 17 February 2000 and Air Force Instruction 13-1AOC, Volume 3, *Operational Procedures—Aerospace Operations Center*, 1 June 1998 both showed only four divisions with ISR as a cross-cutting specialty team. Parker W. Northrup III, Lt Col, USAF, "The Air Operations Center as a Weapons System: Thinking at the Operational Level of War," (Master's Thesis, School Of Advanced Air and Space Studies, Air University, 2003), 39-40 explains the transition that occurred to the new construct of five divisions, codified in Air Force Instruction 13-1AOC, Vol. 3, 1 July 2002.

[41] Jeffrey Hodges, Col, USAF, AWFC/DO (TCT Cell Chief during Operation Enduring Freedom and Operation Iraqi Freedom), email to author, 28 December 2004.

region on September 12, and deployed the Global Broadcast System to move high-bandwidth traffic around—even to the U.S.[42] This was to prove especially useful in sharing sensor video.

Relative to the scope of the operations, the CAOS had a large number of sensors to bring back information from the battlefield. The use of Predator was much more prevalent in Enduring Freedom than it had been in Allied Force. Both the CIA and USAF had Predators flying in Afghanistan, and they were often used to find targets and direct aircraft to them. And the Predator video was available right on the Combat Operations floor, instead of only in the SCIF.[43] In fact, with JSTARS and RC-135 Rivet Joint aircraft working 24 hours a day, the CAOC had direct access to even better multi-spectral ISR than in Kosovo.[44] But most importantly, there were special operations forces on the ground with the Afghanistan opposition troops, so many times the air component would have direct access through radio to these "sensors" as well.

Information from these sensors became the driving force for air operations. For the first time, the air component had a "TCT Cell" at the outset of the conflict. Col. Jeffrey Hodges deployed to PSAB with CENTAF from his job at Langley Air Force Base. He was to be the chief of the TCT Cell for the air component. His team consisted of himself and four others: the Predator liaison officer, an ISR collection manager, and two targeteers. None of the team had been trained on any of the equipment, including TBMCS. They looked at the ATO or the MAAP briefing to see the planned flow of aircraft and an application called Falcon View to see where the aircraft were in real time. There were no written procedures for their task. Yet after the first week, they coordinated on almost every attack mission, as the ATO became merely a scheduling tool to get aircraft in the right area to wait for updated information from sensors or special operations forces.[45]

Most of the attacks still had to be coordinated at the same levels as the pre-planned missions—but faster. There was no doubt in Hodges' mind that CENTCOM was the decision-maker on most of the strikes. Only when the strike occurred within a pre-defined geographical area known as an engagement zone or when the aircraft was talking to a ground controller in the area could the mission proceed without CENTCOM's permission. Obtaining this permission was usually the long pole in the tent, sometimes taking hours. The TCT Cell coordinated with others in the CAOC by walking around to get signatures on a coordination spreadsheet or by chatting or talking to people on the phone. Since the Judge Advocate

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[42] Robert K. Ackerman, "Technology Empowers Information Operations in Afghanistan," *Signal*, vol. 56, no. 7 (March 2002), 18-19. Also Ackerman, "Operation Enduring Freedom Redefines Warfare," Signal, vol. 57, no. 1 (September 2002), 4.
[43] Hodges 28 December 2004 email.
[44] David A. Deptula, Brig. Gen., USAF, "Operation Enduring Freedom—Highlights, Challenges, and Potential Implications," briefing, received by email from 9th Air Force, 24 March 2004.
[45] Hodges 28 December 2004 email.

General was in another part of the building and the point mensurators were in another building with the ISR division, they walked around a lot.[46]

Because of the ad hoc nature of the operations, the air component was hard-pressed to translate the information from the "directed telescope" into an assessment of how things were going in the aggregate. Maj. David Hathaway and his Chief of Assessment, Maj. Stephen Murray, tried to link the missions accomplished to progress towards the objectives. They conducted what they called Operational Assessment each day for the JFACC, Wald and later Lt. Gen. Michael Moseley. Unlike in Kosovo, the assessors were located in the CAOC with the rest of the workers and had access to the TBMCS functions. But this did not make their job much easier.[47]

Their "directed telescope" was still far from automatic. The TBMCS functions still did not do everything the AOC workers wanted, so they reverted to producing customized documents besides. For example, there was a separate spreadsheet to track targets and results. CENTCOM and CENTAF were using two different databases to develop targets, and the two were incompatible.[48] Deptula had brought in Col. Gary Crowder to handle "operations stuff," and he went to work on this problem. To track all the targets, he and Hodges developed a Microsoft Excel spreadsheet to combine all the targets from both databases, retrieve information from the ATO to determine what missions were sent against specific targets, and then attempt to incorporate BDA where it was available from mission reports or intelligence.[49] Once again, the only way for the assessors to find out what was happening was to gain personal access to the people in various divisions of the CAOC.

Overall, it does appear that the CAOS was able to achieve a much improved ability to move and process information. The CAOC people were able to develop and share the MAAP much easier than in the past. However, long-range planning became futile as both commands seemed to be more focused on the ongoing missions, because that was the place where there was success. Headquarters CENTCOM and the CAOC both became "centres of calculation," trying to control the periphery. These two "centres" were able to get an unprecedented amount of information from the sensors relative to the number of aircraft over the battlefield. Some of the information was fed over the radio, but much was digital information that could be combined. The fusion cell and the CAOC saw a display of the real-time position of the aircraft right next to video from the sensors. But the time-sensitive nature of most of the operations made it more difficult to assess the aggregate results. The "centres" could change plans in real time easier than they could change the long-term plans.

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[46] Ibid.
[47] Hathaway interview and Stephen Murray, Maj, USAF, 609 CPS/DOXP (Chief of Assessment, USCENTAF), interview with author, 24 March 2004.
[48] Knaub email.
[49] Crowder email.

Iraqi Freedom

As described in Chapter 5, the process of developing plans evolved between Enduring Freedom and Iraqi Freedom. The air component was now in charge of gathering the different components' targeting requests and making an apportionment recommendation to Franks. CENTCOM still held a targeting board (CTCB), but now its purpose was guidance and approval of the air component's targeting recommendations—not stipulation of the targeting. Similarly, as we will see later, Maj Gen. Renuart worked to get CENTCOM to move its "TST Cell" from the SCIF out to the operations floor. Here it acted more as an overseer of the TSTs, rather than the decision-maker. Authority for most of the important emerging targets was pushed down to the air component.[50] In fact, Franks developed a formal matrix that defined who had the authority to execute the different categories of TSTs. For many of these, it was the CFACC.[51]

Moseley had forcefully argued for this change, so he had to organize and plan to handle it. But the innovations were already in progress. JEFX 02, also known as Millenium Challenge, had experimented with tools and procedures for performing TSTs. Among the tools was a system called the Joint Time-Sensitive Targets Manager (JTSTM), an application in an information system called the Automated Deep Operations Coordination System (ADOCS). ADOCS had been in use in a limited form in Korea for CAS and search and rescue. Then in the late 1990s the Defense Advanced Research Projects Agency sponsored ADOCS as an Advanced Concept Technology Demonstration—a modified pathway through the normally cumbersome military acquisition system. ADOCS was programmed to tap into the Global Command and Control System (GCCS) and TBMCS, among other databases.[52]

This was to be the first use of the full-up AOC weapon system that Gen. Ryan had started in 2000. The Block 10.1 Falconer at PSAB had achieved its full configuration, including TBMCS, various planning and reconnaissance management tools, and the time-sensitive targeting tools mentioned above.[53] Moseley increased the manning in the PSAB CAOC from 672 to 1,966, 43% of whom had received formal training through the AFC2TIG at Hurlburt field.

Although the ATO process and tools were mature, changes still caused late ATOs. The tools had been through Millenium Challenge and acceptance as the first block cycle of the AOC. The Air Force's emphasis on training increased the knowledge of the processes. In addition, the revised CENTCOM process meant that the MAAP was now a more relevant product—the air component now actually had a

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[50] Knaub email.
[51] Gary Backes, Lt Col, USAF, 705 TRS Chief of AOC Tactics and Innovation, interview with author, 27 May 2004, recording in author's possession.
[52] Sandra I. Erwin, "Experimental Battle-Planning Software Rushed to Iraq," *National Defense*, October 2003, accessed via Current Defense News Early Bird, http://www.ebird.afis.osd.mil. The part about
[53] Amy Butler, "Iraq War Underscores Need for Improved and Standardized AOCs," *Inside the Air Force*, 16 May 2003, 3.

hand in planning the airstrikes. Still, after the first week most of the strike sorties took off without targets. The decision-making inside the 72-hour ATO cycle increased the number of changes that had to be made, and the ATOs usually got out late.[54] The good news was that they were now easily transmitted to almost all participants.

The air component was also able to better coordinate the space support they needed. Previously, we identified the fact that Moseley was designated the Space Coordination Authority just prior to Iraqi Freedom. This allowed the air component to synchronize the ATO with a space tasking order (STO). The ATO told the space operators in the CAOC when the critical times were for GPS accuracy, and the STO specified how to tweak the constellation to achieve greater accuracy. For critical periods, the 28-satellite GPS constellation was configured to reduce the normal 3.08 meter accuracy to 2.2 meters.[55]

Other parts of ISR were beefed up as well. The air component was able to fly a record number of ISR sorties and obtain multi-spectral feedback using electronic, infrared, electro-optical, radar moving target indicator (MTI) and synthetic aperture radar. The "records" come from the fact that there were four Predators flying simultaneously and six U-2 flights on a single ATO.[56] People in the ISR division could view imagery and reports from these sensors and chat online with analysts about their interpretation in near real-time, even though the analysts may have been in the U.S. In May 2002 the Air Force had approved "remote split operations" by Predator units, which allowed about half of the 15 Predators in the theater to be operated from the U.S.[57] The aircraft took off and landed in theater, but the Predators were flown by operators in Nevada. U-2 sensors were directed by analysts at Langley Air Force Base in Virginia, where both Predator and U-2 analysts could analyze the results.[58] The CAOC and CENTCOM could see the imagery in theater, but this way only a fraction of the 1500 support people at Langley had to be deployed to the theater. In two dozen dimly lighted trailers inside an old B-52 hangar, these people supported six U-2 flights per day and three or four Predators at any given time.[59]

But despite the huge numbers of sorties, the CAOC did not have a complete picture of this immense area from its ISR coverage. There was only one Global Hawk UAV, with infrared and synthetic

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[54] Briefing, "Operation Iraqi Freedom Observations: Air Warfare," slides 3 and 4, file "TFEL Lessons Learned Air Warfare_jts.ppt," TFEL database, AFHRA. (Secret) Extracted information is unclassified.
[55] William B. Scott and Craig Covault, "High Ground Over Iraq," *Aviation Week & Space Technology*, 9 June, 2003, 44.
[56] T. Michael Moseley, Lt Gen, USAF, "OIF by the Numbers," CENTAF – Prince Sultan Air Base, Kingdom of Saudi Arabia, 30 April 2003, p. 9. Available through Commanders Action Group, 9th Air Force, Shaw AFB, S.C., 7.
[57] Richard J. Newman, "The Joystick War," *U.S. News & World Report*, 19 May 2003, accessed via Defense Current News Early Bird, http://ebird.afis.osd.mil.
[58] Michael Fabey, "Technology Amplifies War Games at Langley," *Newport News Daily Press*, 12 December 2003, accessed via Current Defense News Early Bird, http://ebird.afis.osd.mil.
[59] Eric Schmitt, "6,300 Miles from Iraq, Experts Guide Raids," *New York Times*, 24 June 2003, accessed via Defense Current News Early Bird, http://ebird.afis.osd.mil.

aperture radar sensors, but it put out so much data that the analysts were overwhelmed.[60] Although Global Hawk and U-2s fly high enough to see a good portion of the country, the four Predators flying at speeds around 80 knots and looking at a soda-straw picture could not provide coverage for anything too far from their planned flight path. We need to keep in mind that although the CAOC got unprecedented amounts of ISR information, they still could not see everything.

The process of putting this information together was much more developed in Iraqi Freedom than ever before. Several people who had participated in Millenium Challenge were present at the Scud-hunting practices at Nellis Air Force Base during late 2001 and early 2002. Air Force Lt. Col. Gary Backes was one, and he brought with him his experience with JTSTM. Backes taught the rest of Hodges' hand-picked team about the tools they would use.[61] The JTSTM became a way to share all information about the emerging targets with anyone who had access to the SIPRNET—and to perform virtual coordination with all those involved. In fact, the Air Force thought so highly of it that they developed a companion tool in ADOCS to handle coordination within the air component for targets that were only of interest to the air component.[62] Moseley called these "dynamic targets," whereas those designated by Franks as important were called "Time-Sensitive Targets" (TSTs).

Moseley put great care into the development of his "TCT Cell" for Operation Iraqi Freedom. For one particular type of TST, the Scud, he took the authority that Franks had delegated to him and delegated it to the TCT Cell chief on the Combat Operations floor.[63] His strategy division, led again by now Lt. Col. David Hathaway, wrote Moseley's daily guidance (the Air Operations Directive, or AOD). Over time, Hathaway modified this AOD to guide the TCT Cell in choosing which emerging targets (other than TSTs) were important enough to warrant diverting aircraft from their other targets, and which pre-planned targets could be sacrificed to hit emerging targets without disrupting the overall plan.[64]

The result was a section of the Combat Operations division with a lot of authority to accomplish things in real time. Interviews with TCT Cell team members after the war indicate they were justifiably proud of their accomplishments. There were a total of 19 surface-to-surface missile (SSM) launches in

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[60] Kevin Glenn, Lt Col, USAF, 609 AIS/DO (Chief of ISR Cell in Combat Ops during Iraqi Freedom), email to author, 19 May 2004, and Jeffrey Hodges, Col, USAF, AWFC/DO (TCT Cell Chief in Enduring Freedom and Iraqi Freedom), email to author, 4 February 2005.
[61] Hodges email.
[62] Gary Backes, Lt Col, USAF, "Joint Time Sensitive Target Manager," briefing, updated 27 June 2003.
[63] Bryan Trace, Wg Cmdr, RAF, Asst TCT Cell Chief during Operation Iraqi Freedom, personal interview, 30 July 2004, notes in author's possession.
[64] David Hathaway, Lt Col, USAF, 20 FW Chief of Safety (Deputy Chief of Strategy in Operation Iraqi Freedom), email to author, 21 October 2004.

the 21-day campaign to reach Baghdad—zero launches on Israel—while in Desert Storm there had been 88 Scud launches in a 43-day campaign.[65]

The performance of the TCT Cell depended on a mixture of technology and teamwork. The cell divided the country of Iraq into three sectors: North, South, and West, but the process was essentially the same for each—the division served to divide responsibility among attack coordinators and targeteers.[66] Participants at JEFX 04 in July 2004 set up a similar TCT Cell, whose Cell Chief, Wg. Cmdr. Bryan Trace, had been a Deputy Cell Chief during OIF. His observations were that, although there were "experiment-isms," and the team was not as well trained for JEFX as the one for OIF had been, the processes worked similarly. At JEFX 04, all team members had dual computer monitors at their station, on which they each had at least 4-6 chat rooms open and some type of digital map in the background. Trace routinely watched at least 10-11 chat rooms.[67] These chat rooms linked people in the air component with others in the CAOC, at the other components, and at CENTCOM, including various intelligence channels. It was here that he caught bits of information from intelligence that tipped him off to the existence of an emerging target. The determination that something was an emerging target was made seemingly instinctively; but this was based on the Trace's constant study of the CFC and CFACC guidance, such as the AOD that Hathaway put out daily. This guidance also told the chief whether the target was a CFC-designated TST or a CFACC-designated dynamic target.[68]

Guidance also determined who would have to coordinate on different types of targets. Trace used this information to enter the target into the JTSTM or the Intra-AOC version in ADOCS. Figure 9 shows the front-end view of JTSTM, used to display a list of all TSTs along with essential information about each. To get more detailed information, any player had only to double-click any target and view a set of tab-driven dialog boxes. This application was the vehicle for coordinating among the components for all TSTs. It was so important, the TCT Cell Chief's view was projected on one of the big wall screens in the CAOC—Backes described that it made you "think out loud."[69] Through a mixture of chats and phone call prompts, the TCT Cell focused on getting all coordination blocks green before proceeding to attack a target.

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[65] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Air Power Survey Summary Report*, (Washington: HQ USAF, 1993), 87-88. OIF—By the Numbers, 3.
[66] Hodges email.
[67] Author's personal observations from JEFX 04, notes in author's possession. With all these chats open, it was difficult to determine where a new message had appeared when one appeared. Wg Cmdr Trace had discovered a technical capability to solve this problem, involving highlighting all chats and using a function key that de-highlighted only the room that acquired a new message. There were lots of little quirks like this that were acquired only through experience.
[68] Trace interview 30 July 04.
[69] Backes personal interview.

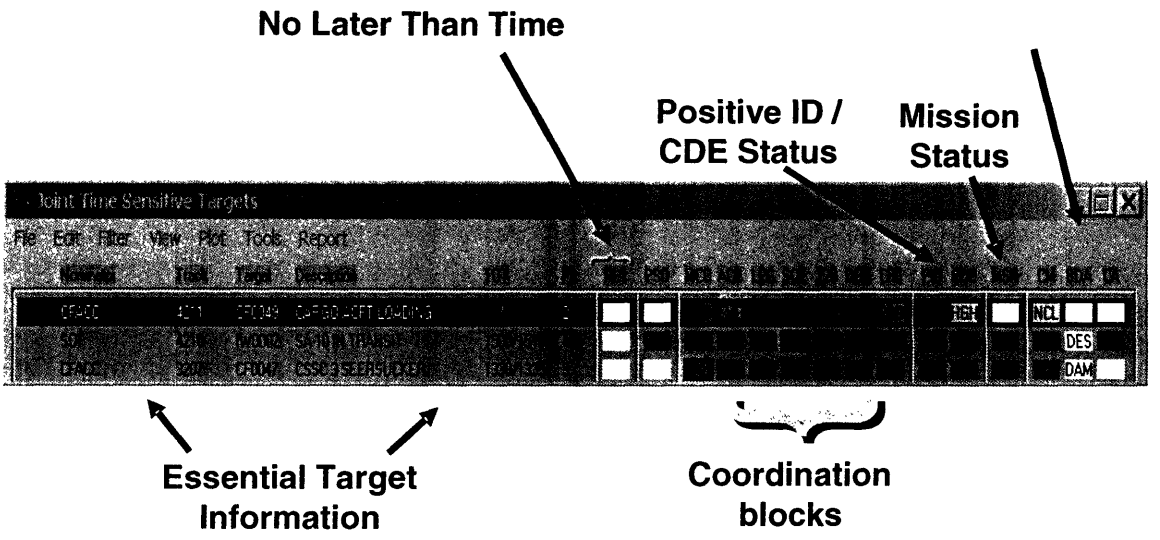

Figure 9: ADOCS Joint TST Manager Coordination View. Source: Backes briefing.

Of course, the TCT Cell team had to get all the information into the JTSTM before anyone would sign off on the target. As soon as the chief Trace had entered the initial information, he alerted the other affected team members by chat or in person to take a look at it (although many times they needed no prompting, because they had been following the chats as well). At this point, two attack coordinators took over to determine how to attack the target. Using a graphic TBMCS application—much like a Gantt chart—they searched the ATO for aircraft that were available, in the vicinity, and armed with the appropriate munitions to attack the target. In doing this, they also had to consider the priorities of any other missions they wished to divert. They also considered other options, such as Navy Tomahawk Land Attack Missiles (TLAMs) or Army Advanced Tactical Attack Cruise Missile System (ATACMS). The Navy and Army liaisons were key to informing them about these options. Upon making the choice of weapons and platforms, the attack coordinators started events in motion to get the weapons to the target while performing the rest of the coordination.[70]

The choice of weapon systems combined with the type of information they already had drove many of the remaining coordination actions. Some weapons required accurate, mensurated coordinates while others did not. Likewise some sensors could readily be used to identify and supply accurate information while others could not. Furthermore, some scenarios required a positive, visual identification by the CFC or CAOC while others did not. Thus, the attack coordinators often had to set others on the team in motion to get another sensor to look at the target, mensurate coordinates, or perform a collateral damage estimate on the target area. Again, they used a combination of chat and face-to-face, depending

[70] Observations from JEFX 04.

on the urgency or the richness of the information required. If there was some misunderstanding, members always got up, walked over to the other person, and talked face-to-face. Finally, when the target was approved, they chatted the information to an individual who was talking to AWACS to pass the approval to the attackers (in the case of aircraft—otherwise to the Army or Navy liaisons for ATACMS or TLAMs).[71]

This is just a quick description of the team's functions. A Mitre study of TCT Cell interactions in OIF, JEFX, and several other experiments found their interactions to be much more complex than merely getting information and following business rules. They were managing a complex, fluid environment—detecting the cues on which they should act while trying to keep in mind that there were other services and countries involved, with all the security and political issues that meant. They were interpreting and sharing information—often resolving ambiguous messages, determining who should see what and in what channel. And they were managing team dynamics—cueing others, teaching and learning roles, figuring out where they were in the process, and establishing trust.[72]

Elsewhere in the CAOS, other organizations were gaining the ability to combine real-time information from sensors to affect ongoing missions, too. The Army's Vth Corps under Lt. Gen. William Wallace, deployed a headquarters in Kuwait that had similar capabilities on a smaller scale. He had an Analysis and Control Element to determine where the enemy was and direct Hunter UAVs, JSTARS, and even strike aircraft to look for targets. Then, when they found the targets, the co-located ASOC directed the aircraft or pushed them to a TACP to give terminal control. Wallace ascribed two functions to the ASOC: to directly support the divisions with CAS and to shape the deep battlefield for Vth Corps operations.[73] This latter seems to bring it into conflict with the air component's mission. Indeed, the Marine Corps chose to handle the deep missions differently, opening killboxes short of the established FSCL.

But the inability of the air component to track the effects of its operations somewhat justified Wallace's desire to hold this control over deep operations. Army officers who worked for the BCD in the CAOC during Iraqi Freedom pointed out that the inability of the air component to determine and communicate the effects of airpower was the biggest source of friction between the air and land components. As the ground troops made their way through the sandstorms, they needed to know how big an effect the attacks were having on the Iraqi Republican Guard units. When the storms were finished,

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[71] Observations from JEFX 04. Surprisingly, passing the information through a single individual was a potential bottleneck at JEFX. It often took several minutes and, in one case, 20 minutes to pass this command.

[72] Lindsley Boiney, Jill Drury, et. al., "Time-Sensitive Team Decision-Making," internal briefing to Mitre Corporation personnel, Bedford, Mass., 25 August 2004.

[73] Wallace Briefing and Patricia Slayden Hollis, "Trained, Adaptable, Flexible Forces = Victory in Iraq: Lt Gen W. Scott Wallace CG of V Corps in Iraq during OIF," *Field Artillery Journal*, 1 September 2003, available at http://www.highbeam.com/library/doc3.asp?DOCID=1G1:110732251&num=6&ctrlInfo=Round6%3AProd%3ASR%3AResult&ao= 24 Aug 04.

even the CFLCC, Lt. Gen. McKiernan was unable to pinpoint weak points in the enemy towards which he could have directed offensive actions to fracture them. Instead, he had to command a general maneuver called "movement to contact"—in a formation suboptimal for the offense.[74]

The air component's practice of satisfying many of the land component's air support requests (ASR) with killbox interdiction did not give land commanders visibility into the results. These were missions sent to a patch of airspace, not a target, so the land component was unable to tell whether its requests were being serviced by the air component. The BCD had to get the air planners to add the ASR numbers into the remarks section and then build a spreadsheet from the ATO to show the McKiernan and his staff how many support missions they were getting.[75] But this did not guarantee the target would be the one that the aircrew chose to hit, and the mission reports by the aircrew did not always specify exactly what had been hit, so there was often no way to tell what killbox interdiction had accomplished.[76]

Part of this was due to the fact that the entire targeting process was unwieldy from a technical standpoint. The components had good relationships at the top. They had worked out a joint strategy. But they had different and somewhat incompatible local systems for developing and tracking target data. For starters, CENTCOM and the air component were using different target databases. CENTCOM was using a system called the Joint Targeting Toolkit (JTT), developed to take advantage of national intelligence databases. But it did not hold enough records for the air component, which preferred the Interim Targeting Solution (ITS). The Army's main information system, the Advanced Field Artillery Tactical Data System (AFATDS), was technically capable of linking with the Air Force's TBMCS.[77] Prior to the beginning of Iraqi Freedom, the air and land components worked out a targeting architecture that used intermediate databases to update and receive updates from the various component systems. It was complicated but seemed workable.[78]

However, when the operation started, the people involved discovered many glitches that they had to work around. The AFATDS-TBMCS interface was only designed for certain specific actions. For example, AFATDS was designed to send targeting information to a targeting program called the Target Weaponeering Module (TWM) in TBMCS. As we said above, the air component used ITS, which took information from TWM but had slightly different fields, so not all the information was passed. BCD

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[74] Thomas L. Kelly, Lt Col, USA, and John P. Andreason, Lt Col (retired), USA, "Joint Fires: A BCD Perspective in Operation Iraqi Freedom," Field Artillery, November-December 2003, 21 and Wingenbach and Andreason interview.

[75] Kelly and Andreasen, 23.

[76] Briefing, "Task Force Enduring Look Lessons Learned," slide 49, from file "LLConf.pdf," Task Force Enduring Look database, AFHRA. (Secret/Noforn) Extracted information is unclassified.

[77] In Afghanistan, the 10th Mountain Division had not deployed with the system since it had not brought organic artillery. Sandra I. Erwin, "Air Wars Demand More Inter-Service Coordination," *National Defense*, September 2003, 22.

[78] Briefing, CENTAF-PSAB Targeting Tiger Team, "CFACC Targeting Architecture," no date, file "CFACC Tareting Architecture.pdf," in TFEL database, AFHRA. (Secret) Extracted information is unclassified.

people had to manually enter the rest. When the land component sent a request for air support (air support request, ASR), TBMCS only took the information if it was designated an interdiction mission—CAS or any other support remained in a message format. Through the BCD, the Army worked out a way to send all ASRs as interdiction requests and then send code in the remarks section that would indicate the mission was other than interdiction.[79]

This was only part of the air component's frustrations with assessing the effects of airpower. Hathaway was again the Deputy Chief of Strategy, and Maj. Stephen Murray was again Hathaway's chief of assessment. Together, these two were responsible for putting together the picture that would tell Moseley what was happening and how it was going. But there were well over 100 colonels in the CAOC, and each seemed to have another problem like the BCD's problems to solve. The result was a lot of customized information formats.[80] To collect and process the information, Murray had to gain personal contact with the operations. He had 7-9 contractor analysts working for him, but instead of turning them loose to analyze the information, he had to send them to gather the data. He sent them to the different cells within the CAOC, including 2-3 on the Combat Operations floor at any given time, to figure out how the various cells turned data into information and which of it could be useful for their assessments.[81] No wonder when on day two of the war, Moseley asked Hathaway for results, Hathaway could not even tell him *what* the air component had done, not to mention *how* it had gone.[82]

At a lessons learned conference after the war, Moseley stated it flatly: "Two wars without [a real assessment process] are enough...I never received adequate, timely feedback. I basically had to wait for CENTCOM to produce the official BDA to have any idea of what happened."[83] But in this war as before, "official BDA" was not timely enough to adjust the ongoing operations. When Moseley told Hathaway to close the loop, Hathaway and Murray worked with their assessors to figure out what targets had been attacked based on the mission reports. Then they made some assumptions based on the type of weapons used—precision munitions were given a high probability of hitting the target. It was a "bandaid" on a broken process, but it was the best they could do.[84]

Iraqi Freedom provides the best example of the increased ability of the AOC to act as a "centre of calculation." In Iraqi Freedom, the AOC workers were able to put together and share a representation of the strategy in the form of a MAAP and meaningful guidance that even helped the TCT Cell pick targets. The technology for this function was not much advanced over that available in Enduring Freedom, so this

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[79] Kelly and Andreason, 22-3.
[80] Murray interview.
[81] Murray interview.
[82] Hathaway interview.
[83] Briefing, "Task Force Enduring Look Lessons Learned," slide 17, from file "LLConf.pdf," Task Force Enduring Look database, AFHRA.
[84] Comments on an earlier draft by David Hathaway, Lt Col, USAF, 20 FW Chief of Safety (Deputy Chief of Strategy in Operation Iraqi Freedom), email to author, 12 April 2005.

probably had much to do with the command relationships we have already covered. It was in the area of ongoing missions that the CAOC really excelled, however. The TCT Cell had the tools to see the real-time positions of the aircraft, chat logs full of information, and graphic TBMCS information all on their own computer screen. They could see sensor video on other screens close by. They could assemble the salient information in ADOCS and coordinate virtually with other components. Through a mixture of this electronic collaboration and good-old fashioned face-to-face, they significantly advanced the art of changing plans based on real-time information. Others in the CAOC were also able to create innovative solutions to several problems they had passing data internally and among organizations in the CAOC. But this autonomy had a price—it made it more difficult for the Strategy Division to determine the results in the aggregate.

Conclusions

Efforts to automate the process of integrating data from all the organizations continue. In 1998, the World Wide Web Consortium defined the specification for eXtensible Markup Language (XML), a different way to think about coding data for exchange over the Web. Conceptually, XML is a meta-lanuage, a language about languages. Like its predecessor, Hyper Text Markup Language (HTML), XML consists of tags and content. But unlike HTML, the tags in XML describe and organize the content. The user can define new tags as desired—the tags are not needed to define how the browser displays the data. Users define the structure elsewhere in schemas or use existing schemas. Most importantly, XML is easily transported via simple Web protocols that make it possible for machines to exchange data. This property has enabled users to supply software known as Web Services that other users can access over the web.[85]

Engineers working on command and control equipment have seized the advantages of XML. It seems to provide a way around a nagging problem of C2 systems: the fact that different services design their systems to different specifications. In the past, systems could not transfer data unless there was a compatible hardware interface.

Now they can pass data using Web protocols. With XML and Web Services technology, Mitre Corporation's Mike Butler has begun building translators to pass information from machine to machine. In 2002, Butler was working on a project to pass mensurated coordinates from the Raindrop mensuration system to F-15E aircrews patrolling the northern no-fly zone in Iraq. While looking at XML schemas, it occurred to him that he could really boil his problem down to four bits of information: what, where, when, and how accurate. Thirty days and $25,000 later, he had built the infrastructure to translate that information from Raindrop into a Link-16 format, and the problem was solved. He calls the program "cursor-on-target," borrowing a phrase from Air Force Chief of Staff Gen. John Jumper, who had

[85] Frank P. Coyle, *XML, Web Services, and the Data Revolution*, (Boston: Addison-Wesley, 2002), 5-12.

challenged the community to find a way to transfer information with the click of a mouse. When he showed up for the first spiral of JEFX 04, he was planning to try the same thing with three other systems. By the time the experiment concluded, there were 54 systems with translators.[86]

This is the reason the officers giving the tour of the Nellis CAOC were so intent on telling the machine-to-machine story. They were also careful to narrow the scope of their use of the technology. The CFACC for JEFX 04, Lt. Gen. Bruce Carlson, put it most succinctly when he said, "None of the machines are making decisions. Humans are still making decisions. All it's trying to do is give you more intuitive data to help make those decisions."

Indeed, there are still many places where the people in the system simply need a better way to pass the information from one place to another. The transfer of ASR data from the land component to the air component is one. In ADOCS, the TCT Cell still needs to cut and paste information from one tab to another, a manual process that adds minutes to a process that is trying to shed minutes.

But the difficulties involved in integrating data from diverse organizations are well-known and acknowledged, in the corporate as well as the government world. Even if cursor-on-target can provide a way to read information from machine to machine, there are difficulties to be tackled. People still need the freedom to handle situations as they occur. When the information systems do not exactly fit the situation in which the people find themselves, they will have to invent work-arounds. Unless the people are able to use the same schema for the work-arounds that the other systems are using, the XML tags will be confusing. One person may develop a database with a field called "coordinates," where another calls it "position" or "location." There will be a need for some type of context mediation.

Digital information is the ultimate in "immutable mobile." The military has come a long way in creating a physical representation of the world, using sensors to send back the location of aircraft, vehicles, and people. In Desert Storm, it was a noteworthy event to be able to talk to all AWACS simultaneously and combine their information into an air picture. In Afghanistan and Iraq, officers in the AOC said it was normal to have a good real-time picture. Furthermore, they got this picture from the common operating picture, which was available to anyone with access to the Global Command and Control System. Transforming the information to digital format and sending it over increasingly high-bandwidth, low error-rate medium made the problem of transporting "immutable mobiles" seem trivial.

It was not so trivial for commanders to use the information to create knowledge of the aggregate results and assess whether the strategy is working. In fact, the better the "centres" get at intervening in real-time missions, the harder it is for them to determine what is going on in the aggregate. There may never be a common perception of this aggregate knowledge as long as human perceptions differ—no

[86] Michael Butler, contractor for Mitre Corporation, personal interview with author, 29 July 2005, notes in author's possession.

"common operational picture" of the strategic assessments. The clarity with which the highest levels define the goals, objectives, and command relationships can aid in this quest. But analyzing progress towards these goals will probably always put competing "centres" at odds with each other.

In addition, it should be obvious to the reader that this ability to act as a "centre" is present only at the headquarters right now. Wallace's headquarters was the lowest level we examined. While the Air Force's portion of his headquarters, the ASOC, is an echelon lower than the AOC, it is still not a very big step toward pushing information out. We did not examine AWACS because its operators claimed they did not have the ability to get the information they needed. Of course, they had datalink capability and could see the relative positions of the aircraft in the air. But this was only part of the representation available to the headquarters—it lacked the positions of the ground participants and the other sensor pictures. They also lacked the ability to communicate with other decision-makers. The AWACS in Iraqi Freedom had only the ability to pass free-text messages at 28.2 kbs—and even then, the formatting was all wrong, so it took three operators to sort out the messages and distribute them to the crew. There are upgrades planned, but they will not be complete until 2010.[87]

If these lower levels are to be a command presence with situational awareness, they will have to either bring the information in or get it from the "centres." However, there is currently no single representation that combines all the information from these assets. It is not yet possible to combine the positions of all the people and vehicles and aircraft with the video and pictures from sensors like JSTARS and Predator in a way that can be sent to anyone in the system. In the headquarters like the AOC, all these different views can be located so close to each other that people in a mini-centre like the TCT Cell can use them all almost as a single representation. But there are space and bandwidth limitations on aircraft and combat vehicles that preclude their ability to display the same information.

The result is that, to react to the information in the sensor communications loops, the "centres" must be involved. This is the current state of "time-sensitive targeting." But to what extent must they be involved. How does the "centre" decide where to become involved?

[87] Samantha Helwig, Maj, USAF, (AWACS Senior Director during Iraqi Freedom), personal interview with author, 2 August 2004, notes in author's possession.

Chapter 7

Decision-making Inside the Loop

"War, however, is not the action of a living force upon a lifeless mass (total nonresistance would be no war at all) but always the collision of two living forces."
- Carl Von Clausewitz

In the CAOC...we knew more about where the Iraqi forces were than the Iraqis did.
- Lt. Gen. T. Michael Moseley, 2003[1]

"I went through this same thing in OIF—guys wouldn't tell you what was going on with their missions, so you didn't know what had happened."

It was 2 August 2004, and JEFX 04 was in its final week. The group of people known as the "TCT Cell" (for Time-Critical Targeting Cell) in the Nellis Air Force Base CAOC had coordinated an attack on some mobile Scuds that had popped up in the experiment script. They had sent some (live) aircraft to strike the Scuds out on the Nellis Range, but now they were unable to determine whether the aircraft had found and attacked them. The Attack Coordinator had worked as the Interdiction Duty Officer during Iraqi Freedom, where he had encountered the same problem.

The significance of the move towards intervening in ongoing missions is that now more than ever the people in the command "centres" like the AOC come into contact with the aircrew during the missions. Van Creveld advocated what he called a "directed telescope," so the commander could find out what was happening and thus make good command decisions without burdening the troops on the battlefield. But on occasion, those troops have need of information to which the commander's staff has access by virtue of its ability to perform as a "centre." Access to this information helps them react more quickly than the enemy. War is, after all, a competition—a duel, according to Clausewitz—between thinking, reacting opponents. Better information on one side can give that side an advantage.

The way living organisms compete is described well by John Boyd's theories. Boyd was an Air Force fighter pilot who combined his experience with flying fighters in combat with his reading of military history and his understanding of scientific laws to come up with a general theory he eventually called "A Discourse on Winning and Losing." The heart of it was the Observation, Orientation, Decision, Action (OODA) Loop. In order to survive, organisms must continually accept input from their

[1] John A. Tirpak, "The Air Boss's Plan; Moseley's Handshake Deal; The Bomb Catalog; BDA Fades Away...," *Air Force Magazine*, August 2004, 9.

environment and use that input to resolve uncertainty and succeed.[2] The essence of Boyd's way of war was to get inside the opponent's OODA Loop by executing your cycle so quickly the opponent cannot react effectively. Boyd's ideas were instrumental in shaping much of current U.S. Army and Marine Corps warfighting doctrine.

Analysts have claimed that Boyd's ideas are equally well-suited to all levels of war.[3] However, we have seen that the U.S. military has been much better at improving the OODA Loop for ongoing missions than it has been at improving the OODA Loop for long-term strategy. The air component's efforts to attack fleeting targets have been an attempt to get inside the OODA Loop of the enemy on a tactical level. The sensor-communications loops and the electronic collaboration and information distribution have improved the way the AOC executes this short loop. But for the longer-range operational strategy loop, the dynamics we saw in the previous chapter keep it from executing quickly.

We will now analyze where the sensor-communications loops are taking this business of shortening the OODA Loop. At the beginning of our study period, the only provisions for attacking emerging targets were the armed reconnaissance (of which killbox interdiction is a subset) and CAS missions. But throughout the period, airpower was called on to affect enemy ground operations in areas outside the reach of friendly ground troops. Someone had to put the information together to attack these emerging targets, so air commanders tried to develop the technology and procedures to do this in the AOC. At times, the AOC's job was to ensure compliance with ROEs—in these cases, it actually lengthened the OODA Loop. But these were cases where military and civilian leaders were wary of the consequences of military action and accepted the loss of response capability. The TCT Cell developed formal procedures and new technology to handle these situations as quickly as possible while still allowing close scrutiny. The same technology and procedures allowed them to help in other situations—even during Killbox Interdiction (KI) and CAS.

Through this evolution, the JFACC has developed the ability to shorten the OODA Loop by delegating authority. Right now, the authority rests with the TCT Cell, in the AOC, so it does not appear to be decentralized. This is partly because, as we saw in the previous chapter, this is the only place that can assemble the information to have the situational awareness. But the TCT Cell suffers from its inability to communicate directly with the strike aircraft. The next step in technological development is the ability to either move the TCT Cell to an airborne platform or communicate with the strike aircraft from the AOC. The former would be more in line with our concept of deepening command relationships.

Desert Storm

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[2] Grant T. Hammond, *The Mind of War: John Boyd and American Security*, (Washington: Smithsonian Institution Press, 2001), 13-16.

[3] Colin S. Gray, *Modern Strategy*, (Oxford, Oxford University Press, 1999), 91.

In Desert Storm, the TACC had a very limited ability to direct real-time operations. We saw in previous chapters that the Desert Storm TACC had recently been transformed from its doctrinal organization. It had been given a new strategy-development function. But it had not been able to develop smooth procedures for getting information to make assessments about how the strategy was going at an aggregate level. Black Hole people had to spend a lot of extra time gathering the results and putting together the MAP. TACC people also found it difficult to share a representation of the strategy, as everything was passed in bits and pieces on target planning worksheets, change sheets, and the user-unfriendly CAFMS. In addition, the TACC did not have sufficient real-time information coming from the TACS to assemble a picture of the ongoing operations. Datalinks were unreliable, so they could not even see an up-to-date AWACS picture.

The TACC could not communicate well with the rest of the TACS, either. It was difficult to even get the ATO out daily. Even those with remote CAFMS terminals had to take over 12 hours to download and print the entire ATO. Most turned to receiving the document either via a data port in their secure STU-III telephones or via a message transmission system known as AUTODIN. Because the Navy had resisted the JFACC concept before the war and had not acquired compatible equipment, they had to resort to flying the document out on helicopters.[4] When it came to real-time communication, the TACC people had to use the telephone to communicate with a ground-to-air transmitter at King Khalid Military City, through which they could then reach AWACS or ABCCC aircraft.

The inability to direct the real-time operations was not seen as a handicap, since Horner did not want the TACC involved in the execution of the missions. He knew there would have to be adjustments made—the enemy gets a vote. But his plan to handle emerging situations was to let the TACS handle them. There were Tactical Air Control Parties with the ground troops who could find and direct aircraft to targets in the vicinity of the front lines. There would be a steady stream of aircraft into the killboxes to find and destroy targets in the other areas occupied by the Iraqi Army. In fact, after the war, Corder, who had performed the role that would later be called CAOC Director, was asked about the inability of intelligence to supply photos of targets in the killboxes. He did not think that had been a problem. The important thing, in his mind, had been keeping the stream of aircraft into the areas—a new flight of aircraft every seven minutes. Any delay to look for specific targets would have disrupted this flow and been counterproductive.[5]

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[4] John Paul Hyde, Johann W. Pfeiffer, and Toby C. Logan, "CAFMS Goes to War," in Alan D. Campen, Editor, *The First Information War: The Story of Communications, Computers, and Intelligence in the Persian Gulf War*, (Fairfax, Va.: AFCEA International Press, 1992), 43-4.

[5] John Corder, Maj Gen, USAF, transcript of interview with GWAPS Kurt Guthe et. al., 18 May 1992, 22, TF5-7-124, v.30, GWAPS collection, AFHRA.

Nevertheless, when the Iraqis surprised the coalition at Khafji, the TACC had to get involved to help adjust. Here the importance of sensor-aided target location proved vital. Although Khafji was in an area close to friendly forces, the Marines responsible for control of CAS in the area became trapped in the town of Khafji when the Iraqis captured it. The Marines had Pioneer Remotely Piloted Vehicles (RPVs), but any target the Pioneers discovered had to be validated by an A-10 or OV-10 acting as FAC-A, because the RPVs' position was very inaccurate.[6] JSTARS became the star in this battle.

The first two nights of the attack, the TACC tried not to overreact to the Iraqi attack. On 28 January, at 2224 local time, TACC officers found out a Saudi observation post was under attack. The AC-130 liaison officer diverted a Spectre gunship to help out, but gave instructions to only hit targets that were clearly on the Kuwait side of the border. An attack so close to friendly forces needed to be controlled by troops in contact with the ground forces, and no such liaisons were available.[7] The next night, Horner learned through JSTARS that this was a large incursion, probably an attempt to start the ground war. U.S. Marine forces reported multiple convoys of enemy vehicles heading toward the Saudi border. Horner, still reluctant to fire in the vicinity of friendlies without control, ordered a Marine FAC to the area and directed JSTARS to look at the columns. Upon receiving verification from JSTARS that there were three columns of armor, Horner knew that the Iraqis were trying to get the ground war started.[8] But with the Marines and A-10s attacking one of the columns; A-10s, F-16s, A-6s, and AV-8s working on another; and an AC-130 the third; there was no need to significantly revise the attack plans. In the TACC, an observer noted the tempo was mainly unchanged as the air component attempted to react to the diversions but avoid getting diverted from its main objectives.[9]

On the night of 30-31 January, the tempo increased. JSTARS imagery now showed an intersection in Kuwait through which the bulk of the Iraqi forces were deploying to divert to the three columns. Some F-15Es and F-16s had a system called Low-Altitude Navigation and Targeting Infra-Red for Night (LANTIRN) to help them fly low-level routes at night; but the system could act as a sensor to help find targets as well. Planners had siphoned some of the LANTIRN-equipped F-15Es and F-16s from their Republican Guard missions to help strike the road to the southwest.[10] But Marine Lt. Gen. Walter Boomer and Saudi Lt. Gen. Prince Khalid bin Sultan bin Abd al-Azziz both called Horner looking specifically for B-52 support. Without ground control, Horner thought it best to use the "Buffs" a little farther from the friendlies, so after repeated requests from Boomer, he finally allowed TACC people to

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[6] After Action Report, 8th Air Support Operations Group, "Operations Desert Shield/Storm," 2, TF4-12-230, GWAPS Task Force IV Collection, AFHRA (hereafter known as "8 ASOG AAR").
[7] Notes, Ted Hosterman, TSgt, USAF, USAF/HO (observer in the TACC during Desert Storm), 105,2224 hours, TF6-46-482, GWAPS Task Force VI Collection, AFHRA (hereafter known as "Hosterman's notes").
[8] Hosterman's notes, 107, 2005Z, 2048Z.
[9] Jamieson, 100-101, Notes, Barton, TSgt, USAF, USAF/HO (observer in the TACC during Desert Storm), 40, 0915 hours, TF6-46-482, GWAPS Task Force VI Collection, AFHRA (hereafter known as "Barton's notes").
[10] Hosterman's notes, 109, Jamieson, 103.

re-target a four-ship of Buffs for the prominent intersection.[11] Only the A-10s and AC-130s were able to work with ground controllers, as an ANGLICO team had reached the coastal area to help defend the Saudis.[12]

As the only real-time picture of the ground battle, JSTARS imagery was seductive to commanders. It gave them a picture of the ground situation, rather than a stream of words over the radio which then had to be deciphered. On 29 January at 0800 local time, Maj. Gen. Burt Moore, Schwarzkopf's J-3 (Director of Operations), called the TACC to alert them that Schwarzkopf had pictures of a convoy of 75 tanks. The picture was already hours old, but Schwarzkopf wanted something done about them. Horner got a similar call from Schwarzkopf soon after, and he put Corder on it. While Combat Operations tried to send planes to the area, Corder went and confronted the Army JSTARS operators in the TACC. They were unable to tell him where the targets had gone, and Corder was livid. The next day, Cols. Reavey and Haar came up with procedures for passing targets from JSTARS to ABCCC to the fighters to "get headquarters out of the targeting business." The ABCCC talked directly to JSTARS. The fighters checked in with ABCCC to get target information.[13]

There were really not many provisions for directing attacks on emerging targets from the TACC. Black Hole planners indicated they kept F-111s on ground alert for the possibility of attacking leadership targets if the intelligence was available.[14] However, this would require a significant lead time, ruling out any targets that required immediate attack. There were several cases where intelligence indicated the potential to attack Saddam Hussein directly. On 22 February, intelligence located one of his famous "Command Winnebagos"—recreational vehicles that Saddam used for off-site or mobile conferences. Two F-111s returning from another mission struck this target.[15] This was a serendipitous event.

The Scud Hunt was therefore a significant strain on the system. The plans to neutralize the Scuds had included strikes against missile storage areas, strikes against fixed launchers, and alert aircraft to attack mobile launchers. When the Iraqis started launching Scuds at both Israel and Saudi Arabia even after the fixed sites had been destroyed, it was apparent the ground alerts would not work. At first, the reaction was to launch the alert aircraft. But comments in a historian observer's log indicate there actually was a shortage of available aircraft to engage the Scud sites—all other aircraft were scheduled.[16]

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[11] Hosterman's notes, 108, 109, 110, 2253L/1956Z.
[12] Hosterman's notes, 110, 2346L/2046Z.
[13] Horner personal interview, Corder Desert Story interview, 48, Hosterman notes, "2053L/1753Z," 109.
[14] Deptula Desert Story interview.
[15] Barry D. Watts and Williamson Murray, "Operations," Part I, Vol. II, *Gulf War Air Power Survey,* (Washington: U.S. Government Printing Office, 1993), 241-2.
[16] TSgt Barton noted on 31 January, "With all of the aircraft in theater, I found it difficult to believe that we were actually 'short' [of aircraft to engage in the Scud Hunt]. We do, however, have that problem. With the number of packages and individual missions scheduled in the ATO, there are, in fact, very few unscheduled aircraft available!"

So planners started devoting resources to searching for these mobile threats. Lt. Col. Phil Tritschler was put in charge of the Scud effort.

Most of the time, Tritschler tried to re-direct aircraft that had not yet taken off. But to find and destroy mobile Scud launchers, they needed to be faster. Since most of the Scud launches were at night, Col. Charles Haar brought in a group of Fighter Weapons School instructors to do nothing but work these changes at night.[17] They worked hard to get aircraft to the launch sites as quickly as possible. Tritschler had to do this once. On 14 February, at 1146 local time, one of Keenan's air defense people yelled out "Scud alert!" She was on the phone with Air Force Space Command officers at Shriever Air Station, and three minutes later she wrote the coordinates down on a yellow sticky and passed it to Tritschler. He walked over to the Senior Air Defense Officer, who notified the AWACS to divert some aircraft to the launch area to try and get the launchers. At 1204 local, the AWACS replied that it would divert a 4-ship of F-16s who were scheduled to hit a target about 20 minutes from the launch site.[18]

Ultimately, the coalition was unsuccessful at finding and destroying the mobile Scud launchers. Most of the necessary information was available somewhere, but the air component was unable to turn that information into successful attacks. Strategic Air Command had developed a way to use its strategic warning systems to give CENTCOM a launch warning and missile trajectory, which helped the Patriots determine where to look for the inbound missiles.[19] But unless the aircraft were right over the site, they were unable to find the launchers. In fact, on 9 February, two F-15Es witnessed a launch but were still unable to find and attack the launchers.[20]

In Desert Storm, the TACC tried to stay out of the business of directing ongoing missions. This was the philosophy of their leadership and also a reflection of their capabilities. The plans were to use Push CAS and Killbox Interdiction to react to the enemy. But the enemy did not cooperate. The TACC found themselves in the position of having to piece together information in order to make the attacks on fleeting targets successful. This happened to some extent during Khafji, although even there the TACC resisted. But the Great Scud Hunt represents an attempt at what we now call time-sensitive targeting. The CAOS was not mature enough to get and distribute the information among the various actors to find and destroy emerging targets employed by a thinking, reacting (hiding) enemy.

However, it was apparent this was the direction in which air war was headed. The Gulf War Air Power Survey analysts presciently said that certain incidents in the air war were "...glimpses of a future,

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[17] Corder Desert Story interview.
[18] Phil Tritschler, Lt Col (retired), USAF, (Deputy CCO in Desert Storm), telephone interview with author, 24 September 2004, recording in author's possession, Barton's notes, 14 February, 66-7.
[19] Thomas C. Hone, Mark D. Mandeles, and Sanford S. Terry, Lt Col, USAF, "Command and Control," Part II, Vol. I, *Gulf War Air Power Survey*, (Washington, U.S. Government Printing Office, 1993), 249-252.
[20] CENTAF TACC/CC/DO Current Ops Log, Vol. 1 of 2, 9 Feb, 0036, NA-215, GWAPS collection, AFHRA. (Secret) Information extracted is unclassified.

perhaps not very distant, when a theater air commander will be able to follow the course of an air campaign in real time, intervening selectively to take advantage of the flexibility of air power."[21]

Allied Force

It was in Allied Force that the efforts to direct ongoing operations became controversial. Our discussion thus far has shown us that the job of the CAOC during Allied Force became one of attacking whatever targets had been cleared by the higher-level decision-makers. This included many fleeting targets.

The air component was not initially set up to pursue these targets. The initial plan included suppression of air defenses and bombing of a limited set of targets until Milosevic capitulated. When he did not, Short's CAOC looked for some way to increase the pressure. They were not allowed to expand the bombing of fixed targets beyond what was approved. Besides, Gen. Wesley Clark wanted them to concentrate on Milosevic's fielded forces in Kosovo. These forces had dramatically increased the intensity of their ethnic cleansing campaign, and this presented an opportunity and a mandate for action for NATO. Lt. Col. Gary Crowder, the Deputy Director of Operations and Battlestaff Director (similar to Keenan's CCO position in Desert Storm), recalls they were just "looking for something to do in the daytime."[22]

The Serbs were winning a cat and mouse game with their air defenses. They rarely allowed their threat radars to radiate, so many of the Air Force's traditional methods of suppressing air defenses, like shooting High-speed Anti-Radiation Missiles (HARM), were ineffective. Instead, the air component had to start targeting the threats as emerging targets, similar to the Scud Hunt in Desert Storm.[23]

The Serbs were also winning a cat and mouse game in the Kosovo villages. Something also had to be done about the ethnic cleansing. But Short knew that by itself, airpower was not very effective against ground troops, especially in an environment where the troops could hide or mingle with civilians. The lack of friendly ground troops meant this was not technically a CAS situation. But there were "friendlies" in the form of Kosovar civilians, so the aircrew had similar constraints against hitting anything but the enemy. Yet the lack of friendly ground troops also meant there were no "sensors" on the ground to identify the enemy and separate them from the civilians. Further, the enemy had no need to mass in order to defend itself against an invasion. So even finding the Serb troops from the air was a major task and, once found, engaging them without hitting civilians and before they made it back to hiding was even more difficult.

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[21] Hone, Mandeles, Terry, 74.
[22] Gary Crowder, Col, USAF, 505 CCW/CC (Deputy Director of Operations and Battlestaff Director, similar to Chief of Combat Operations, in Kosovo), interview with author, 28 July 2004, notes in author's possession.
[23] Crowder interview.

In response to both of these problems, Short set up a "Flex-targeting Cell" in his CAOC. We have seen that it was actually composed of three cells: an ISR cell, an IADS Team, and a Fielded Forces Team. The IADS team, collocated with the ISR cell, had access to much real-time information but had a difficult time fusing it in time to strike the fleeting air defense targets before they were moved.

Once the IADS team had the target located, they had to get the information to the strike aircraft. For the most part, they did this the same way the TACC in Desert Storm had done it: they passed coordinates by radio through either AWACS or JSTARS. There was a JSTARS representative with them in the IADS cell to facilitate this. However, there were other avenues available in Kosovo. Late in the conflict, the air component acquired a real-time targeting system (RTS) that transmitted imagery to F-15Es from a van at Brindisi, Italy. When the IADS team got imagery off the server, an RTS operator transmitted it to the aircraft, where the aircrew could use it to find the target so they could guide a precision weapon (usually an AGM-130). The F-15E was the only aircraft that was successfully re-targeted this way.[24]

However, GPS provided another solution. The Joint Direct Attack Munition (JDAM) was a dumb bomb with an inexpensive tail kit that provided GPS-derived guidance. If the IADS team could provide accurate coordinates, the aircrew of a B-2 bomber could program a JDAM, which would then hit the target with incredible accuracy. To get these coordinates, the IADS team had to rely on agencies in the U.S. to mensurate the coordinates. These people were not always aware of the priorities, so the coordination with them added time.[25] Mensuration is a process that translates coordinates from a flat chart to take into consideration the elevation of the target. If a weapon could fly to a target directly perpendicular to the earth, mensuration would not be necessary. But approaching at an angle, a weapon could be long or short if the target is at a low or high elevation.

The IADS team's successes were few. A briefing by Col. Boyle after the war showed only three examples.[26] On one occasion, a U-2 reprogrammed its sensors in flight to take an image of an SA-6, then sent the image back to Beale Air Force Base, California for an assessment of its coordinates, which were then transmitted to the cockpit of an F-15E whose aircrew were just turning inbound toward the target

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[24] Andrew L. Caldera, Lt Commander, USN, Asst. Intel Officer for Battle Group Staff (Flex Targeting Cell Operations Officer in Allied Force), oral history interview summary sheet, AWOS stand-alone database, AFHRA.
[25] "Seamless Integration of Intelligence, Surveillance, and Reconnaissance is Critical to Rapid Target Destruction (U)," Vol. 2, Section 2, Focus Area 4: Command and Control, Chapter 17, *Air War Over Serbia: Aerospace Power in Operation Allied Force*, 12 July 2000, p. 413. (Secret Noforn) Extracted information is unclassified. The B-2 was also capable of using its radar to further reduce the error of the mensurated coordinates, see Bill Sweetman, "B-2 is Maturing into a Fine Spirit," *Janes International Defense Review*, Vol. 33 (May 2000), 53.
[26] Briefing, "Flex Targeting Success Stories," no name or date, file "(S) FlexTargetSuccess.pdf" in AWOS collection, AFHRA. (SECRET REL NATO) Extracted information is unclassified.

with precision weapons. But more typically, CAOC people had a hard time getting the information to the strike aircraft in time to allow them to attack before the targets moved.[27]

Basically, the Fielded Forces team had the same mission: find and attack elusive targets. However, the parameters of the job were different. As noted above, this was technically not CAS but was just as demanding in terms of avoiding collateral damage. Yet there were no ground troops, no representative of the civilian population capable of directing the attacks and taking responsibility for ensuring they avoided this collateral damage. So the CAOC became intimately involved in making decisions about which targets were approved for strikes.

Rarely did the Fielded Forces team have the information necessary to carry out this responsibility. Sitting with the C-3 Operations people, they used the same information the other operations people did—the common operational picture (COP) and the MAAP slides. These did not answer the questions the Flex Targeters were interested in. Operations people did not consider the COP a complete air picture over Kosovo or Serbia, so they left the tracking of the aircraft to the ABCCC, AWACS, E-2C Hawkeyes, JSTARS, and FAC-As. The Fielded Forces team's main job with respect to the operations in southern Kosovo was to approve the targets in accordance with the ROEs.[28] But most of the time, the targets were visually identified by FAC-As, so all the CAOC people got was a verbal description over the radio, usually passed through ABCCC. From the standpoint of our question about centralized and decentralized control, the approval of targets in southern Kosovo is one of the most crucial issues.

There were times when the Fielded Forces team in the CAOC got information that was not available to others. In a book written by A-10 pilots after the war, these few situations stand out, because the pilots have pointed words about the CAOC's actions in many other situations. On 11 May, Lt. Col. Mark Koechle and Capt. Slobee O'Brien were shocked at the directions they were given through "Moonbeam," the ABCCC. Moonbeam directed them to attack a permanent building, an act that was at that time against the ROEs for fear of collateral damage. Then, after they had completed the attack and moved on, Moonbeam directed them back to re-attack because there were soldiers in and around the building. Finally, Moonbeam directed them to attack a nearby barn in which there were armored vehicles. The A-10 pilots complied, but warily, because they did not find out until later that the directions were being relayed from a Predator through the CAOC and the ABCCC to them.[29] In his written account,

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[27] Benjamin S. Lambeth, *NATO's Air War for Kosovo: A Strategic and Operational Assessment*, (Santa Monica, Calif.: RAND, 2001), 159-60.

[28] Crowder interview.

[29] Mark Koechle, Lt Col, USAF, "Big Brother," in Christopher E. Haave, Col, USAF, and Phil M. Haun, Lt Col, USAF, editors, *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as told by the Airmen Who Fought in Operation Allied Force*, (Maxwell Air Force Base, Ala.: Air University Press, 2003) 245-7.

Koechle did not seem to mind getting the direction, especially since the mission was an extremely successful one.[30] This was clearly a case where the Flex Cell had more information than the FAC-As.

There were other times when the Flex Cell had information from electronic sources. But it was difficult to fuse all these sources, because they were not integrated. Predator and JSTARS video, U-2 imagery, and RC-135 electronic data were available only in the ISR Cell where the IADS team worked, so they were not available to the people in the Battle Staff Division.[31]

In the beginning, the Flex Cell only intervened whenever they had such additional information. Short's guidance to the A-10 and F-16 FAC-As in the beginning was that they had the "hammer" on identifying and approving the targets that would be attacked in the KEZ.[32]

But along the way, several incidents caused the CAOC to withdraw the authority to approve targets back from the FAC-As. On 14 April, an F-16 FAC-A mistakenly directed an attack on a column of civilian vehicles near Djakovica, thinking they were military. In response, planners tightened the ROEs to restrict attacks to strictly military vehicles—ruling out attacks on civilian vehicles used by the military.[33] There were similar changes to ROEs based on geography that further restricted the discretion allowed the FAC-As.

We will see later that this caused the pilots to become overly cautious about attacking any targets without permission. Gradually, the pilots became so cautious that they felt it was necessary to check with the CAOC for approval on most targets.[34] It seems this in turn drove the CAOC to become conservative, since they were now directly responsible for the decisions. The result was a situation where the Fielded Forces team was being asked to make judgment calls on nearly every target based only on information fed over the radio.

This changed during the last two weeks of the war. During this period, the Kosovo Liberation Army (KLA) launched an attack near Mount Pastrik. The Serbs were eventually able to repulse the attack, but to do this they had to come out of hiding and mass for the defense. This made them vulnerable to airpower to an extent not seen before in the war. The ROEs were relaxed to allow the FAC-As to direct aircraft to targets without checking with the CAOC first, provided the targets were within a

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[30] This was verified by another of the authors, Phil Haun, Lt Col, USAF, 355 FS/DO (A-10 FAC-A in Kosovo), email to author, 11 March 2004.

[31] This is from Draft of Command and Control/Intelligence Surveillance and Reconnaissance (C2/ISR) chapter in TAB 99-1, p. X-2. (Secret) Extracted information is unclassified. See also Chris Haave, Lt Col, USAF, "Target Identification and Rules of Engagement," in Christopher E. Haave, Col, USAF, and Phil M. Haun, Lt Col, USAF, editors, *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as told by the Airmen Who Fought in Operation Allied Force*, (Maxwell Air Force Base, Ala.: Air University Press, 2003) 146.

[32] "KEZ Mission," Draft Tactical Analysis Bulletin (TAB) 99-1, "Operation Allied Force Lessons Learned," Nellis Air Force Base, NV, August 1999, X-14. (SECRET). Information extracted is unclassified. Also Phil Haun, Lt Col, USAF, 355 FS/DO (A-10 FAC-A in Kosovo), email to author, 11 March 2004

[33] Haun email.

[34] Haun email.

specified circle.[35] JSTARS aircraft were sometimes able to detect the Serb troops as they moved in their vehicles, even though the Serbs still tried to move as stealthily as possible. The JSTARS then radioed the coordinates to FAC-As who took a closer look and directed strikes.[36] In fact, on one occasion, the JSTARS battle managers directed B-1s to attack a target without a FAC-A involved.[37]

The shift to more decentralized authority near the end of the battle seems to indicate the nature of the war had a lot to do with the way control was handled. The objective was to outlast Milosevic—to show and maintain NATO's determination while causing Milosevic's determination to crumble. This was a game of calculations. How much could the alliance take? How much could Milosevic? The attacks on the Serb Army in Kosovo were vital in that they were the right thing to do, and therefore showed NATO was in the right. But the risk of a crack in the alliance due to careless bombing of civilians was far greater than the potential gain from succeeding on any one attack, or even the attacks in the aggregate. So when the mistaken attack of a civilian convoy near Djakovica proved the risk of collateral damage was high, Short's CAOC levied tight ROEs on the aircrews (although they also loosened the altitude restrictions). The ROEs were so tight that aircrew found themselves calling for permission in most cases, and probably more than were required. So although the Flex Targeting Cell was developed to aid the aircrews in putting together information to find the fleeting targets, they became an inhibitor to ensure the aircrews scrupulously followed the ROEs.

The KLA offensive near the end of May changed the calculations. Now there was a potential to actually defeat the Serb Army, and in the process cause Milosevic to crumble. With the potential gains outweighing the potential risk—especially since the offensive caused some amount of massing of Serb troops—the CAOC delegated more authority. This was still the best way to shorten the OODA Loop.

Enduring Freedom

As it was with Kosovo, it is impossible to talk about the air operations in Afghanistan purely from the perspective of the CAOC at PSAB. As we noted earlier, there was a great deal of uncertainty as to the strategy in Afghanistan. Gen. Franks had a TST Cell at CENTCOM headquarters in Tampa Bay, Florida that allowed him to monitor and even direct ongoing missions. But it was difficult to understand at the beginning how the operations would actually lead to victory—the mechanism for success.

One thing was certain, however. When, on the second night of the war, Mullah Mohammed Omar's convoy was discovered near Khandahar, it was a lucrative target. The strategic consequences of killing the Taliban spiritual leader so quickly could have been enormous. As the convoy moved toward

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[35] Haun email, Mustafa Koprucu, Lt Col, USAF, 552 OSS/DO (JSTARS Senior Director during Allied Force), telephone interview with author, notes in author's possession.
[36] Tony Capaccio, "JSTARS Led Most Lethal Attacks on Serbs," *Defense Week*, 6 July, 1999, 13.
[37] Koprucu interview.

the city, U.S. military leadership that was separated by thousands of miles suddenly became united in their attention to this unfolding event.

In Tampa Bay, Gen. Franks was watching. He'd been alerted by his aide that the CIA's Predator had a target. He went to the TST/fusion cell we described in the previous chapter, where he could watch and direct the action.[38] On this first instance of that process, Franks was the decision-maker for the TST, although later in the war he would delegate the authority to Maj. Gen. Renuart. In his book, Franks recalls asking Renuart to have the CAOC "set up a kill box" so aircraft could destroy the moving convoy before it reached the city. In this account, the CAOC was unable to do that fast enough, and the convoy made two stops in the middle of Khandahar, the second at a mosque. Here, Franks directed the Predator, which was armed with Hellfire missiles, to fire at a vehicle that he suspected was Omar's. The missile destroyed the vehicle, and the people scrambled into the remaining vehicles and sped away to another building. This time, Franks called and asked Secretary Rumsfeld for permission to have aircraft destroy the compound, which he considered a high collateral damage target. Franks insists his legal representative, Navy Capt. Shelly Young, concurred with each target.[39]

At the CAOC in Saudi Arabia, Brig. Gen. Deptula was watching along with Lt. Gen. Wald. They had positioned F-18s just 20 miles south. However, the compound from which the convoy started was a target that had been kept on the no-strike list, waiting for a special operations assault that occurred later in October. As the convoy moved toward Khandahar, Deptula remembers calling one of his contacts at CENTCOM while Wald tried unsuccessfully to reach Franks to ask permission to attack. While they were on the phone, Deptula was surprised to see a vehicle blow up with no apparent warning. He was frustrated by the inability to get permission to use the 500 lb. laser guided bombs on the aircraft to destroy the entire convoy, rather than merely scattering the people.[40]

At Langley Air Force Base in Virginia, CIA analysts were watching as well. Franks recalls getting unwanted input from them that the final target was a mosque—input with which he disagreed and which he ultimately ignored, as was his prerogative.[41] In an article that appeared a week later in the New Yorker, insiders told Seymour Hersh that CENTCOM's legal advisors had balked at attacking the second building—the one Franks described as a mosque.[42]

It is difficult to reconcile the differences in the accounts. The Predator was a CIA Predator, and the command relationships had been set up so CENTCOM, instead of the air component, had operational

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[38] Franks, 289.
[39] Franks, 290-4.
[40] Deptula interview, Grant "The War Nobody Expected," 39.
[41] Franks, 294.
[42] Seymour M. Hersh, "King's Ransom," *The New Yorker*, 22 October 2001, 38.

control.[43] Since this was the first incident, it is predictable that Franks would want to make the decisions. But it is also predictable that the air component would be upset at the direction of such details by a combatant commander, whose responsibilities seemed to them to lie on a higher level than this. The CAOC did not need to set up a kill box to attack the target, but could have done it easily had they gotten the word. What they needed was permission to engage the target.[44] Franks eventually delegated these decisions to Renuart, his Operations Chief (J-3), but that still meant the decisions were made in Tampa by a staff officer, instead of by the functional component.[45] We saw before that Rumsfeld and the NSC had set up tight ROEs about hitting targets with high potential for collateral damage, so this tightly-held authority was probably a natural result of the accountability to which CENTCOM was held.

One thing is certain, however: despite the technology that linked all these decision-makers, not one of them knew the whole picture. Franks apparently tried to get the air component to act while the convoy was out in the desert, but it appears the air component never got the word. They wanted to act, but did not have the authority. There were competing "centres of calculation" as described in the previous chapter. The higher-level centre, CENTCOM, did not have direct control over the aircraft but retained the authority to give permission for them to strike. This made it impossible for the lower-level centre, CENTAF's CAOC, to execute even though it had the same information. According to Col. Hodges, the TCT Cell Chief at the CAOC, this occurred frequently—the biggest hurdle the team had was obtaining permission from CENTCOM.[46] This is another illustration of the fact that holding decision authority at a high level can sometimes dilute, rather than facilitate, centralized control.

The CAOC had new ways to get the information from the Predator to the weapons on the aircraft. Some, like the Predator's laser designator and a modification to AC-130s to accept the Predator feed, depended on the ability of the Predator to work with other aircraft. Others depended on the CAOC or even higher levels to intervene. As we saw above, some Predators carried Hellfire missiles, and these were directed at a very high level. Alternatively, Predator video could be translated into a still picture and used to find mensurated coordinates for a GPS-guided JDAM. The CAOC had a mensuration system, called Rainbow, right there at PSAB, although it was in another building.[47] Fourth, the Combat Operations officers could talk the aircraft onto the target and let the aircrew perform its own delivery with laser-guided or dumb munitions. Although there was eventually a FAC-qualified individual working in the CAOC, at first people just did what they had to, often relaying instructions through AWACS to get to

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[43] Franks, 290 and Woodward, 166, 193-4, 247.
[44] Comments on an earlier draf by David A. Deptula, Maj Gen, USAF, HQ PACAF/DO, email to author, 3 April 2005.
[45] Knaub email.
[46] Jeffrey Hodges, Col, USAF, AWFC/DO (TCT Cell Chief in Operation Enduring Freedom and Operation Iraqi Freedom), email to author, 28 December 2004.
[47] Hodges 28 December 2004 email.

the aircrew. Eventually, the Predator operators received training to allow them to perform the talk-ons directly with the aircrew.[48]

The UAVs had given the CAOC a way to find targets. But they were scarce resources. In addition, they could not help coordinate with the ground forces. There was a battle on the ground, and to be effective, airpower had to be coordinated with that battle. As they had in Iraq and Kosovo, the people in the system found that eyes on the ground were a necessary part of this.

On 19 October the first military special operations teams landed in Afghanistan. The CIA already had a team in country to lay the groundwork for their arrival, so the special operations teams were ready to go to work.[49] However, the two teams evidently had different expectations about their priorities. One team, Tiger 1 (Team 555), went in on the Shamali Plains near Bagram. Tiger 1 had elected to take a Special Operations Tactical Air Controller (SOTAC), trained to control aircraft and equipped to provide precise target coordinates. The other, Tiger 2 went in south of Mazar-i-Sharif and did not bring a SOTAC or the associated equipment. Many key people on the Combat Operations floor of the CAOC did not even know the teams had been inserted. So when, on 22 October, the CAOC received a call for air support, Col. Gary Crowder—performing a role that was essentially the Chief of Combat Operations (CCO)—had to do some improvising. The call came from Tiger 2 over UHF satellite radio. Crowder described the team's calls as "cryptic," because they did not follow doctrinal procedures. The CAOC was able to decipher the fact that Tiger 2 was on the south side of a gorge, receiving fire from the north side. Using rough directions like, "The enemy is located one mile north of my position," Crowder's people plotted an enemy position and directed the nearest aircraft, a B-52, to drop "spotting rounds" with precision, wind-corrected cluster bombs—CBU-103s. After the drop, Tiger 2 called to say the drop had been "one mile" east of the target. The CAOC directed the B-52 to drop the same precision weapons on a point 6000 feet due west of the first point, after which Tiger 2 reported the strike had been "two miles east" of the target.[50] The officers in the CAOC were frustrated.

Tiger 1 had success immediately, where it was to take over a week to get the people and supplies to Tiger 2 to allow them to have similar success getting the support of airpower. From that time forward, all teams to enter Afghanistan took trained controllers and equipment to provide coordinates to the aircraft.[51] From three 12-man teams in mid-October, the U.S. built up to 17 teams by 8 December. These

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[48] Deptula interview, Hathaway interview, Crowder email.
[49] Woodward, 249.
[50] Gary Crowder, Col, USAF, 505 CCW/CV (Chief of Combat Operations in Enduring Freedom-Afghanistan in October-November 2001), email to author, 22 September 2004.
[51] Crowder email.

teams helped target all types of airpower, including supply airdrops for coalition forces as well as bombs on enemy targets.[52]

Aircrew who flew in Enduring Freedom were dependent on information from outside their own cockpits. The U.S. did not have a large conventional force on the ground, and the enemy was in pockets throughout the country. The Push CAS and Killbox Interdiction used in Desert Storm was not possible because the command structure was not there. Airpower's role was to deliver precision firepower on targets. For the fighter aircrew, ROEs were so strict that they were basically unable to find and attack targets on their own.[53] The CAOC did some pre-planning to facilitate rapid retargeting. They made templates of mensurated coordinates for entire towns so they could direct aircrews to attack certain areas merely by referring to a number in the template.[54] But besides these efforts, the aircrews were reliant on either the CAOC or the teams to get them targets while they were airborne. They followed direction from the CAOC for almost all mission details until they were directed to contact a ground team. After that, they were under the team's control.[55]

But while the CAOC was learning to prosecute this new type of war, lessons about the old type seem to have been lost. The fact remains that there were some largely conventional battles between the Northern Alliance and the Taliban forces. In classic land battle, there are some preparations that need to be made in order to smoothly integrate CAS. We saw that the FSCL was a big part of this in Desert Storm. In the first part of the Afghanistan war, it was not possible to use this kind of control measure across the theater, because there was no well-defined boundary between the "friendlies," with whom the special operations forces were working, and the enemy. But there are other preparations, such as designating initial points (IPs) so controllers can flow many aircraft efficiently through an area without causing collisions. For OEF, planners divided the entire country into 30-nautical-mile kill boxes and designated the corners as IPs—a quick fix that turned out to be inadequate for several of the battles, including Anaconda.[56] Normally the link to ensure this happens is the Army's Battlefield Coordination Detachment (BCD) in the CAOC. But during OEF, the CAOC's link to the ground forces was through the special forces teams. Most of the time, the special forces requested GPS-guided munitions and there were a small number of aircraft in a single area, so the detailed coordination was not necessary. The job of the CAOC was to get aircraft out to the teams and help them hit fleeting targets. We saw the results in

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[52] Michael E. O'Hanlon, "A Flawed Masterpiece," *Foreign Affairs*, vol. 81, no. 3 (May/June 2002), 51.
[53] Richard Coe, Maj, USAF, AF/XORC (F-15E WSO during Operation Enduring Freedom and Operation Iraqi Freedom), telephone interview with author, 24 January 2005, recording in author's possession.
[54] Crowder email.
[55] Coe interview.
[56] John M. Jansen, Lt Col, USMC, et. al., "JCAS in Afghanistan: Fixing the Tower of Babel," *Field Artillery*, March-April 2003, 25-6, 29.

Chapter 5—poor or no coordination between the air component and ground forces during conventional assaults like Mazar-i-Sharif and Operation Anaconda.

So Enduring Freedom appears to have been a transition point for the CAOS. The factors we've covered in the previous chapters combined to produce what we saw in this chapter. There was significant uncertainty as to the military objectives for the war. There were complex relationships that took the air component out of the business of developing strategy. The people at the CAOC and CENTCOM turned to doing whatever it took to succeed. They had an increased ability to get and use information from their "directed telescope." All these combined to focus the air component's attention on directing ongoing operations in a sort of "TST war"—a revolutionary type of operation that turned the tide of the war against the Taliban and Al Qaeda. But when the time came to prosecute larger, more complex operations coordinated with other conventional forces, the capability was not there because the depth was not there. Were it not for the relationship-building that occurred between Enduring Freedom and Iraqi Freedom, the latter may have been much harder than it was.

Iraqi Freedom

The practices at Nellis and Shaw Air Force Bases in late 2002 and early 2003 were an essential part of that relationship-building process. By the time combat operations began for Operation Iraqi Freedom, the air component had run three exercises dealing with Scud Hunting and dynamic targeting. The 505th Command and Control Wing at Hurlburt had developed and written formal tactics, techniques and procedures based on the lessons of these exercises and of Enduring Freedom, and had all been trained on the tools they would use. Some had worked together in Enduring Freedom, and others were handpicked from among the instructors at the Air Warfare Center at Nellis and the Naval Strike and Air Warfare Center at Fallon Naval Air Station.[57]

The TCT Cell we studied in the last chapter was, essentially, the center of attention in the CAOC. The official air component report for the first phase of the war, "Operation Iraqi Freedom: By the Numbers," says they prosecuted 156 TSTs and 686 dynamic targets, including 50 strikes against "leadership" targets and 102 against "WMD," which included surface-to-surface missiles like the Scud. This was only a fraction of the almost 20,000 strikes in the first month of the war.[58] But these are only the missions that were strictly classified by Franks or Moseley as TST or Dynamic Targets. As in Enduring Freedom, the TCT Cell was involved in many other missions that did not have a target listed in the ATO. In all, they worked on over 3500 targets, out of which they directed over 2100 attacks, in the

[57] Hodges 28 December 2004 email.

[58] OIF—By the Numbers, 9. Actually, the comparison between TST/dynamic targets and almost 20,000 total may not be accurate. The report claims a total of 19,898 *DMPIs* (Desired Mean Points of Impact), while it reports the number of TSTs and dynamic targets as *missions* (some of which could have had multiple DMPIs). The point is still valid—the number was a small fraction.

first 21 days.[59] Each of these took up a larger amount of attention than the normal mission. For these missions, the CAOC was required to validate the target, get more information from ISR assets if necessary, find the assets to attack the target, and coordinate with all the components. In OIF, coordinating a single mission took anywhere from minutes to hours.

Leadership targets, which required the highest level of approval, took longest. When CIA Director George Tenet got a tip from his agents in the field about Saddam's whereabouts prior to the planned start of the war on 19 March 2003, it took six and a half hours to get the players together, make the decision, and drop the bombs. But the decision-makers were President Bush and the NSC, the decision involved totally re-vamping the war plan, and the aircraft were not even airborne at the time of the tip.[60] On 7 April, it took only 45 minutes from a tip on the ground in Baghdad until a B-1, already aloft awaiting instructions, dropped four 2,000 lb. bombs on a residence in the exclusive neighborhood of Mansur.[61] In this case, the TCT Cell had to clear no higher than Franks, and the strike aircraft was airborne awaiting the task. Each of these missions was essentially a complete ATO cycle condensed into as little time as possible.

The good news was that the processes had improved since Enduring Freedom. Franks realized that his air component had a solid process in place to rapidly prosecute emerging targets. He developed a matrix that specified the decision-maker and the level of verification needed for certain classes of targets. For Scud-hunting in the western deserts of Iraq, the permission went even below the CFACC's level—according to the procedures developed in the practices, AWACS could often direct these missions.[62]

The TCT Cell worked many other missions as well. As in Enduring Freedom, the war became a war of reaction after the first week for the air component. Most missions after that took off without a pre-planned target. Of the 2100 missions the cell directed, only 842 were classified as "TST" or "dynamic targets." The others were missions where the TCT Cell worked on Killbox Interdiction or CAS.

Still, their contribution was felt on only a fraction of the total of these missions. There were over 15,000 missions dedicated to Killbox Interdiction and CAS.[63] Moseley's CAOC had a cell dedicated to these missions: it was called the KI/CAS (proudly pronounced "kick-_ss" by its members) cell. There were members of the cell dedicated to attending all the planning meetings, getting interdiction targets

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[59] Hodges 28 December 2004 email.
[60] Evan Thomas and Daniel Klaidman, "The War Room," *Newsweek*, 31 March 2003, accessed via Current Defense News Early Bird, http://ebird.afis.osd.mil.
[61] David E. Sanger and Eric Schmitt, "CIA Tip Led to Strike on Baghdad Neighborhood," *New York Times*, 8 April 2003, 1.
[62] Jeffrey Hodges, Col, USAF, AWFC/DO (TCT Cell Chief in Operation Enduring Freedom and Operation Iraqi Freedom), email to author, 4 February 2005
[63] OIF—By the Numbers, 7.

from the approved target list (JIPTL), and planning CAS so it complemented the maneuvers of the land component. But the authority to attack a target was generally delegated lower than the CAOC.[64]

The CAOC usually set the aircrew up to make the final decisions about which targets to attack on KI missions. Based on the requests from the land component, the CAOC tasked an aircraft in the ATO to perform interdiction in a specific killbox. If possible, the ATO listed a specific target in the remarks—normally, there was a list of priorities, like armor, artillery, etc. But the CAOC also did something else that the aircrew really found helpful. In the remarks, planners also briefly described the intent of the mission, so the aircrew knew how to apply its judgment in unforeseen situations.[65]

Still, by virtue of its ability to gather the information, the CAOC sometimes played a role in some ongoing killbox interdiction missions. The ISR Division had the ability to find targets and then pass them to the aircrews. In most of these cases, as we will see in the next chapter, the CAOC was facilitating the process of getting information to the aircrew. When the CAOC was able to get updated target information via sensors, especially Global Hawk UAVs, they passed the information on to the aircrew to aid them in finding the targets.

Based on the numbers, it appears the CAOC got involved in as many KI missions as it could, and was limited by resources—either the ability of sensors to find targets or the ability of the TCT Cell to handle the coordination for all those targets. The CAOC was not necessarily making the decision not to get involved in KI missions—they just did not have the ability to get involved in any more.

CAS missions also saw more intervention from commanders than they had in Desert Storm. The CAOC was generally not involved in finding targets for CAS missions. But people in other remote positions were able to use sensor-communications loops to assist the aircraft in finding the targets. They were also able to do this out to fairly long range, lowering the risk of hitting friendly troops. The result was that there were fewer instances of Type 1 controlling, where the controller could see both the aircraft and the target. There were an increasing number of Type 2 (controller can see either the target or the aircraft but not both) or Type 3 (controller can see neither and calls "cleared to engage" rather than "cleared hot.").[66]

This is an indication that others down the line faced the same decisions about whether to direct missions or to delegate the authority. We said in Chapter 5 that the Army tried to closely synchronize fires—including airpower—and maneuvers in its area. One reason Wallace gave for preferring "corps

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[64] "Killbox Interdiction—Close Air Support Concept of Operations," from file "030209 Killbox Interdiction-Close Air Support CONOPS.doc: KI/CAS Annex," Task Force Enduring Look database, AFHRA (hereafter known as "KI/CAS CONOPS." 9-13 describes the KI/CAS planning process, 18 defines the execution authority.

[65] Coe interview.

[66] KI/CAS CONOPS, 3. Briefing, William S. Wallace, Lt Gen, USA, Commander, Combined Arms Center (Commander of Vth Corps in Operation Iraqi Freedom), "Joint Fires in OIF: What Worked for the Vth (US) Corps," 12 March 2004, received in digital format from USAF Air to Ground Operations School. Slide 7 says "Type 1/2/3 employed, mostly Type 2/3."

shaping" to kill box interdiction is that he saw it as much more effective. His data showed that enemy strength did not decrease appreciably after kill box interdiction, but did after his corps shaping.[67] The problem with this claim is that there was no good way to keep track of the damage done by killbox interdiction. We saw that the tasking process between the land and air components left the commanders unable to track the location or results of attacks in killboxes. The result was that the ground commanders had to command general "movements to contact" rather than pinpoint attacks. But this was partly due to the nature of the war. Even Wallace admitted in an interview later that every move at the platoon through the brigade level had been a movement to contact because it was impossible to define the enemy.[68] This seems to be the real reason Wallace preferred "corps shaping" to killbox interdiction. He said the 30-nautical-mile square killbox was too big. He wanted to be able to open smaller, more precise areas.[69] Killbox interdiction did not give Wallace the ability to decide where the attacks should occur, or even the visibility into where they *had* occurred.

The Marines and the Army made quite different decisions with respect to CAS. The Marines' DASC concentrated on maximizing the flow of aircraft into and out of their sector. Aircrew related that there was seldom any delay when they were handed off to the DASC—they were almost immediately handed to a controller for CAS or sent to a killbox. In addition, as we showed, the Marines opened killboxes short of the FSCL. In the Army's sector, every mission short of the FSCL followed strict CAS procedures. Some of them were controlled by the ASOC, as if they were mini-TSTs.[70]

In Iraqi Freedom, the TCT Cell at the air component came into its prime. Refined procedures and equipment combined with a conscious delegation of authority from Franks and Moseley to make them a very productive team. They were able to run the TSTs and dynamic targets, getting the execution times down to minutes in some cases. They were also able to contribute to some of the KI/CAS missions as well, when they had ISR information that could aid the aircrew in finding targets. The Push CAS and KI system still handled most of the real-time reactions. But now, the CAOC got involved whenever it could. Due to the limited resources (compare with the scale of the war), this was not very much. The ASOC also had the ability, as we discussed in the previous chapter, to get involved in a similar manner. But this kind of intervention was not the universal choice of control method. The Marines' DASC chose to maximize

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[67] Wallace briefing. Slide 12 claims the Iraqi 11 Div was at 84% strength before OIF, 81% after KI shaping, and 63% after corps shaping. The Medina RG Division, 96% before the war, was reduced only to 92% by KI, but to 29% by corps shaping. The Hammurabi Division went from 97% before to 73% after KI to 23% after corps shaping.

[68] Patrecia Slayden Hollis, "Trained, adaptable, flexible forces = victory in Iraq: Lieutenant General W. Scott Wallace CG of V Corps in Iraq during OIF," *Field Artillery Journal*, 1 September 2003, available at http://www.highbeam.com/library/doc3.asp?DOCID=1G1:110732251&num=6&ctrlInfo=Round6%3AProd%3ASR%3AResult&ao= 24 Aug 04.

[69] Ibid.

[70] Coe interview.

the flow of aircraft into open killboxes and delegated the targeting authority to them, rather than trying to pick the targets themselves.

Conclusions

Warfare has always contained an element of time-sensitive targeting. The competition to outmaneuver your opponent and thus cut off all his options while maintaining yours leads to a race. Boyd called it the OODA Loop. But his ideas were developed from dogfighting concepts, where the Observe, Orient, and Decide phases were done by a single individual. The complex organizational actions of the "centre of calculation" from the previous chapter are so cumbersome that they inhibit tactical actions. This is why Van Creveld wrote that commanders had to train their organizations to be able to act independently in periods of uncertainty. It is the same reason that in Desert Storm, Horner wanted to let Push CAS and Killbox interdiction handle all the emerging targets. The pilots' eyes and those of the TACPs would find and direct the attacks.

There was no conscious decision to get into the business of directing real-time operations. Rather, as we discussed earlier, it was an evolution. But the air component was called on to accomplish some missions it did not count on. The Scud Hunt in Desert Storm was considered necessary to hold the coalition together. In Allied Force, airpower had to attack enemy fielded forces without the aid of ground troops because the strategic level determined the interests involved did not warrant the use of friendly ground troops. Short had to come up with something, so he and his CAOC developed a Flex Targeting Cell. In Enduring Freedom, the job of developing strategy was again held above the air component's level, though for different reasons this time. The CAOC workers became focused on doing whatever they could to contribute. The rapidly moving ground battle in Iraqi Freedom created a fluid environment where aircrew did not know where the targets would be when they took off. In these last three conflicts, air operations enabled by air superiority became increasingly geared towards taking off without a target and finding the target while airborne. Thus, the TCT Cell became a fixture in the AOC. From the ad hoc "change cell" in Desert Storm, it became a formal, 25-person team in Iraqi Freedom.

The Air Force put significant effort into developing the procedures and tools to handle emerging targets. Time-critical or time-sensitive targeting played big parts in the JEFX experiments in 1998, 1999, 2000, 2002, and 2004. The TCT Cell faced the problem of shrinking the targeting cycle from days to minutes. They had to get information about a target, determine how to attack it, coordinate permission to do so, enable the strikers to attack, and assess the results (find, fix, target, track, engage, and assess—the "kill chain"). The ISR enhancements above helped finding the targets. Chat and ADOCS helped them coordinate. The tools are improving, so it seems we have not hit a physical barrier to reducing the time it takes to hit a target.

In some cases, the AOC played this role because someone had to tie all the players together in order to accomplish the mission. When the opportunity or necessity to react to the enemy is detected by a sensor without the ability to act, someone has to find an actor that can respond and get that actor to the scene. This was the case in the Scud Hunt, Khafji, and many of the incidents in Allied Force, Enduring Freedom, and Iraqi Freedom. It appears that now the ability to do this is limited mainly by scarce resources.

There were other cases where the AOC played a real-time role because it was imperative to ensure compliance with a strategy. In Allied Force and Enduring Freedom, the inability to tolerate tactical mistakes led to tight ROEs that brought the CAOC (and, sometimes, higher headquarters as well) in on many of the tactical decisions. This happened when there was some type of judgment involved in the ROEs. For example, in Allied Force A-10 pilots gradually began checking with the CAOC before attacking targets. In Enduring Freedom, the CAOC had to clear targets with CENTCOM unless they were in specially designated areas. In the beginning, CENTCOM had to clear targets with moderate or high potential for collateral damage with Secretary Rumsfeld. These are the cases where the intervention of the commander inhibits the execution of the tactical mission. It may be that the negative strategic goals outweigh the positive tactical goals. This is the decision the commanders must make.

It is clear that military commanders still agree the way to shorten the OODA Loop is to delegate authority to those able to affect the actions most directly. Both the fusion cell at CENTCOM headquarters in Tampa Bay and the TCT Cell in the CAOC in Saudi Arabia had the ability to direct ongoing missions in Afghanistan. The discussion that led to a change between Enduring Freedom and Iraqi Freedom happened because the air component and the land component had not been empowered to work to the full extent of their capabilities during Enduring Freedom. CENTCOM had taken over some part of each component's responsibilities, so that each thought the coordination was above their level. CENTCOM had to make conscious efforts to empower its subordinates through the definition of the command relationships.

The AOC has learned a similar lesson, although it escapes many observers. It can be confusing that the AOC plays two different roles in the CAOS. It is simultaneously the air component's portion of the Plans subsystem and the lead agent in the Adjustment subsystem. In the last three conflicts, its Plans role was to allocate resources and give guidance to the Adjustment subsystem as to how those resources should be used. It specified fewer and fewer of the details prior to the missions. The TCT Cell and others in Combat Operations then used those resources, the guidance, and the sensor-communications information to prosecute the war as it occurred—with a shorter OODA Loop than the full ATO cycle.

The reason this confuses many observers is that, as we saw in the previous chapter, it is not currently possible to delegate the role of information gathering and distribution much lower than the

AOC. There is no single representation that includes the digital position data and the sensor video; therefore, even if the bandwidth and network existed, it cannot be passed to lower echelons. So the TCT Cell can be looked at as an entity that could be moved an echelon down from the AOC if it were possible to either distribute the information to them or gather the information somewhere else. The ASOC has a limited ability to gather information because it is co-located with corps headquarters. But it would be more convenient to put the TCT Cell in an aircraft with instant communications to both the AOC and the strike aircraft to skip the radio relays. This would be a big step towards the kind of depth of command relationships for which we are searching.

Prophets of Network Centric Warfare envision a time when all in the system will have the ability to access the same information. If this occurs, there will then be a necessity to make conscious decisions about who should make decisions. Gen. Franks made a move in this direction when he established the matrix for TSTs in Iraqi Freedom. This will have to be done in a way that affirms and emphasizes the command relationships, or there will be more problems of the sort that we studied in Chapter 5.

But the next chapter shows us that this move toward getting more people involved in making decisions and providing information has other side effects. Officers in the CAOC did not like CENTCOM being involved in ongoing missions. What is the effect of the CAOC's intervention into ongoing missions on the aircrews—is there a similar effect at this level?

Chapter 8

Distributed Cognition in the CAOS

The computational power of the system composed of person and technology is not determined primarily by the information-processing capacity that is internal to the technological device, but by the role the technology plays in the composition of a cognitive functional system.

- Edwin Hutchins, *Cognition in the Wild*

Some futurists seem continuously anxious to replace humans...in certain tasks without quite appreciating how people accomplish those tasks. In general, it will be better to pursue not substitution but complementarity. ...But complementarity requires seeing the differences between information-processing agents and human agency.

- John Seely Brown and Paul Duguid, *Social Life of Information*[1]

On Saturday, 31 July 2004, the Joint Expeditionary Force Experiment (JEFX 04) took a break from flying missions. The missions that week had gone well enough that they were on schedule and did not need the extra day. Instead, JEFX workers staged an "AOC 101" class where CAOC workers taught the flyers what goes on in an AOC. At one point during the lecture, a lieutenant colonel who had been acting as the Chief of Combat Operations implored his audience to "bear with us," when the instructions the pilots received from the CAOC over the radio seemed a bit odd. Unusual instructions could result from "experiment-isms," or from any situation where the CAOC simply had more information than the aircrew. After all, he reminded them, "We in Combat Operations represent the 'decentralized execution' part of command and control." The stone-cold reception this declaration received from the aircrew in the audience was unmistakable. A moment later, it gave way to murmurs of disbelief.

We have seen that the AOC has become more involved in ongoing missions. Sensor-communications loops have provided the AOC with the "immutable mobiles" it needed to become the most knowledgeable entity in the CAOS. The need to attack some emerging targets with a high level of accountability provided the impetus for the AOC to do this quickly and during the operations, rather than during the planning. The end result is a certain amount of confusion about who is really executing. In fact, the operations required to accomplish a strike mission are now sometimes performed by a distributed group of people.

In his book *Cognition in the Wild*, Edwin Hutchins described the actions of a Navy ship's crew in navigating their vessel. He examined the way different crew members performed specific parts of the

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[1] John Seely Brown and Paul Duguid, *Social Life of Information*, (Boston: Harvard Business School Press, 2000), 62.

task of navigating by using specially made instruments and following pre-determined procedures. Different crew members used tools to gather information, translate it from analog to digital or vice versa, store it, transport it, and eventually bring it together on a chart in a way that made the solution to the question "Where am I?" obvious. Hutchins observed that no single person was performing the entire complex task of navigating. Each was performing only a small task requiring much different cognitive abilities than that complex task would require.[2] Furthermore, Hutchins observed that the tools these crew members used did not amplify their abilities; they transformed the nature of the task that the human performed.

In this chapter we will examine the actions of the people in the CAOS in a similar manner. We will take a fifth look at the period from Desert Storm to Iraqi Freedom, this time concentrating on the actions of the aircrew and ground controllers. We will look at the process of attacking a target as a sort of "fix cycle," where the entire process consists of deciding to hit a certain type of target, finding the target, getting a weapon system to the target, and getting the target information into a format that the weapon can use to strike the target. The "kill chain" of "find, fix, track, target, engage, and assess" (F2T2EA) is the way Air Force officials talk about this sequence. We will not be held tightly to these terms, but will look at the actions required to get and pass the information needed for an attack.

The role of the aircrew in this sequence is in the process of changing. In Desert Storm, those in the physical vicinity of the targets performed almost the entire sequence. But while this was fine for performing CAS and killbox interdiction, it was insufficient to solve the problem of the Scud Hunt. The consequences of using sensor-communications loops and precision weapons that can accept information passed via these means is that the entire sequence may now involve a distributed team. A single sequence can be performed by people distributed from the U.S. to the ground and air near the target. The successful attack of emerging targets depends on a "distributed cognition," rather than the cognition of the aircrew alone. Those in the battlespace are being asked to perform different tasks now than they were in the past. This is yet another reason to strive for depth of command relationships, for without it the CAOS becomes more deadly but more chaotic.

Desert Storm

In Desert Storm, as we have shown, the people in the TACC had very little real-time information to help them figure out what was going on. They assembled the "change cell" to respond to new information by trying to adjust the day's missions. But the real-time adjustment required by the Scud Hunt was beyond anyone's capabilities at the time.

In the Scud Hunt, the sequence often started when wide area surveillance was able to detect a launch. U.S. Space Command alerted CENTCOM when Defense Support Program (DSP) satellites

[2] Hutchins, 173-4.

detected a large infrared signature. CENTCOM then alerted the Patriot batteries to give them enough notice to get them pointed in the right direction.[3] In the example from the previous chapter, the TACC got word of a launch by phone. The information was a time of launch and rough launch coordinates.

The people in the TACC passed the information over the radio. In most cases, they had no way to get more information about the launcher. They could determine the best attack option by getting the experts together over the map table, but in most cases where a launch had already occurred this was too slow. In our example, TACC people let AWACS direct the nearest aircraft to the area. Thus, the same rough coordinates were passed to the aircrew by voice over the radio.

The aircrew then had to translate these coordinates into a visual picture of the launcher. The launch site coordinates were enough to get the aircraft to the general area of the site, with AWACS direction. At that point, the aircrew had to get updated or refined information to the weapons to get them to the target. The launcher may have moved in the time it took to arrive at the site. Even if it had not moved, the pilot had to visually find the target in order to engage. But to do this, the aircrew needed sensors with the ability to pick the launchers out of the background, which usually included night conditions. The F-15E was the favorite platform because it had infrared and synthetic aperture radar sensors, so it could search at night. F-16s with infrared LANTIRN sensors were devoted to this task as well. Even the lumbering AC-130 gunships were used because of their infrared and low light level television.[4]

People on the ground near the site would have made good sensors. One of the recommendations Tritschler proposed was to send special operations forces into western Iraq to hunt for Scud launchers. When they were finally sent, he was hopeful—the British Special Air Service (SAS) came to coordinate with him at the TACC. At the beginning of each day, Tritschler rolled out a piece of acetate on top of a chart, and an SAS representative showed him where their special forces were going to be that day. Tritschler then developed no-fire areas to protect them. For the American special forces, the process was reversed. They did not coordinate with the air component, but instead called the western AWACS on guard to notify them they were establishing a no-fire area. Then AWACS had to distribute this information to all aircraft in the area, whose pilots had to try and mark their charts while flying. This was

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[3] Thomas C. Hone, Mark D. Mandeles, and Sanford S. Terry, Lt Col, USAF, "Command and Control," Part II, Vol. I, *Gulf War Air Power Survey*, (Washington, U.S. Government Printing Office, 1993), 249. John E. Shaw, "The Influence of Space Power Upon History 1944-1998," *Air Power History*, vol. 46, no. 4 (Winter 1999).

[4] Barry D. Watts and Williamson Murray, "Operations," Part I, Vol. II, *Gulf War Air Power Survey*, (Washington: U.S. Government Printing Office, 1993), 183-8. The F-15 and F-16 infrared sensors were called LANTIRN for low-altitude navigation and targeting infrared for night. MGen Corder wrote up the tactics and procedures for the Scud Hunt in CENTAF TACC/CC/DO Current Ops Log, Vol. 1 of 2, 27 Jan 2300Z, NA-215, GWAPS collection, AFHRA. (Secret) Information extracted is unclassified.

so difficult that the pilots gave the entire area significant latitude.[5] In the end, special operations forces were no more successful than the air component at finding and destroying mobile Scuds, and the two were not able to link up as a sensor-weapon team.

The process was very similar for killbox interdiction. The difference was that the targets—Iraqi armor and artillery—were much more plentiful and predictable. They were part of a large, regular army that was massed and dug in for the defense. Therefore, U.S. intelligence was able to determine where in general the targets would be—wide area surveillance was not necessary as it was in the Scud case. In addition, the desert battlefield environment afforded the targets little opportunity to hide. However, the Iraqis made good use of the five months preparation time and their experience from the Iran-Iraq war to bury and camouflage their equipment. Combined with the extent of the theater and the dispersal of the Iraqi equipment, this made it difficult to determine the location of specific targets.[6]

So the aircrew knew what, but not exactly where, they should attack. The sequence started with the Army's intelligence determining what it wanted airpower to attack. Aircrew took off with their ATO tasking, which included an area in which to search and a prioritized list of targets for which to search. They were directed to the killboxes by AWACS. Then they contacted the ABCCC or the Marine Direct Air Support Center, if the killbox was in the 1st Marine Expeditionary Force's (MEF's) area, who gave them updated targets to attack.[7]

But no one in the existing TACS knew where the targets would be when the aircraft arrived. Neither the AWACS nor the ABCCC could see what was on the ground, and therefore their role in assembling information was limited to relaying it by voice over radio. Only the JSTARS or Army or Marine RPVs could pick up targets on the ground. In fact, there were instances where the JSTARS provided target cueing to aircraft in the killboxes.[8] In these cases, the JSTARS operators or the analysts at the ground stations had to find coordinates for the graphic picture on their screens and transfer these coordinates to the attack aircrew. Then, at least the aircrew knew there were potential targets there. They did not know what they were or how to find them visually. The RPVs, on the other hand, were not well

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[5] Phil Tritschler, Lt Col (retired), USAF, (Deputy CCO in Desert Storm), telephone interview with author, 24 September 2004, recording in author's possession.

[6] Watts and Murray, 267-8.

[7] Hone, Mandeles, and Terry, GWAPS Vol. I Part II, 310-14. This posed another problem: without access to the current ground situation, the ABCCC had only its targeting lists to guide the crew. The Army liaison officer on the ABCCC had ARCENT's prioritized list, which did not match the list in the ATO because the ATO reflected Schwarzkopf's guidance instead of ARCENT's. The ABCCC was caught in a conflict between two different constituencies, neither of which was necessarily reflective of the up-to-date ground situation, with no means to rectify the difference. Randall Soboul, Capt, USA, memorandum, subject: Desert Storm After Action Review, 29, NA-287, GWAPS Collection, AFHRA.

[8] Perry D. Jamieson, *Lucrative Targets: The U.S. Air Force in the Kuwaiti Theater of Operations*, (Washington: Air Force History and Museums Program, 2001), 77, and After Action Report, 8th Air Support Operations Group, "Operations Desert Shield/Storm," 2, TF4-12-230, GWAPS Task Force IV Collection, AFHRA (hereafter known as "8 ASOG AAR").

integrated into the operation. Army and Marine commanders viewed them as means to see the deep battlefield, not means to direct real-time operations.[9]

By 3 February, the pilots of the interdiction aircraft could tell they were not accomplishing much in these killboxes. Weather kept them from picking out targets until they started an attack run, and this did not give them time to discern the primary targets from others, which looked the same at their medium altitude. Early in the planning process Lt. Col. Deptula, the chief Iraq Cell planner, had designed attack packages to remain at medium altitude to keep aircraft and aircrew losses low by staying above the reach of Iraqi anti-aircraft artillery (AAA). Horner had concurred in that approach and endorsed it. At this altitude, the accuracy of non-precision munitions from the F-16 or F-18 dropped substantially.[10] After a bomb drop, the smoke took so long to clear that the pilots could not assess the damage before they went back above the weather or evaded threats.[11] Both the pilots and the people at CENTAF knew something had to be done.

Both the pilots and CENTAF came up with identical plans. The group of Fighter Weapons School instructors that had formed the night change cell, led by Lt. Col. Bob Phillips, resurrected a concept that had been called "Fast FAC" in Vietnam. Shortly after, Gen. Glosson got a message sent by pilots in the 388th FW, telling of the pilots' frustrations and recommending a solution. Both came up with a plan to have specific, experienced pilots fly over the killboxes to validate targets, find new ones, direct other planes to the targets, and assess the damage. They chose F-16s and F-18s to do the job. These "Killer Scouts" stayed over the same areas day after day, logging missions averaging five and a half hours, and became so successful at directing and assessing strikes that Glosson and the air component whole-heartedly embraced the concept, increasing their numbers from 8 to 32 after the first couple days. They had only binoculars and the moving target indicators on their radars, but they were able to piece together a picture of the battlefield that was far more useful than the outdated target lists ABCCC and the DASC had.[12]

Now the aircrew had help finding the targets. Still, for the most part, the aircrew still had to acquire the target visually and then drop a dumb bomb on the target. The results suffered because of this awkward method of transferring the information to the weapon.

In early February, the air component figured out how to use precision munitions to perform some of these attacks. At that time, F-111 crews noticed that their infrared sensors could detect the buried

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[9] 8 ASOG AAR, 2, and William R. Cronin, Maj, USMC, "C3I During the Air War in South Kuwait," *Marine Corps Gazette*, Vol. 76, No. 3 (March 1992), 36.
[10] Watts and Murray, 260.
[11] Mark A. Welsh, Lt Col, USAF, student at National Defense University (commander of the 4th FS and one of the first Killer Scouts in the war), "Day of the Killer Scouts," Air Force Magazine, Vol. 76, No. 4 (April 1993), 67.
[12] Ibid., 67-8.

armored vehicles at the end of the day, when the sand cooled more quickly than the metal.[13] Now pilots had a way to transfer the information to the weapons. Cueing from Killer Scouts or JSTARS told them where to look. They found the target visually, using infrared sensors. Then they put a laser spot on the target, and the weapon followed it in. Aircraft with infrared sensors and the ability to drop laser-guided weapons, like the F-111, F-15E, and A-6E, were able to "engage" with a single, 500 lb. bomb per tank. In the desert environment, the only constraint this arrangement was unable to overcome was bad weather—it still required the pilots to "see" the target with their infrared sensors.

Precision munitions made up only about 10% of the munitions used in Desert Storm. For the most part, they were the same type that had been used in the Linebacker campaigns during Vietnam—laser guided bombs (LGBs).[14] These required the aircrew to keep a laser spot on the target throughout the missile's flight so the missile could guide to the reflected energy. Mavericks were new. The Maverick missile tracked infrared energy from a target, and therefore needed the aircrew's help only to lock onto the target signature, after which the crew could "launch and leave." But only A-10s and F-16s were capable of employing Mavericks; F-16 pilots were not trained to employ them and F-16 avionics were not optimal for Mavericks. Only 130 F-16 sorties employed Mavericks, while over 8,700 employed dumb bombs.[15]

The Killer Scouts added another level of depth to the command relationships the air component had already set up. Before the Killer Scouts, aircrew were on their own in the target area; with the Killer Scouts, they were given targets. The find, fix, and target portions of the chain were all performed by the Killer Scout.[16] The strike aircrew still had to find the target visually and then engage, but the scout even helped assess the attack. Because the Killer Scouts were guided by the ATO and ABCCC target lists, they extended the TACC's ability to align these attacks with the overall strategy to an area where this alignment had been absent.

With the CAS mission, the terminal control was more formal. Airmen had long been convinced of the need for terminal guidance in supporting ground troops. Back in World War II, airmen had learned that someone in the vicinity of the ground troops had to identify targets and keep the attacking aircraft clear of the friendly forces. By Desert Storm, the concept of the Tactical Air Control Party (TACP) was well established. The TACPs included an Air Liaison Officer (ALO) and several enlisted controllers. They were Air Force people attached to Army battalions, brigades, or divisions. Then, at the corps level, an Air Support Operations Center (ASOC) coordinated the efforts of all the TACPs under it.

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[13] Jamieson, 81.
[14] David R. Mets, Col, USAF (ret.), "The Long Search for a Surgical Strike: Precision Munitions and the Revolution in Military Affairs," Cadre Paper No. 12, (Maxwell Air Force Base, Ala.: Air University Press, 2001), 35.
[15] Watts and Murray, 261.
[16] Comments on an earlier draft by Phil Haun, Lt Col, USAF, 355 FS/CC, email, 11 April 2005.

As with Killbox interdiction, there was never much doubt about the general area of the targets. By definition, CAS is performed in the vicinity of friendly forces. But just as with killbox interdiction, aircrews did not know where the targets would be until they got there. Unlike killbox interdiction, there is another imperative besides engaging the target: staying clear of friendly forces.

Therefore, TACP people filled two roles. They had sensors, in the form of ground troops. They or their associated ground troops detected the targets, aiding the aircrews in finding targets that emerged and could not be put into an ATO because of their time latency. For this purpose, they had only binoculars and radios.[17] The corps level had RPVs, but as we said, these were viewed as assets for the corps commander to see the deep battle, not to aid the close battle.[18] Of course, unlike with the Killer Scouts, the TACP people did not make the decisions about which targets to attack—the Army chain of command did this.[19] But even more importantly, the TACPs were there to avoid fratricide. They were trained to follow strict procedures, transmitting a "9-line" brief to the fighters for each target. The TACPs also had suitcase-size GPS receivers, which made them popular with the Army commanders.[20]

TACPs directed the aircraft, while the ASOC coordinated to get the aircraft there. The CAS sequence started when troops encountered the enemy and decided they needed air support. If the target was not urgent, Army channels sent it up the chain as an air support request (ASR), to become part of the ATO. But if it was urgent, they notified the TACP, who passed it up from battalion to brigade to division and finally to the ASOC at the corps level.[21] At each level, the ALO filtered the requests to determine which were priorities to receive the available Push CAS sorties. The ASOC had the final say, allocating sorties, informing the ABCCC, and sending the information back down the chain to the originating TACP, who took over directing the aircraft.[22] Battalion TACP people directed most of the aircraft, and those above that level served more as "traffic cops" to prioritize and allocate resources.[23]

Then the TACP or an airborne Forward Air Controller (FAC-A) transferred his knowledge of the target to the strike aircrew. If either the ground controller or the FAC-A could see the target and the

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[17] Bryan Lanning, TSgt, USAF, Joint Tactical Air Controller Instructor, Air-to-Ground Operations School (Battalion ETAC in Desert Storm and Iraqi Freedom), interview with author, 31 July 2004, recording in author's possession.
[18] 8 ASOG AAR, 2.
[19] Comments by Haun, 11 Apr 05.
[20] One Brigade ALO recalled he traveled as the number three vehicle in his brigade's convoy so his brigade commander could keep track of the brigade's position. The commander instructed the ALO to call the ASOC every 30 minutes to update the brigade's position. Walter Sams, Lt Col, USAF, (Brigade ALO in Desert Storm, SEAD Duty Officer in CAOC in OIF), personal interview with author, 26 March 2004, recording in author's possession.
[21] Lanning interview.
[22] The ASOC had CAFMS terminals and could look at the ATO to determine which aircraft should support a request. TACPs did not look at the ATO very often. They noted the only way to get it from the ASOC to them was to hand deliver it by floppy disk or hard copy, because there was no way to get it to the TACPs. Sometimes that meant an extra 150-mile trip per week to coordinate. (U) Lessons Learned, Detachment 1-1, 602 TAIRCW, "I. Operational Issues," TF4-12-228, GWAPS Task Force IV, AFHRA.
[23] Sams interview.

strike aircraft, they could try to perform a "talk on"—to help the strike aircrew find the target by describing the scene below, thus orienting the strike aircrew to the picture they were seeing. This was done by voice, over radio, essentially translating the controller's view of the target into a verbal description that could be transmitted to the aircrew over the low-bandwidth medium of voice communication by radio. The aircrew then had to assemble this information and relate it to what they were seeing on the ground to create their own knowledge of the target location. This "talk-on" was and is an essential skill for these controllers, and in Desert Storm they are the only ones who performed it.

The sequence worked well for the very few CAS sorties flown during Desert Storm. The TACPs found the targets, the chain of command up to the ASOC determined whether a target would be engaged, the AWACS and ABCCC got the aircraft to the area, and the TACPs or FAC-As helped them find the target visually. After action reports estimated that, with the Push CAS system, they never waited longer than 15 minutes for an aircraft to respond to a request.[24]

Still, they were unable to overcome some of the constraints imposed by the demanding mission. Weather hampered the aircrew's ability to find the targets they were being directed to attack. When 20-year-old Air Force Sgt. Bryan Lanning headed into Kuwait through the Rumaliyah oilfields with the 24th Infantry Division, it was not long before he needed CAS. Although Lanning worked at the battalion level, getting clearance up the chain was easy—the brigade TACP was already screaming for help. They were given A-10s within minutes. In fact, aircraft stacked up, waiting to help. But the weather was bad—low clouds obscured the battlefield from the pilots. Having gotten guidance from Horner that all stops were to be pulled out, the pilots dipped low beneath the clouds, but were unable to visually sort out the friendlies from the targets before the Iraqis zeroed in on the perfectly-contrasted black aircraft against backlit clouds. It was more than three hours before the weather cleared enough to allow the aircraft to come in with laser-guided munitions and aid the 24th ID in destroying the Republican Guard forces.[25]

In Desert Storm, for missions where it was impossible to know the exact target or location beforehand, the aircrew had a great deal of freedom and responsibility in executing the "kill chain" sequence. Even when there was a specific target, aircrew were usually only given rough coordinates. Command and control aircraft directed the strike aircraft to the general location, but then the aircrew had to find the target visually, and then transfer the information to a weapon. Killer Scouts and TACPS or FAC-As could sometimes guide aircraft to a specific target by transferring their knowledge over the radio to the strike aircrew, who then had to assemble that knowledge relative to their own view of the world. But in all cases, the aircrew had to find the target visually (although sometimes aided by infrared) in order to transfer the information to a weapon through an aimed delivery or a laser spot on the target.

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[24] Lessons learned, "4 ASOG DESERT SHIELD/STORM Lessons Learned," 6, TF4-12-228, GWAPS Task Force IV Collection, AFHRA.
[25] Lanning interview.

Because of this awkward method of transferring information, the TACC was not involved in very much of the process. The ATO merely allocated sorties to Scud Hunting or Killbox Interdiction or Push CAS. Tritschler did his best to give guidance to the Scud Hunters, and the change cell people did get together to assemble information for some missions. But even in these cases, the aircrew still had to find the target on its own.

Allied Force

In Kosovo, the question of what to target was more complicated than it had been in Iraq. We have discussed the disagreement between Lt. Gen. Short and Gen. Clark over how to fight the war, and the fact that at the outset, the air component was not equipped to fight a ground war without friendly ground troops. The establishment of the Kosovo Engagement Zone (KEZ) on 14 April seems at first similar to the establishment of killboxes in Iraq. Indeed, the purpose was to allow aircraft to engage ground targets without the help of friendly ground troops—just like in Iraq. Specially designated A-10s, F-16s, and F-14s flew over the KEZ, found targets, and directed other aircraft to strike them. But that is as far as the similarities went.

Target identification was 95% of the problem in the KEZ.[26] The Iraqi military had been deployed in defensive positions in flat terrain, so wide-area search to find the equipment was not difficult. In Kosovo, there was no invading army to force the Serbs to take up positions, move to reinforce each other, or even use heavy supply convoys. The Serbs were free to move in small numbers, at will, and in unorthodox vehicles if necessary. It was like the problem of finding the mobile Scud launchers, without the tell-tale launch. In addition, Kosovo afforded mountainous regions and vegetation that aided the Serbs' efforts at camouflage and concealment.

The FAC-As had little to aid them in the quest to "find" and "fix" targets. Before they took off, they were given a list of the most up-to-date targets the CAOC had to offer, but it was 12-24 hours old and invariably the targets were not there by the time the FAC-As showed up. The pilots were unable to get imagery from satellites or UAVs at their units, so they were unable to get previews of any previously identified targets. They took off with very little information about where the targets were.[27]

They coordinated with the other airborne elements of the TACS for help in solving this problem. In Kosovo, this was the ABCCC, the AWACS, and the JSTARS. For the majority of the missions in the KEZ, the FAC-As dealt with the ABCCC. By this time, the ABCCC had an updated electronics suite that included Link 16 datalink information, so the 12-person battlestaff in the back of the EC-130 aircraft

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[26] Tactical Analysis Bulletin 99-1 "KEZ Mission," X-3, AWOS stand-alone database, AFHRA. (Secret). Information extracted is unclassified. Haun email.

[27] Chris Haave, Col, USAF, "Target Identification and Rules of Engagement," in Christopher E. Haave, Col, USAF, and Phil M. Haun, Lt Col, USAF, editors, *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as told by the Airmen Who Fought in Operation Allied Force*, (Maxwell Air Force Base, Ala.: Air University Press, 2003), 138.

could view a computerized image of all friendly aircraft and known enemy positions superimposed on a map of Kosovo and Serbia. On a laptop, they could view a detailed map of the ground, provided by the National Imagery and Mapping Agency (NIMA).[28] This did not help them locate the type of targets the FAC-As were looking for. Essentially, the ABCCC became an extension of the AWACS, handling part of the job of directing air traffic and passing information back and forth between the FAC-A and the CAOC.

The JSTARS was more help, with its moving target indicator and synthetic aperture radar sensors, and FAC-As sometimes worked directly with them. However, the mountainous terrain of Kosovo made it difficult to keep a track on moving vehicles, which were sometimes lost in the shadow of a hill. The crew searched in MTI mode most of the time, but switched to SAR if a target disappeared, to determine whether it was masked by the terrain or just stopped. The main problem with JSTARS was that it could not identify the targets. FAC-As had to fly to the area to visually identify the targets.[29] At first, they responded to every JSTARS prompt, but eventually found this a waste of time if they were already working on another target.[30]

Later in the war, the air component started to use JSTARS and Predator as a team. The wide surveillance of JSTARS and narrow, high resolution picture of the Predator seem to be natural complements. But JSTARS crew members remarked it was not standard procedures. People onboard the JSTARS or in the CAOC started to use Predator to refine JSTARS targets mainly when JSTARS had to leave an area for another target. The Predator was also too slow to fly over and check out all promising JSTARS targets.[31]

Most of the time, the FAC-A was on his own. The A-10s flew in the daytime, and had only their own eyes and gyro-stabilized binoculars. The F-16s and F-14s flew most of the night missions, because they had night vision goggles and a targeting pod, which was the most often-used piece of equipment for them. The F-16's targeting pod was an infrared device that displayed video of the temperature differential on a four-inch square monitor near the pilot's knee. The pod had two settings: narrow, with a 1.7 degree field of view; and wide, with a 6 degree field of view.[32] Neither was satisfactory for finding targets from 10,000 feet above ground. After the Djakovica incident, where an F-16 FAC-A mistakenly directed a strike on a column of vehicles that contained civilian vehicles, Short allowed the FAC-As to descend to 5000 feet to verify targets.

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[28] Michael R. Gordon, "A War out of the Night Sky: 10 Hours with a Battle Team," *New York Times*, 3 June 1999, 1.

[29] Mustafa Koprucu, Lt Col, USAF, 552 OSS/DO (JSTARS Senior Director on JSTARS in Kosovo), telephone interview with author, 6 April 2004, notes in author's possession.

[30] Haave, "Target Identification and Rules of Engagement," 138.

[31] Koprucu interview.

[32] Jeffrey R. McDaniels, Maj, USAF, "VIPER FAC-A: Effectiveness of the F-16 Block-40 (U)," (Master's thesis, Air University, April 2000).

It was also the Djakovica incident that tightened the rules for "targeting." We have already discussed the fact that the Fielded Forces part of the Flex Targeting Cell started becoming more involved in approving targets, even though they often had only the information they were fed over the radio. This was frustrating for the FAC-A pilots. In the A-10 pilots' account, the veterans claimed it "usually took 15 to 20 minutes to obtain approval." On one occasion, Lt. Col. Christopher Haave asked the CAOC—through ABCCC—for permission to attack a target and waited 25 minutes, after which the answer was to "use the gun and not hit any houses!" During the wait, clouds moved in and foiled the opportunity. Haave cited the delay and tactical direction as "absurd" and a "clear violation of the principle of 'centralized control and decentralized execution.'" He argued that the pilot was the expert on the decisions that needed to be made, and had been "fully capable of making a real-time execution decision consistent with ROEs that centralized control had generated."[33]

The incident suggests a lack of empowerment took away the aircrews' initiative. Why did Haave even ask for permission if there were ROEs to guide the decision? Co-author and fellow A-10 pilot Lt. Col. Phil Haun explained that as the ROEs got tighter and started to change regularly, pilots got wary of making decisions. Once they found they had to ask permission to attack some targets, they started asking permission for almost all.[34]

There were occasions when the CAOC had more information than the FAC-As. On those few occasions when the CAOC had Predator video of a target, they truly did have a better picture than the FAC-A did. In these situations, the visual representation of the battlefield (albeit a "soda straw" view of it) was digitized, sent back to the CAOC, and reconstructed exactly as the sensor saw it. This is what made possible the "centres of calculation," as we saw in Chapter 6. As we discussed before, aircrew did not seem to mind being directed when they were receiving a new target—conflict occurred when the aircrew had to ask permission to strike a target only they could see.[35] Still, this put the CAOC people in a position that was formerly only occupied by a Killer Scout or a TACP.

In these cases, the CAOC had to transfer the target location to the FAC-A by means of a talk-on. As we discussed, the talk-on was formerly an exclusive tool of the TACP and FAC-A, who were trained and experienced in this method of knowledge transfer. It is a procedure so conceptually simple it seems to be common sense. Yet the book published by A-10 pilots after the Kosovo war pointed out that, in their view, it was frequently performed incompetently. In one case, Capt. Joe Brosious remembers being so confused by a particular talk-on from Moonbeam that he wrote it out in grease pencil on his canopy.

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[33] Haave, "Target Identification and Rules of Engagement," 147-8.
[34] Phil Haun, Lt Col, USAF, 355 FS/DO (A-10 FAC-A during Allied Force), email to author, 11 March 2004.
[35] This is backed up by the Haun email as well.

He then made sense of it by comparing it with various features he saw on the ground.[36] In another case, the pilots pointed out that the narrow field of view of a Predator made it difficult to translate the UAV's picture to the wide field of view the pilot had with only his eyes at his altitude.[37]

But even after this part of the sequence had been accomplished, the next problem was getting other aircraft to strike the targets. The FAC-A could store the target location in his memory and direct other aircraft to it as they became available, so the Predator could be released to other areas. Transferring the information to a strike aircraft was still difficult. None of the strike aircraft were equipped with Link 16, although some of the F-16s had an Improved Data Modem that allowed them to send data to similarly-equipped F-16s.[38] But most of the strike aircraft still dropped weapons that required the pilot to see the target himself—dumb bombs, LGBs, or Mavericks. The F-16 targeting pod could "buddy-lase" for another aircraft's weapons in certain situations.[39] Sometimes the FAC-A could drop a bomb or smoke to mark the target. But much of the time, the FAC-A had to perform a talk-on to get the other pilots' eyes on the target.

Even transferring the information using target coordinates was difficult for the A-10s. F-16 pilots with a targeting pod could merely center the pod on the target and read digital coordinates off the screen. But A-10s did not have this capability. Lt. Col. Haave explained the process of getting coordinates for a target entailed:

1) finding the general area on a large-scale map that could translate the area to a small-scale chart (from a 1:250,000 to a 1:50,000, for example);

2) finding the corresponding small-scale chart and determining the target coordinates by matching the terrain features to those the pilot could see on the ground. Then following the contour lines to determine the target's elevation;

3) storing the coordinates and elevation by writing them (often in grease pencil on the canopy of the aircraft);

4) using aircraft avionics as slide rules to convert the coordinates and elevation to units the other pilots could work with;

5) passing the information over the radio to the other pilots.[40]

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[36] Joe S. Brosious, Capt, USAF, "A Monkey and a Giraffe," in Christopher E. Haave, Col, USAF, and Phil M. Haun, Lt Col, USAF, editors, *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as told by the Airmen Who Fought in Operation Allied Force*, (Maxwell Air Force Base, Ala.: Air University Press, 2003) 203-5.
[37] Chris Haave, Lt Col, USAF, "Tactical Innovation," in Christopher E. Haave, Col, USAF, and Phil M. Haun, Lt Col, USAF, editors, *A-10s Over Kosovo: The Victory of Airpower over a Fielded Army as told by the Airmen Who Fought in Operation Allied Force*, (Maxwell Air Force Base, Ala.: Air University Press, 2003), 211.
[38] McDaniels.
[39] McDaniels.
[40] Haave, "Tactical Innovation," 210.

This is all very similar to the process we described in Desert Storm. The "kill chain" sequence was performed by passing visual pictures over the radio to a receiver who then had to assemble another visual picture in his mind. There were improved sensors in that Predator was available, and when used it made a big difference; but there were not enough of them to make an appreciable difference. Most of the time, the FAC-As' eyes were the sensors.

But the interaction of a different kind of war and a different environment caused several distinct differences. First of all, there was not as good an idea where the enemy troops could be found. The Serbs did not have to fight from conventional, prepared positions and could use the terrain to hide. Second, there were no ground troops to aid in target identification and collateral damage avoidance. Third, the CAOC got involved in the "targeting" part of the sequence frequently. They frequently made the decisions about whether to execute a strike, to the frustration of the pilots.

The engagement part of the sequence was also similar, except that there were more precision munitions. In Kosovo, 29% of the munitions expended were precision munitions.[41]

However, although this may look like only a minor evolution from Desert Storm, it masks the important changes that were occurring. In 1997 and 98, the B-2 underwent operational testing to allow it to drop a new munition: the 2000 lb. Joint Direct Attack Munition (JDAM), a GPS-guided bomb. The B-2 was the only aircraft to employ the weapon during Allied Force. Furthermore, because the JDAM was useful only against fixed or, at best, relocatable targets, it could not be used for KEZ missions.[42] Therefore, it had minimal effect on the operations of the fighter pilots who flew those missions.

Enduring Freedom

This was not the case in Enduring Freedom. By the time the U.S. went to war against the Taliban and Al-Qaeda in Afghanistan, other aircraft had been certified to carry JDAMs. Because the bombs were inexpensively made by attaching a tail kit to Mk-84s and BLU-109s—older bombs stored in huge numbers around the world—there were many of the weapons available as well. Their big advantage was that they were not reliant on visual acquisition of the target (by the aircrew or the weapon). They were guided by an inertial unit that could receive updates through a simple GPS receiver during the bomb's fall to the target. Therefore, they could be launched at night or through bad weather.[43]

Of course, this capability only solved problems in one part of the "kill chain" sequence: the "engagement." The JDAM did not make it any easier to find targets. In fact, it required extremely accurate intelligence about the location of the target. And in this war, the decision about what was a valid

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[41] "Air War Over Serbia (AWOS) Fact Sheet," 31 Jan 00, 6. Although PGMs were only 29% of the weapons dropped, they hit 64% of the DMPIs.

[42] Briefing, Jeffrey R. Ball, "JDAM Weapon Effectiveness and Accuracy over Serbia (U)," *Air War Over Serbia (AWOS)*, Force Applications Operations Focus Area, Interim Report, 14 March 2000, slide 7. (Secret) Extracted information is unclassified.

[43] Mets, 43.

target was most often made at a high level. The policy-makers were very concerned about the possibility that collateral damage in Afghanistan could send the wrong message. The U.S. was not fighting against Muslims—only terrorists and those who would harbor and aid the terrorists. Without accurate, discriminating information about the locations of these targets, airpower would be subject to some of the same limitations that had frustrated aircrews over Kosovo. Concern in the CAOC was that the CENTCOM leadership was taking the approach of fighting Enduring Freedom using the approach of the last war—Allied Force—even though the conditions in Afghanistan were very much different than those in Serbia and the impetus for war was different—the U.S. had just lost over 3000 innocent civilians.[44]

The solution was to deploy sensors that could get the required information. We have seen that the process of trial and error convinced the special forces troops that they must have the ability to get accurate coordinates and then direct aircraft to those coordinates. The technology to which these special operations tactical air controllers (SOTACs) turned was much improved over the equipment used in Desert Storm. They had the option of taking a laser designator or a range finder, both of which could provide precise coordinates for a target. Later, they started deploying with laptops that had digital maps that could provide accurate coordinates. These SOTACs were able to provide target coordinates and elevations. This was good enough information for JDAMs in most cases. The SOTACs did not have UAVs at their direction, but could ask aircraft with sensor pods to perform reconnaissance for them. In fact, several of the controllers related they had broad permission from the CAOC to work directly with the aircraft. They also had clear guidance on what types of targets they could have the aircraft attack without coordinating, and what types required higher-level coordination. The mountainous terrain allowed them to see for miles and detect targets before they came into contact with them.[45]

Thus, the "kill chain" that involved these SOTACs was often significantly different than it had been for typical CAS in Desert Storm. Just as with typical CAS, the SOTACs were in areas where the enemy was—they traveled with the anti-Taliban troops—so wide area surveillance was not a factor. The SOTACs could aim the laser designator at the target and read accurate coordinates in digital form. They could then pass these by voice over radio—passing numbers over the radio is much easier than trying to talk someone's eyes on to a target when you do not even share the same vantage point. If the target was stationary, the target coordinates did not change, and there was no need to "track" it. There was also no need to talk the aircrew onto the target—"engage" meant drop the weapon within the envelope that

[44] Comments on an earlier draft by David A. Deptula, Maj Gen, USAF, HQ PACAF/DO, email to author, 3 April 2005. He further noted the concern in the CAOC was that CENTCOM was more concerned with collateral damage than accomplishing the military objectives.

[45] Unnamed TSgt, USAF, AFSOC/XP (720 Special Tactics Squadron, Texas 12 during Enduring Freedom-Afghanistan, October-December 2001), interview with author, recording in author's possession. Frank Lofton, SSgt, USAF, 12 CTS (ETAC with 19th Special Forces Group (SFG), 2nd Battalion (Bn), Operational Detachment Alpha (ODA) 923 and 20th SFG, 1st Bn, ODA 2025 from 26 August 02 to 29 January 03), email to author, 6 May 2004.

allowed the bomb to guide to those coordinates. In fact, the aircrew could do this through the clouds or at night. The fact that the weapon could use digital information meant the people involved could pass that information much more easily.

To find targets outside the areas where the SOTACs were deployed, the U.S. had airborne and space sensors. The workhorses were the Predators from the CIA or the Air Force, which sent streaming video back to anyplace that could link into SIPRNET.[46] To drop a JDAM on a target from this information, the CAOC had to mensurate the coordinates. The air component had a new tool called Rainbow right in the CAOC, so they could do this in less than an hour—a major reduction from Allied Force, where the CAOC had to rely on analysts in the U.S. to perform this service. Intelligence analysts had to take a still image from the Predator and use features to line it up with a special digital image map. Then the analyst used special "stereo" glasses to pick out the elevation of the target area. The end result was the same: digital information that was easily passed to the aircrew and, ultimately, to the weapon. But the difference was that the CAOC and even analysts in the U.S. were inserted into the sequence. If the target required high-level approval, Gen. Franks or even Secretary Rumsfeld were sometimes involved in the decision to engage. But as long as the weapon was a JDAM, engaging was easier.

Of course, not every weapon was a JDAM, although the JDAM became the most popular of weapons in Enduring Freedom. Weapons using GPS guidance were only appropriate for stationary targets, and not every platform could carry them. All other weapons required the aircrew to acquire the target visually before engaging. Since the CAOC and CENTCOM both had Predator pictures, they were often able to talk the aircrew onto the target from there. Again, telecommunications technology enabled the CAOC (or CENTCOM) to share the sensor's representation without having to corrupt it during the transmission process. And again, this allowed remote decision-makers to play a part in the sequence that they had been unable to play before.

In cases where the command and control arrangements and ROEs allowed, CENTCOM and the CAOC tried to push these actions down to lower levels. When the AC-130U Gunship was involved, there was a technological aid to this delegation. The AC-130U model had a modification called "Rover," consisting of a receiver and monitor to display the Predator video to allow the crew to orient itself to the target.[47] Now the sensor and shooter could share the representation by passing it digitally, much the way the SOTACs and JDAM-shooters shared information by passing coordinates. The difference, of course, was that in the Rover case, the aircrew still had to translate the representation into information that the

[46] The first Global Hawk UAV was not quite ready for operational service, although it was redirected to look at Khandahar during the prison riot in November 2001. Rebecca Grant, "Eyes Wide Open," *Air Force Magazine*, November 2003, 38.

[47] Robert K. Ackerman, "Operation Enduring Freedom Redefines Warfare," *Signal*, vol. 57, no. 1 (September 2002), 3. Don Richardson, Maj, USAF, 16 SOS/DOT (navigator on AC-130H Gunships during OEF-Afghanistan), personal interview with author, 28 May 2003, notes in author's possession.

weapons could handle. The Gunship crew had to relate the Predator's picture to what they were seeing, find the target with one of their sensors (either infrared, all-light-level television, or radar), and then aim the guns at the target by flying the plane in the correct geometry around it.

The air component also started to train the Predator operators to control aircraft in the absence of the Rover modification. On 8 December 2001, during the battle for Khandahar, an AC-130U aircrew got a call from a Predator operator to attack a target in the town of Mushkill. However, the crew's radio and Rover modification were not working, so they passed the mission to an AC-130H aircrew. Without the benefit of the Rover modification, the Predator and Gunship crews had to pass information that built a mental picture. The Predator was orbiting over the town, while the Gunship was seven miles away, avoiding detection by the enemy. The Predator operator passed coordinates for the target, but at this distance, the AC-130's sensors could not show the crew enough detail for them to find the target—a walled compound with enemy soldiers in it. The Predator operator did not know the Gunship crew could not discern the details near the target, so he spent almost half an hour trying to describe the buildings and empty fields nearby. The Gunship crew did not realize the details they were being asked to discern were too small, so they were searching bigger areas farther from the target. Finally, the two crews verbally backed out of the city and found large landmarks, like a river and a road to lead them into the target area. This accomplished, the Gunship crew went in to the target area.[48]

In this case, the CAOC, and even CENTCOM were aware of the mission. It was a TST. Moseley and Franks were both listening in but chose not to intervene.[49] To the AC-130 crew, the efforts to talk them onto the target were a bit cumbersome but within the normal command and control procedures. The crew's only complaints were that, after the talk-on, the Predator crew tried to direct the AC-130 crew's shots. In effect, the Predator operator was trying to control the "engage" part of the sequence as well.

Another sign of delegation to the lower levels was that the ground controllers were afforded a high degree of authority to clear attacks on targets. There was no ASOC at the time, because as we saw earlier, the conventional U.S. forces with whom the ASOC usually works were not engaged in the fight. Aircrew members related that they were often sent off on a mission with nothing but the approximate location of a ground team and a frequency on which they could communicate with the team. The CAOC did not know the exact position of the teams in real time, because there was no tracking system for this.

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[48] Richardson interview; Marcel Benoit, Capt, USAF, Jason Miller, Maj, USAF, and Steve Gregg, Maj, USAF, 19 SOS (Benoit was an EWO on AC-130H Gunships during OEF-Afghanistan, Miller was a pilot on AC-130H Gunships during OEF-Afghanistan, and Gregg was a pilot on MH-53J Pave Low helicopters during OEF-Afghanistan), personal interview, 28 May 2004, recording in author's possession.

[49] Don Richardson, 16 SOS/DOXT (navigator on this AC-130 mission), email to author, 1 November 2004. In fact, Franks sent the aircrew a personal note congratulating them for a fine mission. The personal note was displayed in a glass showcase in the 16 SOS operations building, next to other war memorabilia. Richardson interview.

The team's word was the clearance to fire. In one case, on 25 November 2001 during the fight for Konduz, an AC-130 Gunship crew stumbled upon a single vehicle heading back into the city. The crew relayed that fact to their ground team, who recognized that this vehicle was part of a plan to launch a counterattack under the guise of surrender. The team cleared the Gunship to fire on the vehicle instantly.[50] Essentially, this was equivalent to a TST, but executed in a matter of minutes. The rapid reaction was made possible by the fact that the team on the ground had authority to clear the attack. They had the authority because the ROEs allowed it, because the target was in an area where an attack would not cause collateral damage and the attacking aircraft was working with and for the ground team.

Because of this authority, their unique mission, and their ability to transfer digital information almost directly to the weapons, the controllers often did not follow standard procedures. In a conference in Kuwait after Operation Anaconda, aircrew recalled most of the calls for fire in the early parts of the Afghanistan conflict were abbreviated. The controllers usually neglected to use the standard nine-line request, but there was such a low volume of aircraft that this probably did not put anyone at risk, although it undoubtedly cost time and efficiency.[51] There were no ABCCC aircraft in the theater and no ASOC, and the over-worked AWACS often used non-standard language to communicate. There was often no need to mark the target, because the munitions were predominantly JDAMs that did not require the aircrew to visually acquire the target.[52] The use of the SOTAC-airpower teams to create effects on the ground in the absence of conventional U.S. ground troops was revolutionary, a point which analysts are right to point out. Indeed, it was a capability sadly missing in Kosovo. But a joint group of participants in Operation Anaconda pointed out that CAS "did not adhere to agreed upon fundamental mechanics." They cited that, "The amount of self-induced friction experienced by all players during the Operation Anaconda was so significant that a JCAS [Joint Close Air Support] Conference was convened at Al Jaber Air Base in Kuwait immediately after the operation..."[53] The authors pointed out that all the lessons from the conference were already addressed in the current joint doctrine, JP 3-09.3.[54]

It is important to realize that this shows a lack of "depth," as we have defined it, in the command relationships. The troops at the lowest level had a great deal of freedom. But this freedom was not a result of intentional decision-making on the part of command and control agencies who could monitor and hold the troops accountable. On the contrary, the freedom was as a result of the fact that it was impossible to attain this level of control. There was a gap in the command and control chain caused by

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[50] Benoit, Miller, Gregg interview.
[51] Haun comments, 11 Apr 05 email. He gave a personal example where imprecise communication had cost him ten minutes of searching, where a nine-line request would have given him a hint that the directions were faulty.
[52] John M. Jansen, Lt Col, USMC, et al, "JCAS in Afghanistan: Fixing the Tower of Babel," *Field Artillery*, March-April 2003, 24-25.
[53] Ibid., 24.
[54] Ibid., 26.

the lack of fully empowered components. In the fluid environment that existed during Operation Anaconda, there was no way for the existing command and control agencies to become part of the "kill chain." There was no way for them to get the information except through the interpretation of the aircrew, so they had a low-fidelity and slightly delayed picture of the battlefield. When things went wrong, the decisions and actions needed to happen quickly.

Even after Anaconda, when troops came into contact in desperate circumstances, the digital equipment was often too cumbersome to be of use. The only solution was often to just put the aircrew in touch with the troops and let the two work things out. On 2 December 2002, Air Force SSgt Frank Lofton was working with an Operational Detachment Alpha (ODA, or special operations A-team). The team was tasked to do reconnaissance of a possible Al Qaeda hiding location just west of Jalalabad. He and two others drove to an observation point and got grid coordinates off the hiding place, a cave complex near the crest of a ridge. When the three had finished getting the information, they noticed people coming from a town only 500 meters away, carrying lanterns. These people were close enough for the three to see they were carrying AK-47 rifles. Lofton and his teammates waited until the unknown group got within 30 meters and turned on their lights, putting them at an advantage. They identified themselves as American in their best Pashtu, but the opposing group started to spread out, enveloping them. The Americans opened fire, but found they were outnumbered and outgunned—troops from a rooftop in the town had opened up on them with a 14.5mm weapon as well. They got in their jeep and sped off in the only avenue of escape left. But because it was night and they were unfamiliar with the terrain, they ended up racing down a boulder-strewn wadi at 45-50 mph, launching themselves off a ledge and cracking the front axle of the jeep on the landing. The other two team members left the jeep to find higher ground; Lofton remained to try and radio for CAS.[55]

It was under these circumstances that Lofton had to try and direct aircraft to help him out. While receiving sporadic fire, he fumbled through his scattered, damaged equipment to find his night vision goggles (NVGs). He flipped to a familiar frequency on the radio, relayed grid coordinates from his GPS to the Special Operations Task Force Commander (C/JSOTF), and got out of the jeep to try and find an escape route. Finding himself blocked by a ledge on one side and dangerous open space on the other, he got back in to await the aircraft or the enemy, whichever came first. Seven minutes later, two A-10s caught him in mid-prayer as they checked in with him on the radio. Lofton directed the first to make a low pass and drop flares to try and direct the pilot to his position. Fortunately, although the pilot did not see Lofton, the pass was perfect, so Lofton cleared the pilot to shoot 2.75-in. rockets down the wadi, halting the enemy fire. The other two of Lofton's team members contacted the pilot of the aircraft on

[55] Frank Lofton, SSgt, USAF, 12CTS (ETAC with 19th Special Forces Group (SFG), 2nd Battalion (Bn), Operational Detachment Alpha (ODA) 923 and 20th SFG, 1st Bn, ODA 2025 from 26 August 02 to 29 January 03), email to author, 5 May 04; personal interview with author, 28 July 2004, recording in author's possession.

guard frequency, and the pilot helped direct them back to Lofton's position so the ODA could come, an hour and a half later, and pick them up at the broken vehicle.[56]

How ironic that a mission to obtain the type of information that could be passed digitally, almost automatically, from ground controller to the weapon ended up relying on good old-fashioned CAS for a rescue. But this did not erase the fact that in Afghanistan, the seeds of distributed cognition had bloomed into a recognizable fruit. It merely underlined the fact that the distributed way of war was not a substitute for developing depth in the command relationships—only an aid for getting information to the weapons. As Lofton was resting from his near-fatal mission, the rest of CENTCOM was preparing for Iraqi Freedom, a war that would go even a step further towards making the job of attacking a target a distributed job where the pilots' tasks were a mere part of the entire sequence.

Iraqi Freedom

In Afghanistan, the missions seemed to be unorthodox ones. Everything seemed to be either a TST, characterized by the use of Predator or precise coordinates, or it was traditional CAS, where the aircraft and ground controllers worked together over the radio.

Iraqi Freedom was a much more conventional fight from the U.S. standpoint. The U.S. military had conventional forces on the ground. Franks had developed a command structure with a full complement of functional component commanders. The air component would be performing the standard missions: counter-air, strategic attack, interdiction, close air support, along with some other not-so-standard ones. The air component, under Moseley, was satisfied with the prominent role they would play in the targeting process. But underneath these comforting relationships, the roles played by the people involved were continuing to change. The "standard" missions were not always so standard when we examine how the parts of the "kill chain" were accomplished.

Killbox interdiction was based on the same concept that had served the air component in Desert Storm. There was still a provision for a "Killer Scout" of sorts; only now it was called a Strike Coordination and Reconnaissance (SCAR) mission.[57] The SCAR aircrew took off with a briefing from intelligence about the current state of the ground war. But the coalition forces were moving so rapidly this was old news, so it would not tell the SCAR where the targets were. They went to their ATO-assigned killbox, but if it was empty they had to find work elsewhere. The SCAR would often be an F-15E with LANTIRN or a Litening pod, a targeting pod similar to those the F-16s had used in Allied Force. But the pod and even the F-15's radar only gave the aircrew a limited view. They needed a

[56] Lofton interview.
[57] KI/CAS Conops, 3.

surveillance mechanism to put them in the right place. So they tried to get an idea where to look by talking to the other pilots as they were leaving the killboxes to find out what they had seen.[58]

But once in a while, they became part of a distributed team. The ISR division of the CAOC programmed the Global Hawk UAV to fly over suspected enemy positions a few hours in advance of the missions to find targets. Global Hawk put out so much data that it was impossible for the CAOC people to keep up with it. Maj. Kevin Glenn worked as the ISR Manager in Combat Operations, and he recalled the data from Global Hawk was so overwhelming that they frequently had to ignore all the data coming from the UAV, putting it in the "penalty box." Fortunately, analysts in Reno, Nevada were devoted to scouring it. When they found a target, they sent the imagery to the CAOC over SIPRNET and sent word by chat to Glenn. He in turn notified the Interdiction Duty Officer or the TCT Cell on the Combat Operations floor, who sent a datalink message to the F-15E SCAR.[59]

For example, on 3 April Maj. Richard Coe was the Weapon Systems Officer on an F-15E performing SCAR in a killbox south of Baghdad. He and the pilot had taken off, gone to a tanker, and almost immediately been contacted by AWACS to alert them of a datalinked message. In the cockpit, Coe could see a tank symbol on his Situation Display. The display was a view of his world from above, showing his aircraft and his wingman traveling over a map of the battle area. The display showed any threats that Rivet Joint or other data collectors had identified in the area, and it now had a yellow tank. The yellow color alerted him that it was improperly identified—the tank was the best symbol the CAOC could find for the target. While the pilot flew the aircraft toward the area, Coe put a cursor on the symbol and slewed the aircraft's radar and Litening pod to the location to get a view of the actual target. This was a night mission, and the Litening's IR showed him a large group of self-propelled artillery pieces. The two F-15E crews expended their laser-guided weapons and then called in F-16s and F-18s with GPS-guided munitions. Since the other aircraft did not have Link 16, the SCARs had to get coordinates with their pod and read them to the other crews, who typed them into their aircraft's computers.[60]

In this case, the CAOC had a digital means of transmitting information to the aircrew, who could then almost automatically translate that information into a form that the weapons could handle. The aircraft's computer translated the datalink message from the CAOC into a position on its digital map. By placing the cursor there and slewing the sensors to that position, the aircrew pointed the sensors to a location in the real world. By flying the aircraft close to the location and doing some fine adjustment of

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[58] Richard Coe, Maj, USAF, AF/XORC (F-15E WSO during Operation Enduring Freedom and Operation Iraqi Freedom), telephone interview with author, 24 January 2005, recording in author's possession.
[59] Rebecca Grant, "Eyes Wide Open," *Air Force Magazine*, November 2003, 38. Kevin Glenn, 30 IS/CC (Combat Operations ISR Cell Chief during Iraqi Freedom), telephone interview ("penalty box"), 25 March 2004 and email to author, 20 May 2004. (Secret Rel USA CAN AUS GBR) Extracted information is unclassified.
[60] Coe interview.

the sensors, they found the target in that location and pointed the laser designator at it. This gave the weapon, a 500-lb. GBU-12 laser-guided bomb, the information it needed to guide to the target.

When the aircraft had JDAMS, they could even perform this work in bad weather. In late March, fierce sand storms hit the area. With surface visibility of less than 30 feet at times, aircraft could not find targets on the ground using their optical or infrared sensors. Even ground troops could not find targets no matter how close they were. But during this period, the Republican Guard divisions began moving toward the south to surprise the U.S. troops under what the Iraqis thought was the cover of impenetrable weather. JSTARS moving target indicator (MTI) radar picked up tracks of moving vehicles. JSTARS and Global Hawk synthetic aperture radar searched suspected areas for targets that could be attacked with JDAMs. The result was that, although aircraft were working in killboxes and were authorized to execute their missions without terminal control, they were given help through the CAOC at finding the targets to engage. With the JDAMs, the aircrew did not need to (and could not in many cases) find the targets visually, so engagements became a routine part of the sequence.

People in the ASOC were also part of the same type of distributed cognition. When the 3rd Infantry Division was heading north along the west bank of the Euphrates River, Iraqi troops and Fedayeen from the city of An Najaf fought them viciously. The 3rd Squadron, 7th Cavalry got the task of seizing a bridge south of Najaf to help isolate the city. When they finally fought their way across the bridge, they came in contact again. While the squadron was fighting an extremely close-in fight, a JSTARS was monitoring. The crew saw returns on its MTI radar, moving south from Al Hillah towards the bridge fight. With night and weather hampering any optical deliveries, the ASOC in Kuwait chose to send in a B-1 bomber armed with JDAMs. The people in the ASOC used satellite imagery to pick targets along the road where the convoy was passing, with the intent to at least crater the road, if not destroy some of the vehicles. The B-1 dropped its full load of JDAMs and successfully stopped the reinforcements.[61]

Like the people in the CAOC, those in the ASOC had access to UAV and JSTARS video. In Desert Storm, RPVs had mainly been used to show the division and corps commanders what was happening in the deep battle, allowing them to adjust their operations. In Iraqi Freedom, the Hunter UAVs allowed the ASOC people to become part of the "kill chain."

SSgt Lofton had returned from Afghanistan in November of 2002 and was soon deployed to work in the V Corps ASOC. The main ASOC traveled with the 3rd ID, but was unable to set up permanent operations during the rapid move to Baghdad. So Lofton worked out of a rear ASOC in Kuwait. They

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[61] Frank Lofton, SSgt, USAF, 12CTS (worked in V Corps ASOC during Operation Iraqi Freedom), personal interview with author, 29 July 2004, recording in author's possession. History of the 3-7th Cav on its web site: http://www.stewart.army.mil/Display.asp?Page=6D468FDF-4A90-4B87-9FE5-EA681A1C9369, accessed 8 November 2004.

had rigged an INMARSAT telephone to relay information to a mobile communications vehicle that traveled with the 3rd ID, so the people in the ASOC could talk directly to the aircraft. During the 3rd ID's quest to cross the Euphrates River near Karbala, the Hunter UAV flew over an Iraqi multiple-launch rocket system (MLRS) at the exact instant it fired a volley across the river at the U.S. troops. Suddenly, the ASOC in Kuwait was swamped by Army troops from the co-located Tactical Operations Center (TOC), who had been watching the Hunter video as well. As the MLRS scooted away to a hiding place to reload, Lofton tried to talk two A-10s onto the target, using the Hunter video. When the talk-on became too time-consuming, the air boss in charge of the ASOC decided to bring in two F-15Es with laser-guided bombs. Lofton simply fed them the grid coordinates from the Hunter video and let them guide the bombs in the general vicinity of the hiding place. When the second bomb produced a huge explosion, the entire TOC erupted with elation.[62]

This was not a typical CAS mission. Obviously, it had an immediate impact on the close fight. But the request was generated at the corps headquarters in Kuwait—the troops at the front line could not have located the MLRS to direct CAS on it. The ability of the ASOC to use sensor-communication loops allowed Lofton to "find," "fix," "track," and "target" the enemy instantly. Then he transformed the "engage" part by passing information that could be transferred to the weapon without the need for the aircrew to visually find the target. The pilots found the spot on the ground by looking through their heads-up display at a cursor that gave them a read-out of the coordinates where the laser spot would go. Obviously, this is not quite the same as a JDAM, because the LGB did not carry the information with it—it needed to follow the laser spot provided by the pilot. But it is another case where people in remote places contributed information about a fleeting target that the aircrew then had to verify and attack.

There were still plenty of opportunities to execute close-in CAS as well—it was an important part of the success of the land invasion. Whenever there was a troops-in-contact (TIC) situation, that situation received everyone's attention right away. Although many aircraft performed "CAS," the Air Force's workhorse for the under-the-clouds, eyes-on-target tasks was the A-10 Warthog.[63] The A-10s and the primary Marine CAS platform, the AV-8B, were in the midst of upgrades to their information capabilities. The Harriers and one squadron of Warthogs had Litening pods. The Marines also had a downlink system to send the video from the targeting pod down to a FAC's vehicle.[64]

The ground controllers were more capable in OIF than ever before. Joint Forces Command had begun a program to train and equip all controllers as joint tactical air controllers (JTACs), with

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[62] Lofton 29 July interview.
[63] Amy Butler, "As A-10 Shines in Iraq War, Officials Look to JSF for Future CAS Role," *Inside the Air Force*, 23 May 2003, 1. Also Wallace briefing and Hollis.
[64] Tim Ripley, "Close Air Support: Closing the Gap," *Jane's Defence Weekly*, 2 July 2003, accessed via Current Defense News Early Bird, http://ebird.afis.osd.mil.

compatible equipment that could get, process, and distribute information digitally.[65] Bryan Lanning, the Air Force controller we saw in the Desert Storm portion of this chapter, was now a TSgt, deployed to Iraq with an Army battalion just as he had been 12 years before; except, where he had worked with an armored division in Desert Storm, he now "hoofed it" with the infantry of the 101st Airborne Division (Air Assault). Up until 11 September 2001, the equipment with which he did his job had not changed much since Desert Storm, but since then it had improved immensely. He now had a night vision device and a laser designator that interfaced with GPS to give him fairly accurate coordinates. Although many TACP units now had laptop computers with the ability to download and filter the ATO, Lanning did not need it. When he needed CAS, he relayed his request up the chain. Lofton and the others at the ASOC sent the aircraft when they heard the call, so that by the time they received approval from the division and brigade levels, Lanning had his aircraft—usually within 5 minutes. Almost every time Lanning called for CAS, he was in contact with the enemy.[66]

This is the situation in which he found himself on 6 April 2004. After U.S. troops seized the Baghdad airport, they moved in toward East Baghdad. The 3rd ID had gone quickly through the area on its way to a "thunder run" into Baghdad, leaving an empty palace under construction in its wake on the northern side of the airport. The Fedayeen had staked out the palace as their stronghold, and 101st troops were engaging them rifle to rifle. Lanning could see enemy troops in a tower of the palace with his thermal scope, but did not have the firepower to knock them out. He called for CAS and quickly got British Tornados with 1000 lb. JDAMS—not his first choice, because he did not want to take the time to get accurate coordinates. He would have preferred to talk the aircraft onto the target and let them drop laser guided bombs. But he needed the firepower, so he pulled out his Mk-VII laser designator, got coordinates to the bottom of the tower, estimated its elevation, and fed the information to the aircrews by radio. Because of the inherent errors, the JDAMs missed, but the shock from the explosion knocked the people out of the tower. The fight lasted another eight or nine hours, during which time Lanning called in A-10s to strafe with their 30mm guns and drop 500 lb. air-burst bombs.[67]

Such an engagement, reminiscent of the SOTAC-airpower teams from Afghanistan, reinforced the fact that ground controllers and aircrew were now a very capable team. If the ground controller could obtain accurate coordinates and the aircrew had JDAMs, the "kill chain" sequence was easy. During the push to Baghdad, the controllers never worried about obtaining mensurated coordinates—there was no time and the weapons got close enough without them.[68] The flat terrain probably helped here.

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[65] Briefing, Charles Heidal, MSgt, USAF, AFC2ISRC, "USAF TACP Modernization Program Capabilities."
[66] Lanning interview.
[67] Ibid.
[68] Ibid.

This was the backdrop when the F-16s of the 77th Fighter Squadron from Shaw Air Force Base, South Carolina were tasked to perform airborne alert for attack missions. The squadron's mission is normally to perform suppression of enemy air defenses (SEAD). They carry High-speed Anti-Radiation Missiles (HARMs) that lock onto enemy surface-to-air missile radars. But like the Serbs four years earlier, the Iraqis were not using their radars. As a result, although the Iraqis seemed afraid to use their air defenses, they were still present, and air operations were necessarily curtailed in the high threat areas. So three days into the war, Moseley made the decision to turn from SEAD to destruction of enemy air defenses (DEAD). Instead of waiting for the threat radars to radiate, the air component would seek the threat equipment and destroy them, whether they were in use or not. The ATO required the F-16s to be loaded with 25% HARMs and 75% precision munitions. The aircrew were to fly to a specified killbox and await instructions. They were to rapidly attack threats when directed by AWACS.[69]

It was a mission that openly called for them to perform only the small portion of the "kill chain" that we have been describing. The pilots could not plan for anything, because they did not know what the mission would entail. The only factors that affected their pre-mission planning were the type of weapons they would carry and where they would refuel. The aircraft in the 77th FS had no targeting pods or LANTIRN, so the pilots could not search for targets. They took off, went to an air refueling tanker, and then sat in an orbit at their designated position. When they were out of fuel, they went back to the tanker. Each aircraft could stay for three orbit periods (called "vuls" for "vulnerability periods") interspersed with refueling before their time on station was over and they headed home with their bombs, without having—in their minds—contributed to the war effort that day—a point which was not lost on these fighter pilots.[70]

Their response was predictable. In the beginning, the pilots waited through the three vuls. But near the end of the third, they started "flipping through freqs," asking various command and control agencies whether anyone had a target that required their bombs. They found the ground parties receptive to these offers—the only requirement was a set of coordinates suitable for JDAMs or CBU-103s, and as we have shown, the people on the ground could obtain coordinates that were good enough.[71] When the pilots found a target, they checked with the CAOC through AWACS for permission. The usual response was "Stand by," followed by a 15-20 minute wait while the people in the CAOC checked to see whether the target was suitable, including any collateral damage concerns. After a while, the pilots stopped waiting until the third vul to find targets, because this increased their chances of finding a target to attack.

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[69] Scott Manning, Lt Col, USAF, 55 FS/DO, (F-16 pilot with 77 FS in Iraqi Freedom), personal interview with author, 26 March 2004, recording in author's possession.
[70] Manning interview; Michael Stolley, Capt, USAF, 77 FS (F-16 pilot during Iraqi Freedom), personal interview with author, 25 March 2004, recording in author's possession; Jay Mahajan, Capt, USAF, 77 FS (F-16 pilot during Iraqi Freedom), personal interview with author, 25 March 2004, recording in author's possession.
[71] Stolley interview, Mahajan interview.

The 77 FS squadron commander, Lt. Col. John Norman, encouraged them to "Get out there and help Americans."[72]

The distribution of tasks also had the effect of making pilots information gatherers at times. The pilots from the 169th Fighter Wing, a South Carolina Air National Guard F-16 wing, were directed to perform a mission similar to that of the 77th FS. They also started trying to find targets just like the 77th FS pilots did. But aircraft in the 169th FW were equipped with Litening pods, so the pilots could search for targets autonomously. They could also offer another service to the troops on the ground: they could offer to perform reconnaissance. Many times, the ground troops sent them to locations where there were suspected targets. In fact, even after the F-16s were out of bombs, they were in demand. The pilots recorded the target coordinates in mission reports so the CAOC could task others to attack them.[73]

The tendency of pilots to become service providers increased after the 21-day push to Baghdad, when the nature of the Iraq war started to change. On 8 April, three A-10s were hit by surface-to-air missiles while providing support to troops near Baghdad. The CAOC decreed that no flights would go below 10,000 ft above ground without permission. On 9 April, a statue of Saddam Hussein was toppled, providing a visual symbol that power had changed hands. The flow of CAS, which had been so abundant before, stopped like an abrupt end to a rain shower.[74] The urgency had decreased, and the need to limit damage and risk of losses became greater than the need to destroy—especially since the fighting had moved to the urban environment.

The role of airpower was then to do whatever was needed in support of the ground troops. The people in the CAOC had less ability to plan the missions that would be in the ATO. Most missions were flown to fill air support requests (ASRs) submitted by Army or Marine officers. The Army considered any ASRs submitted within 48 hours "immediate" requests, meaning they were submitted directly to the ASOC and the CAOC never saw them.[75] In fact, the procedures were now flipped: the aircrew got the ASRs and told the CAOC which requests they would be supporting.[76] Much of the time, the ground troops were only interested in using the aircraft as ISR assets. The aircraft with Litening or LANTIRN were preferred. AC-130s with their multiple sensors were even more in demand. In Chapter 5, we saw an example of the Marines using the AC-130s as an ISR asset—until the enemy shot at the Marines. In this type of war, with an enemy that looked like the civilians, there was no room for error. There was also no way to determine who had the best information at any given time.

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[72] Manning interview.
[73] Walter Sams, Lt Col, USAFR, 79 FS/ADO (F-16 pilot and CAOC fighter duty officer in Iraqi Freedom), personal interview with author, 26 March 2004, recording in author's possession.
[74] Lofton interview, Lanning interview.
[75] James Prior, Lt Col, USAF (worked in CAOC KI/CAS Cell during Iraqi Freedom), personal interview, 26 March 2004, notes in author's possession.
[76] Charles Stoner, 4 SOS/ADO (and AC-130U aircraft commander during Iraqi Freedom), personal interview, 27 May 2004, notes in author's possession.

Conclusions

Our short history of the engagement sequence gives us a basis to see that new technology has made the air component more capable of finding and engaging emerging targets. In Desert Storm, the TACC was not able to get involved in ongoing missions. TACC people rarely had an up-to-date air picture and had difficulty even talking to the aircraft. Their plan was to let the TACS handle the engagement of emerging targets. They therefore had significant difficulties finding and destroying mobile Scuds. Because the Iraqi Army provided more predictable targets in an open environment, killbox interdiction was more effective. Still, the aircrew had to develop ways to find and direct them to the targets. They turned to the Killer Scout concept. Precision laser-guided weapons allowed the aircrew to be effective while remaining at medium altitude, above the reach of many defenses. But this, like the visual delivery, only worked in good weather. Above all, the process of passing target information to the aircrews was a tedious job, involving breaking a visual description down into bits of information that could be passed via radio, to be reconstructed in the mind of the receiver. It was inefficient and inaccurate, and could really only be done by those in the immediate vicinity of the target.

Several advances aided the evolution. The development of the JDAM provided a weapon that could be guided to a target based only on a piece of information that was easily passed via digital means: target coordinates. If the aircrew had accurate coordinates, there was no need for a visual acquisition of the target. The drawback was that more accurate target information was required. The ground troops got better sensors and the CAOC obtained the ability to pull accurate information off imagery with mensuration systems like Rainbow. These processes really came together in Enduring Freedom, although the pieces were available in Kosovo as well. The air component's capability continued to improve in Iraqi Freedom, where the CAOC was able to prosecute time-sensitive targets more quickly and also aid the SCARs in finding interdiction targets, even during bad weather.

But along with this evolution to greater capability came a subtle and possibly un-acknowledged change in the aircrews' tasks. The process of engaging a target gradually came to include many people distributed in remote places. The aircrew's part in the attack sequence was in some cases just a small part of the chain, while the ground controller, the CAOC worker, and even the analyst back in the U.S. took over other parts of the sequence. The aircrew also started to take on other tasks as their aircraft became capable of gathering information because of new pods or more capable radars. They became service providers in someone else's attack sequence.

What this all means is unclear right now. The number of missions for which this distributed cognition applies is still low. Perhaps there will always be a mix of some where the aircrew have to perform the entire sequence and some where they will be a small part. This makes it difficult to train the aircrew to perform in the cases where their role is limited. Training cannot ignore the other cases,

because they are the ones that require the most competence from the aircrew. However, training must also address the limited role case, so aircrews will know how to play that role.

This distributed cognition also makes a demand on the commander. When aircrew, ground controllers, CAOC workers, and even analysts can find themselves on a team in an instant, the command relationships can be confusing. Suddenly, as in the case we studied earlier where the Marines worked with an AC-130 in Fallujah, the commander in charge may not be the one with the best situational awareness. Commanders must come up with a way to discern who is on the team at a given point and dynamically shift control to the one in the best position to exercise control. But this demand runs headlong into the organizational problems we studied earlier.

There is also another potential problem with the limiting of the aircrew's role. If it is not accompanied by a redefinition and training, there may be a latent potential in the aircrew—the ability and ambition to do more than they are allowed. The next chapter will show us that this could be highly effective in certain circumstances but dangerous in others.

Chapter 9

System Accidents in the CAOS

We have now navigated four conflicts five times, each time telling a slightly different but related story. We have analyzed Desert Storm, Allied Force, Enduring Freedom, and Iraqi Freedom with a view to politico-military interactions, inter-component command relationships, the quest to gather and distribute information at the air component, and the sometimes competing quest to execute the "kill chain" at the force application level. Through it all, we have been most interested in identifying the part that the information and tools played in the behavior of the CAOS. We have delved only shallowly into the implications of those interactions, and whether they were appropriate or not. This is partly because the main point of this thesis is to define the "trade space" within which commanders must view command and control—to define the variables they must think about in order to solve the problem of how much control to delegate and how much to retain. It is also partly because it is difficult to define, in retrospect, how appropriate an action was. Even success is not always a good measuring stick—flawed decisions can be successful with forceful execution or overwhelming advantage in other areas.

How does the JFACC deal with the F-16 pilots who are aggressively trying to contribute to the war effort rather than doing only what they are ordered to do? If they take tasking from the ASOC or DASC, the JFACC loses control of them—they become supporting assets for another commander's objectives. Worse, the air component in all probability also loses the ability to track the effects of their attacks. The targets they are after may not have ever reached the land component's awareness, and the results may be difficult to track, especially since the weapons may be JDAMs dropped at night. The JFACC knows he needs to support the JFLCC, but he also has objectives of his own. Those pilots are there in case the air component needs to use them to destroy threats to the other aircraft or execute a TST.

Commanders must also be mindful of the potential for system accidents. Scholars of systems theory have proposed that netting players together in networks creates a tremendous robustness to random failures. It also, however, increases complexity and therefore makes the system vulnerable to unpredictable and dramatic cascading failures.[1] For example, Charles Perrow prophesies that "We have not had more serious accidents of the scope of Three Mile Island simply because we have not given them enough time to appear."[2] Others have claimed that big blackouts are a natural product of the electrical power grid. The forces to minimize cost put more power onto existing lines until they reach a critical

[1] Albert-Laszlo Barabasi, *Linked: The New Science of Networks*, (Cambridge, Mass.: Perseus Publishing, 2002), 121-2.
[2] Charles Perrow, *Normal Accidents: Living with High-Risk Technologies*, (Princeton: Princeton University Press, 1999), 60.

point. After a power outage, angry feedback from the public drives improvements that make the system more stable. But then the forces to minimize cost take over again, starting another cycle.[3]

The CAOS may be a similar system. Political pressures and technological development have combined to produce innovation in the form of sensor-communications loops that distribute the attack sequence tasks. This has produced a complicated web of possibilities that makes it more difficult to predict the outcomes of some military actions.

We will now look at several mechanisms by which this evolution could lead to accidents. The "friendly fire" shoot-down of UH-60 Black Hawks in the No-Fly Zone over Iraq in 1994 illustrates the possibility that drift in procedures combined with a change in the dynamics of the system can cause accidents. The change in aircrew roles that we saw last chapter has led to such drift several times in our study—the F-16 DEAD missions in Iraqi Freedom and the CAS procedures at the beginning of Enduring Freedom are two prominent examples. However, not all such situations lead to accidents. A system accident requires an incident of such magnitude that it affects the output of the system. The nature of the war determines the type of incident that will trigger this. Commanders try to avoid these situations by imposing constraints on the aircrews. But this can cause drift if the procedures are too constricting for a loosely coupled situation. This also risks the loss of human innovation where it is desirable. Technological development can also help by taking the human out of the loop in some cases. But relegating humans to supervisory roles often takes away the humans' ability to intervene when it is necessary or desirable.

In discussing military actions, it seems almost paradoxical to talk about accidents. In an endeavor so violent, chaotic, and full of risk, how can we even define what an accident is, much less be concerned about them?

In Charles Perrow's *Normal Accidents*, he defines an accident as "a failure in a subsystem, or the system as a whole, that damages more than one unit and in doing so disrupts the ongoing or future output of the system."[4] The transition from incident to accident is where engineers generally install safety features like redundancy to try and avoid accidents. He also distinguishes between component failure accidents, which are due to component failures linked in a foreseeable sequence, and system accidents, which are due to the unanticipated interaction of multiple failures.[5]

According to Perrow, there are two key characteristics that predict whether a system is prone to system accidents. One of the keys is the type of interactions among components in a system, which

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[3] Peter Fairley, "The Unruly Power Grid," *IEEE Spectrum*, vol. 41, no. 8 (August 2004), 25.
[4] Perrow, 66.
[5] Ibid., 70.

Perrow labels either linear—meaning components interact in a predictable chain—or complex.[6] According to his reasoning, if there are complex interactions, there is the potential for failure sequences that are unanticipated, whereas failure sequences in a system with only linear interactions can be anticipated and, therefore, defended against. Another of Perrow's keys to whether failures will result in system accidents is the degree of coupling among components, whether loose or tight—this has been one of our running themes. Perrow claims that complex interactions combined with tight coupling cause unanticipated failure sequences. By now the reader should be convinced that the CAOS has complex interactions—people at any given place in the system are not completely aware of the effects of their actions on others in the system. In addition, our historical study has shown that as the technology evolves, the people in the CAOS are creating new interactions among distributed players. Finally, we will borrow the idea that the principle defining characteristic of a system-level accident is that it disrupts the ongoing or future output of the system.

The accidental shoot-down of two UH-60 Black Hawks in Northern Iraq in 1994 was a system accident—a series of unintended interactions caused an incident so tragic and so unpredictable that it sparked two years of investigation and major redesigns to the "system." On 14 April of that year, two U.S. F-15C pilots were conducting a sweep of the area of operations for Operation Provide Comfort (OPC), the multi-national humanitarian effort to ease the suffering of hundreds of thousands of Kirdish refugees who had fled to the hills during Operation Desert Storm. The F-15s detected radar contacts and, after trying to identify the helicopters electronically and visually, determined they were Soviet Mi-24 Hinds and shot them down. The entire engagement lasted only eight minutes, during which time the F-15 pilots were in contact with an AWACS crew who had originally had radar contact with the helicopters and who were in radio contact with the AOC-equivalent organization. Both helicopters were destroyed immediately, and all 26 people on board perished. Hours later, a team of over 30 technical experts assembled in Turkey to conduct an investigation. Over the next two years this accident investigation was followed by separate military service investigations, congressional investigations, and uniformed code of military justice hearings.[7] The investigations led to many lessons learned and procedural changes. It did not, however, lead to any "smoking gun."

Accidents like the Black Hawk shoot down are disasters – not just because of the lives lost, but because of the inevitable (and seemingly unanswerable) question: "Why?" There were multiple safeguards in place, designed to avoid what happened. Military professionals had designed formal

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[6] Ibid., 78. Perrow notes that these terms are not opposites, although his usage seems to denote such a relationship. His purpose is to describe the degree to which a sequence of events can be understood and predicted based on the perceived interactions in the system. Nonlinear and simple did not seem to apply to these characteristics.

[7] Scott A. Snook, *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq*, (Princeton: Princeton University Press, 2000), 4-10.

organizational relationships and a system of procedural constraints conveyed in an ATO and SPINS to the different organizations. The errors were avoidable. Yet seemingly no one was held accountable.

There were many instances where the constraints put in place did not function as designed. One individual in the organization who was responsible for coordinating procedures between the Army helicopter unit and the air component staff had been reassigned and not replaced, so the Black Hawk pilots had a different version of the ATO than the others. The Black Hawk pilots went about their business in a manner unfamiliar to the fighter pilots: their schedule was so flexible that it could not be published in the ATO. The UH-60s and the F-15s had incompatible radios—the F-15s had anti-jam radios for which the UH-60 radios were not keyed, and the F-15 pilots were not instructed to use another mode. The day of the shootdown, the AWACS crew did not switch the helicopters to a separate controller when they entered the area. Then, when the helicopter returns faded because the helicopters entered mountainous territory, the AWACS crew lost track of them. The crew then failed to inform the F-15 pilots that there were helicopters in the area and did not step in to take control of the situation. The F-15 pilots used sloppy language and a hasty—and ultimately inaccurate—visual identification pass to confirm that they were cleared to fire on the helicopters. The identification friend or foe (IFF) equipment did not operate as expected.[8] These are just a few of the many ways that the constraints that should have prevented the accident were violated.

But why were they violated? In Scott Snook's Book, *Friendly Fire*, he looks at the accident through several different lenses to determine why the people involved did what they did. The fighter pilots, making sense of their world based on their training and pre-flight preparation, essentially did what came naturally to them. The commanders involved relied on the fact that each unit was trained to do its job and the procedural controls would harmonize them. But one of the teams involved (AWACS) was a new crew, untrained in the procedures and not even used to working with each other, not to mention the other teams. Another team (Black Hawks) was not considered an integral part of the overall organization. Since they went about their business in a different way than all the Air Force players, they were considered to be playing by their own rules, and were treated as somebody else's business.

Every player involved had slowly drifted away from strict adherence to the global procedures over time. Because of this drift, in an emergency the procedures that were supposed to guarantee safety were non-existent. Snook calls this process "Practical Drift." Over time, organizations go through different stages that determine how strictly they adhere to procedures. In OPC, when units were initially assigned to the command, they probably followed written procedures strictly. Then they found more convenient ways of doing things as the operation went on. When these deviations were not punished (and were in fact rewarded by the added convenience), they became the norm. For example, the Black Hawk

[8] Nancy Leveson, *A New Approach to System Safety*, draft, 2005, 87-128.

crews did not change Mode 1 IFF codes when they entered the No-fly Zone (NFZ) because they did not have the right ATO. The AWACS crews accepted this because they did not feel the need to get into the Black Hawk crews' business and because the Black Hawks were generally only in the NFZ for a short period of time. The AWACS crews responded by keeping the Black Hawks on a single radio frequency so they could stay with a single enroute controller, instead of switching, as they were supposed to. The OPC commander did not know anything was wrong because he was in tune with the F-16 procedures, which included a non-standard personal communication network with the Black Hawk crews (something the F-15 pilots did not have).[9]

According to Snook, these locally adapted procedures were all seemingly harmless because the different organizations were very loosely coupled. Not much happened on a day-to-day basis, so there was rarely any consequence to going outside of global procedures. In fact, there were perverse incentives—the locally adapted procedures were more convenient.

But when chance intervened and there was an emergency, the players needed tighter control. When the F-15 pilots got radar contact with the helicopters, the actions of the Black Hawk crews, the F-15 pilots, the AWACS crew, and all the staff were tightly coupled—actions taken and even words spoken by one significantly affected the others. By this time, however, global procedures had given way to local accommodations. What had taken over was culture-based action.[10] Worse, there was no one who could take charge and step in, because there were so many who were supposed to be in charge that everyone thought someone else was in control.[11]

Snook's contribution to Perrow's theory was that the degree of coupling and the type of control are variables. Instead of "centralization" and "decentralization," Snook focused on the "logics of action" that drive the actors. People switch back and forth from focusing on the task at hand to following rules, depending on the context of the situation, and these shifts have a predictable effect on the smooth functioning of the organization.[12] So in the end, a complex system is not either tightly coupled or loosely coupled but dynamic. In addition, although Perrow stipulates a certain degree of centralization is desirable in a given situation, Snook showed that the people involved may shift behavior in ways that defy centralized control by procedures or constraints in certain situations.[13]

We have studied other examples where this kind of drift has occurred. In Afghanistan, the SOTACs worked out procedures to quickly and efficiently direct aircraft onto a target. Most of the time,

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[9] Snook, 199-200.
[10] Snook, 182-200.
[11] Snook, 124-130.
[12] Snook, 188.
[13] The idea that organizations do not implement policy as it was intended is not new; in fact, we have introduced the idea already in this work. One of the classic works on this subject is Graham T. Allison, *Essence of Decision: Explaining the Cuban missile Crisis*, (New York: Harper Collins, 1971). However, Snook introduces a new mechanism for this phenomenon: Practical Drift.

these procedures involved skipping lines one through three of the standard nine-line briefing usually given to CAS aircraft. These three lines describe an initial point, a heading into the target, an offset left or right, and the distance from the initial point to the target.[14] As we discussed in previous chapters, several factors made this possible. The pilots did not need to see the target to launch the JDAM weapons they usually carried. There were rarely enough aircraft in the area to require traffic control. The targets were often not in close proximity to friendly troops—the SOTACs had equipment to allow them to find target coordinates from a distance. In fact, we saw that many analysts and military officers alike claimed the mission was so different than a normal CAS mission that it called for new procedures. Nevertheless, there never were any standard procedures developed, so the adaptations could be called drift. It was appropriate for the relatively loosely coupled situation that existed during the initial phase of Enduring Freedom. In fact, it was beneficial. It was this "drift" that enabled the revolutionary marriage of special operations and airpower that helped the Afghanistan opposition forces rapidly overthrow the Taliban.

Then, during Operation Anaconda, the situation transitioned to a tightly coupled situation. Now there were large numbers of friendly troops in close contact with the enemy, and the enemy was not retreating as had been expected. There were many aircraft in close proximity trying desperately to help the ground troops. In this situation, the actions of any of the participants could have significantly affected the others.

For example, during the battle for Takur Ghar peak, the crew of an AC-130H Gunship observed evidence of unintended interactions and tight coupling. While the crew, under call-sign "Grim 32," was heading to their mission area, they overheard a radio call from a helicopter, call-sign "Razor 04," who was looking for a lost wingman. Two helicopters, Razor 04 and Razor 03, had attempted to insert special operations troops to take over the 10,000 ft Takur Ghar peak to observe and call in CAS for the unfolding Operation Anaconda below. Upon landing, Razor 03 had been met by heavy enemy fire. The crew had hastily taken off and maintained control of their damaged aircraft long enough to execute a controlled crash landing seven kilometers away. But in the escape, Petty Officer Neil Roberts—one of the SEAL team members whom the helicopter had been trying to insert—had fallen out the back of the helicopter and been left behind.[15] Grim 32 asked if they could help, and with their infrared and low-light television they were able to locate the crash site of the helicopter that had been shot down.[16]

While helping out was the right thing to do, this put Grim 32's crew at the crossroads of several groups of agencies who were evidently not prepared to interact with each other. The first group was the

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[14] Joint Publication 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, 3 September 2003, V-23.

[15] "Executive Summary of the Battle of Takur Ghar," *Defenselink News*, 24 May 2002, available at http://www.defenselink.mil/news/May2002/d20020524takurghar.pdf, accessed 6 January 2005.

[16] Ian Marr, Maj, USAF, 19 SOS/DOI (Fire Control Officer on AC-130H Gunships in Enduring Freedom), interview with author, 2 June 2004, recording in author's possession.

command and control agencies. The crew was under the command and control of one of the Joint Special Operations Task Forces (JSOTF), and was therefore considered to be in a different category than the fighters and bombers. Although their missions were represented in the ATO, they received their tasking directly from the JSOTF through one of the two Joint Special Operations Air Components (JSOACs) that worked for the JSOTF.[17] They were responsible to one JSOAC, while the mission they were flying was the responsibility of the other. There ensued a discussion of who was in charge over satellite radio. The discussion was muddled by the fact that there was also another JSOTF, with whom the crew was unfamiliar. This JSOTF also claimed some responsibility for the mission, and at one point cleared Grim 32's crew to fire on the landing zone. The crew could not identify the friendly and enemy troops at the time, and did not know what authority this agency had, so they refused to fire.[18]

They were also powerless to affect the action of the friendly ground troops. After Razor 04 had picked up Razor 03's crew and flown back to base, they made the decision to go back after Roberts. Razor 04 inserted the remaining SEAL team members at the same point where Roberts had fallen, but the team quickly took three casualties and found themselves in a deadly crossfire. They disengaged under covering fire from the gunship. However, a quick reaction force of Army Rangers and an Air Force Pararescueman had already taken off and were unable to communicate with Grim 32. The gunship crew tried to tell the two MH-47E helicopters in the Quick Reaction Force to avoid the hot landing zone and use an "offset" area 2000 feet down the mountain because the SEALs had vacated the area.[19] Oblivious, the helicopters attempted to land at the hot landing zone, but one of the two was shot down before the other decided to go to the offset zone.[20]

In the meantime, the conventional air component seemed to be oblivious to the ongoing rescue. The copilot was talking to AWACS, who kept trying to clear the gunship from the area so two B-52s could drop their ordnance on a pre-planned target. The crew of Grim 32 felt the rescue efforts were higher priority and refused. Later, the crew was ordered by the JSOAC to return to base. Neither the ground command and control agencies nor the AWACS were able to help find a replacement to take over, so the crew had to find its own replacement. Finally, the pilot called on guard for "any daylight CAS aircraft," and found an F-15E whose crew agreed to take over.[21] Conventional CAS began dropping bombs on enemy positions, sometimes within 50 meters of the Rangers' position near the downed helicopter, to enable them to survive. After the other Ranger group made it up the steep mountain

[17] This may seem confusing to some readers. A theater combatant commander can set up a JSOTF alongside the conventional Joint Task Force (JTF) if there is a significant job for the special operations forces to perform. The JSOTF would then have its own air component, the JSOAC, just like the JTF has its own air component, the JFAC (commanded by the JFACC). In this case, there were multiple JSOTFs and multiple JSOACs in one of the JSOTFs.
[18] Marr interview.
[19] Marr interview.
[20] "Executive Summary of the Battle of Takur Ghar."
[21] Marr interview.

through three feet of snow, the two groups organized a heroic attack on the enemy positions to gain control of the top of the hill. Finally, that night, they were extracted by helicopter.[22]

In this example, procedural drift led to some mistakes in a complex, tightly coupled situation that resulted in a near-accident. The complicated command structure we identified in Chapter 5 combined with the non-standard arrangements for providing CAS during the initial, loosely coupled period of Enduring Freedom produced confusion during the tense moments of the tightly coupled Anaconda. It is impossible to determine whether things would have been different if there had been a classic component structure with a full Air Support Operations Center (ASOC) and if the controllers and aircraft had been following standard procedures the entire time. But the types of confusion the crew of Grim 32 experienced are exactly the types that these measures are meant to avoid.

This is the risk with the development of the distributed cognition in the previous chapter. With the tasks to attack a target distributed among several remote locations, there is less coherency to the team involved in any attack. There are also more potential avenues to accomplish the same tasks. Even though the F-16 pilots had no pre-planned targets and could not see at night (in the case of the 77th FW aircraft), they were able to find a way to get target coordinates that allowed them to drop precision weapons. There is more potential to devise ad hoc procedures and "drift" from standard procedures when it is convenient.

On the other hand, the advantage is that there is more potential for innovation to solve problems. In Enduring Freedom, the use of Special Operations troops with high technology sensors to call in support for foreign troops was a highly innovative adaptation. It likely turned the tide of the war and made possible the rapid victory to wrest control from the Taliban. Although we have claimed the pre-planned targeting of airpower was done in a very centralized manner, it is also true that the command structure put in place by Gen. Franks gave the special forces troops significant freedom to develop these innovations for emerging targets. In Iraqi Freedom, the F-16 pilots' actions may have contributed to the ground troops' ability to march to Baghdad in 21 days.

It is also worth noting that the Battle of Takur Ghar was not an "accident" under our definition of the term. Though it could be argued that there were mistakes that led to more loss of life than necessary, the "system" was not halted. The troops performed heroically and continued the mission.

Whether a failure leads to an "incident" or an "accident" is determined by whether the system is required to halt its ongoing or future output. There is an issue of scope here: one system's incident is another system's accident. If a panel of experts examines the wreckage of a fighter aircraft and finds that the crash was caused by an unforeseeable interaction of components, the crash may be deemed a system accident. However, if it occurs during a war where numerous aircraft are involved, the air commander will probably treat it as an incident and continue the war. An aircraft and crew together constitute merely

[22] "Executive Summary of the Battle of Takur Ghar."

a "part" in our system, however tragic it may be to lose an aircraft and the human beings on board. Still, in certain cases the loss of an aircraft and crew in combat could be an accident, where in others it is merely an incident.

For example there was a significant difference between the way commanders in Desert Storm approached losses compared with those in Provide Comfort. In his post-war auto-biography, Gen. Norman Schwarzkopf put it this way:

> I detest the term 'friendly fire.' Once a bullet leaves a muzzle or a rocket leaves an airplane, it is not friendly to anyone. Unfortunately, fratricide has been around since the beginning of war. The very chaotic nature of the battlefield, where quick decisions make the difference between life and death, has resulted in numerous incidents of troops being killed by their own fires in every war that this nation has ever fought...This does not make them acceptable. Not even one such avoidable death should ever be considered acceptable. And in a war where so few lives were lost on our side, the tragedy is magnified when a family loses a son or daughter in such a way.[23]

Similarly, Lt. Gen. Charles Horner also noted that, although he tried hard to avoid fratricide, it was "a battle we did not win." However, he also said, "Though all were great tragedies, when placed against the total of air-to-ground attacks, their numbers were quite small—especially compared with other wars. Moreover, we must also weigh in the lives of friendly ground forces saved because air attacks on the Iraqis were so devastating."[24]

The implication is clear. Military commanders want to keep the level of friendly losses as low as possible; but they have a larger purpose: to win the war. Losses to friendly fire and enemy fire occurred during Desert Storm. In the battle of Khafji alone, there were two such events that involved losses of large numbers of U.S. troops. In the evening on 29 January, a malfunctioning Maverick missile from an A-10 killed eleven U.S. Marines. Then on the morning of 31 January, an AC-130 was shot down by Iraqi fire, killing all fourteen crewmembers on board. Neither of these incidents, tragic as they were, caused any break in the air component's efforts.[25]

There were even differences among periods during Desert Storm. Horner took great care to get aircraft to fly at medium altitudes where they would be above the reach of most anti-aircraft artillery during the initial air campaign, despite the fact that it likely decreased the effectiveness of some of the weapon systems. Then at the beginning of the ground war, Horner made it clear that aircrews would significantly increase their risk tolerance in order to support the ground invasion. In his comments on 24 Feb, he stated, "...make sure that the air is there where they need it, when they need it—that's your job.

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[23] Norman Schwarzkop and Peter Petre, *It Doesn't Take a Hero*, (New York: Bantam Books, 1992), 500.
[24] Chuck Horner, Gen (retired), USAF and Tom Clancy, *Every Man a Tiger*, (New York, Berkley Books, 1999), 497.
[25] Jamieson, 99-100, 104. The AC-130 incident, however, was to have significant impact down the road, as it sparked a revision of Gunship command and control procedures.

No excuses. I don't want to have any weather abort or any of that crap. Get up there and do the job the best you can."[26]

This is because the determination of whether the system must halt its output is based on the strategic feedback loops we identified earlier. If the interests are great enough, decision-makers will perceive that the public can accept a higher cost in money and lives to achieve the goals of the war. The loss of 18 Rangers was significant relative to the U.S. goals of trying to stop Mohammed Farah Aideed from interfering with humanitarian aid efforts in Somalia in 1993. The loss of 26 U.N. civilians and troops during a relatively peaceful period was significant relative to the U.S. goals of trying to contain Saddam Hussein and give humanitarian aid to his people in 1994. The loss of 25 troops in 1991 while conducting a major war to eject his entire army out of a nation he had invaded was not nearly as significant. In addition, in the latter case, the troops died defending U.S. troops on the ground.

Similar mechanisms seem to operate in other types of "accidents." Friendly fire is not the only type of failure that can halt the output of air operations. When F-117s struck the Al Firdos bunker in Baghdad in 1991, television media showed pictures of dead civilians. When bombs from a B-2 hit what later turned out to be the Chinese Embassy in Belgrade in 1999, the incident triggered a diplomatic crisis between Washington and Beijing, disrupted negotiations to end the Kosovo conflict.

Policy-makers and commanders alike have become extremely sensitive to these feedback loops throughout the 1990s. When the results of military action could have undesirable effects on the public's perception of policy, policy-makers act quickly to show that the actions were a mistake and that they will not happen again. After the Al Firdos incident, Schwarzkopf effectively halted strategic bombing in Baghdad. The Chinese Embassy strike prompted a halt to bombing of targets in Belgrade for two weeks thereafter. Ever since the media made it possible to speed up these feedback loops, this type of information warfare has occurred.

This is why, in Iraqi Freedom, there were differences in the way the CAOC handled these decisions during the different situations. During the initial push to Baghdad, the CAOC did not deny many requests to attack the targets that the F-16 pilots got over the radio. In fact, when Lt. Col. Sams performed reconnaissance with his targeting pod and found new targets, he provided the coordinates to the CAOC through his mission report, and the CAOC planners typed them into the remarks section for interdiction missions on the next day's ATO.[27] The pilots accepted coordinates directly from ground troops even though they had not been mensurated. In fact, the JTACs admitted they never worried about

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[26] Daily comments of Lt Gen Horner, quoted in Barry D. Watts and Williamson Murray, "Operations," Vol. II, Part I of *Gulf War Air Power Survey*, (Washington: HQ USAF, 1993), 296.

[27] Walter Sams, Lt Col, USAFR, 79 FS/ADO (F-16 pilot and CAOC fighter duty officer in Iraqi Freedom), personal interview with author, 26 March 2004, recording in author's possession. James Prior, Lt Col, USAF (worked in CAOC KI/CAS Cell during Iraqi Freedom), personal interview, 26 March 2004, notes in author's possession.

mensurating the coordinates during this period.[28] The accuracy of their equipment was considered good enough for their purposes. Their immediate concern was getting ordnance on the target quickly. As we saw in Air Force TSgt Bryan Lanning's case, sometimes almost any weapon would do. However, after the statue of Saddam Hussein fell, the flow of CAS stopped. The goal of toppling the regime was in sight, and the fight progressed to the streets of Baghdad, where a mistake could mean significant unnecessary deaths and unwanted media attention.

In this environment, the CAOC came up with a plan to provide calibrated firepower when necessary. In the airspace around Baghdad, they stacked aircraft with different weapons loads, from 5000 lb. bunker-busters to 500 lb. bombs with seekers but no explosives, each tailored to a different situation. The CAOC knew the specific weapons on each aircraft, and could therefore pick the correct weapon for each situation.[29]

Since this solution reduces the role of the aircrew in the attack sequence, it carries with it the potential to cause the drift we discussed earlier. The example of the F-16 pilots in Iraq shows that this reduction in role and the aircrews' latent excess capability caused some tension for the aircrew—the highly trained F-16 pilots, capable of more complex tasks and wanting to contribute, went in search of ways to contribute to the war effort. There is also the Black Hawk shoot-down to show that this drive to contribute, when combined with other factors, can produce disastrous consequences. The F-15 pilots in this case did not have to respond as quickly as they did—they were in no danger, and could have watched the helicopters while working through any confusion that was present. The pilots were conditioned to respond aggressively; in addition, they also had a rivalry with the F-16 pilots, who had made all the kills after Desert Storm (as well as over Bosnia to this point) and would be entering the NFZ in 10 to 15 minutes.[30]

The factor that will determine whether the situation over Iraq during the insurgency becomes like that over Iraq in Provide Comfort is the depth of command relationships. In 1994, the command relationships, although stipulated in procedures, were deteriorated. There was no agreement about who was in charge at any particular time. The players performed their missions by following procedures, which they then modified to fit their missions better. When all the players came together unexpectedly, there was no one with the situational awareness to step in and make command decisions. The CAOC does not yet have the ability to perform this task, because it does not have ability to communicate with all the aircraft during the missions. None of the other TACS nodes have the ability to combine the air picture

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[28] Bryan Lanning, TSgt, USAF, USAF Air Ground Operations School instructor (Battalion JTAC during Operation Iraqi Freedom), personal interview with author, 31 July 2004, recording in author's possession.
[29] John A. Tirpak, "Washington Watch," *AIR FORCE Magazine*, August 2004, 9.
[30] Snook, 95-6, Leveson (2005), 98.

and sensor videos. Only when these two capabilities come together will there be an on-scene command presence with the ability to handle the shift from loose to tight coupling.

The problem with changing the roles of the aircrew is not just in the fact that they may drift from procedures but that their role may become inappropriate. The precision, information, sensor, and telecommunications technologies we have been discussing are making the CAOS much more capable, to the point where it may be over-reaching their ability to keep up. At the same time, the humans are being moved to more supervisory and less hands-on types of tasks. In her book *Safeware*, Nancy Leveson argues against the myth that machines make a system more reliable. Automation does not remove people from systems—it merely moves them to maintenance, repair, and higher-level supervisory control and decision-making. But it removes them from the immediate control of the energies of the system, and instead locates them in central control rooms with only indirect information. This can make them less familiar with what is actually happening in the system and less able to intervene when intervention is necessary.[31]

There was evidence of this problem in the Black-Hawk shoot-down. The AWACS was tracking the helicopters until the helicopters entered mountainous terrain. At this point, the IFF return faded and the Air Surveillance Officer's display dropped the "H" symbol used to identify the helicopters, but the AWACS computer continued to move their symbol at the last known speed and direction. The Air Surveillance Officer placed an "attention arrow" on the Senior Director's display to indicate an area of interest where the helicopters had been. But the Senior Director failed to acknowledge the arrow and the computer dropped it after 60 seconds. Later, one minute before the F-15 pilots detected the helicopters on their radars, the AWACS crew dropped the helicopters' symbols from the scopes, and all reminders were gone.[32] The AWACS crew did not know exactly what was happening with the helicopters or why they had dropped from the scope. The same thing had happened earlier when the helicopters had landed, so they may have assumed that is what happened again. The crew was reduced to monitoring the automatic actions of the sophisticated radar and computer system. When the F-15 pilots checked in on the radio, the AWACS crew was unable to tell them there were helicopters in the area.[33]

With the change in the aircrew's role in the "kill chain," they are also given a similar supervisory role. As we said before, when an aircrew drops a GPS-guided weapon on a target at night or in the weather, they are often unable to verify that the weapon is aimed at the correct target. The aircrew's job

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[31] Nancy G. Leveson, *Safeware: System Safety and Computers*, (Reading, Mass.: Addison-Wesley Publishing, 1995), 10-11.

[32] Leveson (2005), 88-9.

[33] There were other factors involved here as well. Snook points out this was a new crew, and therefore not up to speed on the procedures used in this area.

is to type in the coordinates and then drop the weapon when the symbols in their heads-up display line up. Humans are notoriously bad at transferring data by hand.

The same thing could happen in the AOC. We saw previously that there has been a move toward machine-to-machine interfaces, demonstrated by Mitre engineer Mike Butler's success developing XML translators for machines for JEFX 04. The "cursor on target" program holds the potential to drastically improve the ability of the CAOS to share data and reduce the transference of data by hand. But it also has the potential to change the jobs of those people working in the AOC to a much more supervisory role.

During JEFX 04, the officers in the TCT Cell were confronted by questions from contractors who were looking at ways to automate the functions of dynamic targeting. The officers were skeptical, and perhaps a bit defensive, about the feasibility of replacing their positions with a machine. For one thing, they were unable to specify a set of "business rules" that could be used to automate the decisions they were making and the actions they were taking.[34] As we saw in Chapter 6, their actions and decisions are based on many different information sources and information about the information and about the status of the team. Even if the functions were automated, someone would still have to be accountable. This person would most likely lose visibility into the actions that the machines take, and be less capable of intervening to stop potentially undesirable actions. The person would also be less capable of developing innovative work-arounds in situations that did not fit the "business rules."

Of course, developing the ability to distribute actions and decisions can also avoid many hazardous situations. Scholars of network theory have shown that networks are incredibly resistant to failure from random attacks. They fail only after a critical number of nodes have been destroyed. However, in most networks all nodes are not equal. Most networks have stronger nodes, called "hubs," which are connected to more nodes than most. If an attack is not random, but instead targeted against these hubs, the network can fail rather easily.[35] The AOC would definitely be considered a hub in the CAOS. If information processing can be distributed throughout the system rather than at the hubs, the network can be made more robust to failure.

Additionally, the distribution of roles has made the system more capable. We must keep in mind that the changes in the aircrew's role have come about as the result of efforts to improve the quality of sensors that gather the information, processors that make sense of it, and weapons that make use of it. Precision weapons were developed during Vietnam to more effectively destroy hardened structures like bridges.[36] In Desert Storm, these weapons were married with stealth technology to allow the air component to attack the enemy as a system, rather than concentrating on key targets as it had in World

[34] Larry Haskells, Lt Col, USAFR, (TCT Cell Attack Coordinator for JEFX 04 and Interdiction DO for Iraqi Freedom), personal interview with author, 28 July 2004, notes in author's possession.
[35] Barabasi, 111-122.
[36] Find this in Mets.

War II. During the conflicts of the 1990s, air commanders found that these same weapons paired with better sensors also allowed them to put at risk targets in areas where there was a risk of collateral damage, taking away the enemy's ability to use the city as a sanctuary. GPS guidance allowed them to deny the enemy the sanctuary of night and bad weather. Time-sensitive targeting is aimed at taking away the sanctuary of rapid movement and concealment. But these technologies require many different players to work together to put together a solution for each attack. Thus, the pieces of the "kill chain" are more distributed. If the air component can solve the problem of allowing all the pieces to communicate and share information rapidly, network centric warfare means the CAOS will become more effective and also more robust to attacks.

To this end, the Air Force is working on many solutions. Cursor-on-target and an alternative, gateways that tie systems together, will help solve the infrastructure problems. In addition, one of Mitre JEFX Manager Carmen Corsetti's major projects is to experiment with airborne IP—tying airborne platforms together with an internet protocol so they could pass data and voice to anyone in a network. Voice-over-IP (VOIP) could provide a way to ensure communications with all players in the system—voice communications could be sent to any player in the network, regardless of whether the communicating parties are within line-of-sight. With this capability, the air component might even have the ability to perform many of the AOC's command and control functions in the E-10A Multi-sensor Command and Control Aircraft (MC2A) when it comes on line later. Of course, this would also make it more difficult to secure the communications.

But the purpose of this chapter has been to alert decision-makers to the fact that there are some hidden consequences to these actions. Netting people together increases the number of unintended interactions that are possible. This is a great facilitator of innovation. It is also a potential cause of failure sequences. For military commanders, this causes the tension we have been studying. They have to be sensitive to the strategic level feedback loops that may occur, and impose constraints to ensure these are not activated—this would be one way the CAOS could have an "accident." But in imposing these constraints, they have to keep in mind that they may be creating situations where the humans in the CAOS will drift from the established procedures during slow times, only to foil the effectiveness of the constraints and procedures when they are really needed.

Any attempts to treat the pilots like cogs in a machine must acknowledge that there may be side-effects to this latent capability and aggression. It may be possible to address this through training, but only after it is acknowledged and not without a price. The price would be the loss of the very warrior qualities that have always been desirable in military leaders. While these qualities are present in the aircrew, there will always be the chance that these human beings will act in innovative ways to increase

their contribution to the war effort, potentially in ways that are contrary to the commanders' desires. Like the nuclear reactors or the electrical power grid, it may be a problem just waiting to happen.

Chapter 10

Conclusions and Implications

What a commander wants to take with him into war is a set of organizations that can learn while they execute their missions. What those organizations can learn in peacetime is not so much precisely what to do in war but how to learn, and learn quickly, what to do...
However, there always will be a tension between organizational adaptability and organizational procedures in military command and control...
Command and control personnel must, therefore, balance the need to respond to the situation against the equally important need to maintain a structure within which information can be organized and analyzed and decisions made and quickly communicated.

- Gulf War Air Power Survey, Vol. I, Part II, 1993

The incredible pace of technological development throughout the last decade and a half has not altered the fundamental truths about command and control of airpower, which are similar to the fundamental truths about command and control of other military power. This CAOS we have studied is an intensely human system, as war is an intensely human experience, facilitated by technology. The information, telecommunications, sensor and weapons technology have altered the methods by which these humans perform their jobs. The technologies have even changed to some extent the jobs that are performed. But they have not changed the fact that the commander's job is to get these humans to work together with others of different cultural backgrounds to accomplish an ill-defined mission in an environment of uncertainty.

In our five different walks through the last four major U.S. wars, we have seen an important pattern. At every level, the more a decision-maker tried to use the near-perfect information to manage the details of his subordinates' actions, the less those subordinates were able to handle the inevitable uncertainty that accompanied war—the less they were able to act like a learning organization. We can boil the system diagrams in Chapter 3 down to one simpler diagram that shows this. The purpose is not to pretend the complexity does not exist. The purpose is to organize the complexity in a way that illuminates the causes of problems and enduring remedies—as organizational theorist Peter Senge puts it, to find "patterns where others see only events and forces to react to."[1]

This pattern is reinforced by the changes we have seen when decision-makers could adjust. Most vividly, between Enduring Freedom and Iraqi Freedom, both the policy-makers and the theater-level

[1] Peter M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*, (New York: Currency Doubleday, 1994), 126-8.

military commanders worked hard on developing command relationships that would allow them to remain out of the details of the ongoing military actions. More subtly but just as surely, the air component has evolved a method of pushing authority down as well. Sending aircraft up without targets and then having the TCT Cell work the targets in real time may appear to be an over-centralized process now, because the TCT Cell works in the CAOC. But it is a way for the JFACC to avoid specifying the details of the missions in advance and relying instead on the lower levels to work together. All these changes require depth in the command relationships.

This chapter will lay out these conclusions in answer to the four questions we asked in the first chapter: 1) how has the Information Age affected command and control of combat airpower, 2) have these changes impacted the military's adherence to the doctrinal tenet of "centralized control and decentralized execution," 3) is there a general formula that better characterizes command and control of the system, and 4) where are these changes headed? The first involves how the CAOS got to be the way it is today—what forces shaped it and in what shape they left it. The second is a determination of whether this has fundamentally affected the U.S. military's adherence to airpower's tenet of "centralized control and decentralized execution." This will answer the third—whether there is a more precise way to state a doctrinal tenet to more accurately describe how commanders should control airpower. Finally, we will extrapolate lessons for future technological, organizational, and doctrinal development.

1) How has the Information Age affected command and control of combat airpower?

A combination of political, organizational, and technological developments have brought the U.S. military to a point where it is more vital than every for commanders to intentionally balance empowerment and accountability. In the 1990s, a change in the international security environment and stealth and precision technology made airpower a favorite instrument of policy-makers. Without a superpower peer, the U.S. could get involved in conflicts where there were less than vital interests at stake. But the interests in these conflicts did not support high costs in terms of friendly or innocent lives lost. Airpower seemed to be the answer. Policy-makers chose strategies that depended on their ability to control military action by ROEs and target approval because the results of air strikes could have been disastrous to their strategies. But airpower was not always the surgical instrument the leaders needed, so Air Force leaders found themselves chasing the ability to get and process information in the AOC.

Constraints from the strategic level affected the way the Joint Force Commanders defined command relationships. In Kosovo, the stipulation that there would be no ground troops combined with the high-level target approval process drew Gen. Clark into many of the details of the air strikes. In Afghanistan, the uniqueness of the CIA-military relationship and the ROEs about collateral damage had the same effect on Gen. Franks. The more the constraints from the strategic level, the less the JFC

empowered component commanders under him. The less these components were empowered, the less they coordinated with each other, regardless of their technological capability to communicate.

So the argument that airpower has become increasingly centralized—in some minds, "over-centralized"—comes in part from the effect of the peculiar strategic situations in which the U.S. found itself in the 1990s and early 21st century. But these effects had technological and organizational consequences at the lower levels.

JFACCs initially tried to stay out of ongoing missions, but two parallel trends led to the development of the time-critical targeting (TCT) Cell in the AOC. First, sensor-communications loops that the Air Force developed to help accomplish the complete control cycle also made it possible to direct the missions. In fact, the air component gained much more success at intervening in these missions than at assessing the aggregate results of operations. At the same time, the air component was called on to accomplish some politically sensitive missions; to accomplish these, someone had to pull information together quickly and feed it to the strike aircraft. The same processes they used for these missions were useful in some other missions that required quick reaction as well, like KI/CAS. The result is a very active cell on the Combat Operations floor that handles a lot of real time decisions about targeting airpower.

The use of sensor-communication loops and precision munitions led to a distribution of the tasks in the attack sequence, sometimes known as the "kill chain." In the last three conflicts, most of the missions were accomplished by sending the aircrew up without pre-planned targets so they could respond to the fleeting targets that emerged during the battle. On some of these missions, the job of finding targets and putting together the information to attack them was done by people distributed all over the globe. With a GPS-guided munition (or, in the future, sensor-aided weapons), the aircrew's job became one of delivering the munitions based on information provided by someone else. With new sensors on the aircraft, the job of the aircrew was sometimes to collect information for someone else's attack sequence. However, in many cases, the aircrew still needs to perform the whole sequence, so they cannot be simply re-programmed to perform a different role. The result is an increase in the number and complexity of ways to accomplish the emerging target mission.

The fact that this distribution increases the potential for people to find alternative ways to exploit opportunities makes it a blessing or a curse. Depending on the type of war, a commander may want the aircrew to use this "latent potential" to go find new opportunities and exploit them, or the commander may want the aircrew to follow strict orders. The trouble with the second situation is that it depends too much on the ability of humans to monitor compliance. Evidence shows that, when the orders have not been strictly enforced because deviations did not make much difference, people drifted from established procedures. Then, when the system transitioned from loose coupling to tight coupling (where deviations

can be fatal), global procedures meant to avoid accidents were non-existent. There is also reason to believe this gets worse when humans are relegated to roles where they supervise machines—they become less able to intervene when needed. Somehow, the CAOS has to be given the capability to intentionally shift between being responsive to directives and adapting to opportunities.

2) Have these changes impacted the military's adherence to the doctrinal tenet of "centralized control and decentralized execution?"

Commanders must realize that the way to cope with the uncertainty involved in military operations is to build depth in the command relationships; focusing on specific details rather than these relationships has the unintended consequence of making lower levels unresponsive to directives and unable to adapt to opportunities. Our system diagrams from Chapter 3 illustrated this, but it was buried in the complexity of the CAOS. But we can now use them to construct a simpler model to show this tension. Because the diagrams noted areas where there were common components in different subsystems, we can follow the links to show the major feedback pattern that causes the tension between centralized and decentralized control.

Figure 10 shows that the tension is between the need to accomplish specific actions precisely and the need to create a learning organization. There is an obvious inner loop, called the "Direct Control" loop, that policy-makers have to manage. But there is also a not-so-obvious balancing loop, called the "Learning" loop that they must also manage.

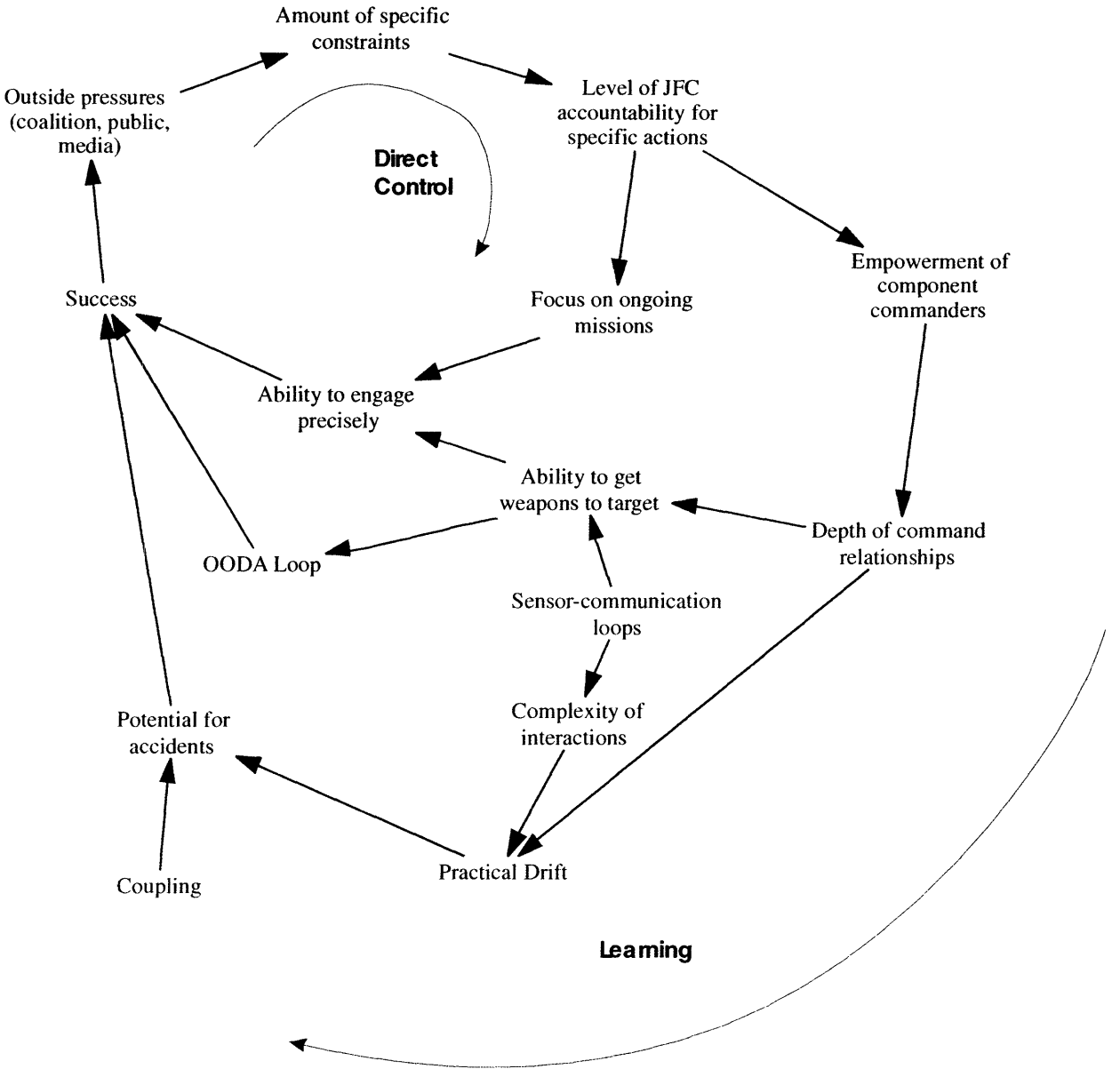

Figure 10: Overall command and control feedback pattern in the CAOS

Policy-makers begin the cycle by determining the extent to which their strategy will depend on controlling the military through the use of specific constraints, as opposed to objectives and guidance (while leaving the specifics to the military). This is usually an unconscious decision that is tied to the—also usually unconscious—determination of the nature of the war. There are, of course, some of each of these methods embedded in each situation. But each war can be characterized by a predominance of one or the other method. We would say Desert Storm was a war characterized by the use of objectives and guidance; Allied Force was a war characterized by the use of specific constraints (a target approval process at the strategic level, a prohibition against the use of ground forces, and strict ROEs about targeting). Policy-makers use specific constraints when there are outside pressures to make the military

action conform to some desirable outcome (or avoid some undesirable outcomes); leaving the details to the military could jeopardize this, as we saw in the cases of the Al Firdos bunker and the Chinese Embassy.

The desired outcome from these constraints is that they should raise the accountability level for the undesirable actions, so the military actions produce politically desirable results. Indeed, we saw that targets and ROEs set at the strategic level became very high priority in the consciousness of the commanders in both Allied Force and Enduring Freedom. This raised the level of accountability of the JFC for the details of tactical actions; the JFC, in turn, had a high incentive to hold authority for these actions at his level. In these cases, this translated to a high level of target approval and the JFC's decision to hold the target development process at his level, with his staff instead of the warfighting components. In theory, with the use of sensor-communications loops, this would increase the ability to target precisely, leading to the politically desirable outcome.

But we also saw unintended consequences from the use of specific constraints. The component commanders were afforded less authority than their doctrinal procedures recommended, and were not empowered to the full extent of their capabilities. The results were that they lost the ability to coordinate well with other components and did not set up the mechanisms that assure deep command relationships down to the tactical level. In an ironic twist, the ROEs and command relationships in Enduring Freedom kept the targeting authority at Gen. Franks' level, but this left him without the ability to ensure the actions of the SOTACs conformed to his strategy. There were no command and control nodes like the ASOC at the lower levels to allocate resources and enforce procedures, so when they were needed in Anaconda the controllers and aircrew had to fend for themselves. By contrast, between Enduring Freedom and Iraqi Freedom Franks and his component commanders worked hard on the command relationships and personal relationships. Franks gave his component commanders more authority and delegated authority over the targeting process and some TSTs to the air component.

In fact, this lack of depth of command relationships can potentially affect the achievement of the desired political outcome. The same sensor-communications loops that allow the JFC to intervene in ongoing operations re-distribute the tasks involved in the "kill chain." The interactions have become more complex, so that there are now many different paths to accomplishing a given mission. This could makes it more difficult to hold people to global procedures, allowing them to engage in Practical Drift. Depending on the amount of coupling involved, this could lead to accidents or innovation, both of which could have a dramatic impact on the results.

But with depth in the command relationships, this drift can be held to a minimum while the opportunities afforded by the sensor communications loops are still exploited. The aircrews in Iraqi Freedom still felt the CAOC was involved in their decisions; however, there were relationships set up to

allow them to use discretion at times. They were directed to the killboxes, but often they were left to find their own targets once there. When the CAOC contributed information that led to new targets, it was welcome.

Depth of command relationships can help deliberately choose the time and place to exploit opportunities while avoiding drift. If the command relationships are of sufficient depth, the aircrew will be aided in these tasks by the ASOC, ground controllers, AWACS, JSTARS, and others according to the procedures. But if some of the relationships are not present or not strong, then there may be ambiguity about who is in charge. This was the case during Operation Anaconda, when the AC-130 crew found themselves being directed by three different command and control agencies, not one of whom knew the entire story. There was no one able to prioritize and direct aircraft to the fight. It was also the case in the Black Hawk shoot-down, when the command relationships did not really include the Army helicopters and the AWACS crew was not really in command of the mission.

3) Is there a general formula that better characterizes command and control of the system?

We have uncovered a consistent pattern that pervades the entire system. At the strategic, theater, and component commander level, the choice of how to exert control had unintended consequences. Commanders attempted to maintain the integrity of the actions of their subordinates by specifying constraints on some of the details. This raised the visibility of these details down the line, consequently elevating the level of authority to make decisions about them. The subordinates, denied the full use of their capabilities, developed other ways to contribute in non-standard ways. This affected the way they were able to coordinate with other players at their level, so that when this coordination was vital, it was missing.

The theoretical solution to these problems is a synthesis of the maxims that we have been exploring. The Air Force's tenet of "centralized control and decentralized execution" aims to give a single air commander the ability to make air operations conform to a strategy while leaving room for those closest to the battle to show initiative to overcome unforeseen obstacles emerging during the battle. It suffers because it implies a "laissez faire" attitude toward execution—we have seen it is important for the commander to be able to pull information together for his subordinates and to ensure they conform to the orders. Similarly, Huntington's "objective control" has been misconstrued to mean the civilians should stay out of military matters. Cohen clarified this by advocating the civilian bosses maintain a bruising dialog with the military to ensure they adhere to the overall strategy set by the civilians. Neither says much about how to get and assess the results. Van Creveld goes further, advocating the commander use technology to its fullest extent, institute a "directed telescope" to find out what is happening and make command decisions, but organize and train his subordinates to operate in uncertainty.

Put together, these theories describe an optimum way to approach the cycle of control to avoid the pitfalls we have uncovered. To follow the general formula for control, a commander at any level should:

1) set the goals for the organizations that are to be unified under his or her command;

2) empower subordinates to come up with plans for their respective parts;

3) enter a bruising, running dialog to critique and correct the subordinates' plans, essentially making them his or her own and ensuring the different parts are coordinated;

4) create depth in the command relationships by defining authority and providing situational awareness in the places where diverse organizations will need to coordinate;

5) use people and technology to create a "directed telescope" to track the actions and hold subordinates accountable; and

6) assess the effectiveness of the actions and the need for a change in plans.

In doctrinal terms, as a bumper sticker, "centralized control and decentralized execution" is still an excellent philosophy. As guidance it suffers from imprecision and does not portray the complete control cycle as accurately as the above series of statements. However, the evidence from this study gives weight to even more specific recommendations. We should give commanders a better idea what the specific trade-offs are. Let us be more specific in pointing out where current practices agree and disagree with our general formula and what the trade-offs are.

At the strategic level, the theater (JFC) level, and the component (JFACC) level, the exercise of control depends on answering questions about effects, coupling, and depth of command relationships.

3A) Trade-offs at the Strategic Level

At the strategic level, policy makers have the difficult task of trying to define the nature of the war, setting goals and strategy for the war, and then ensuring the military action is coherent with these goals and strategy. The decision-makers at this level include the President, Secretary of Defense, the Joint Chiefs of Staff, and the rest of the NSC. But Congress and coalition governments are heavy players as well. And the media, although not a strategic decision-maker per se, plays a big role by determining what the public sees and thereby helping to shape their perception. According to our general theory of control, the central decision-makers should develop a broad grand strategy, give the military goals and guidance for the war, force the military to come up with military plans, and then enter a bruising debate to shape those plans in accordance with the strategy. They should then develop a directed telescope to ensure the military follows those plans and to assess the results.

However, at the strategic level, strategy is very nebulous, depending as it does on the shifting perceptions of friendly and enemy public and government. Decision-makers at this level cannot foresee everything that may affect the success of the strategy. They are forced to get information through a very

slow and methodical military command and control channel but to be wary of feedback through relatively rapid and sometimes not so methodical media channels.

Decision-makers at this level are therefore pre-disposed to use more direct methods of control. They can impose ROEs that limit the possible actions the military can take. They can force the military to clear actions through them—like the target approval processes. They can develop the courses of action for the military, as the Johnson Administration appears to have done with the Rolling Thunder operation. As we have shown, these actions carry unintended consequences.

Therefore, the policy-makers need to consider two questions regarding the nature of the war: 1) whether they can determine the precise effects that will obtain the strategic goals, and 2) whether these effects require military actions that tightly couple the different organizations.

If there is a clear mechanism for success and it is possible to plan the military actions in detail, then it may be possible to put constraints on the actions without adversely affecting them. These would normally be small, precise efforts like special operations actions, rescues, or limited strikes. The achievement of the military mission will normally be secondary to achieving some other negative goal—or vitally dependent on this other goal. For example, if it was more important to avoid an incident that would fracture NATO than to stop the ethnic cleansing in Kosovo, then the administration was correct to rule out ground troops and approve targets. But the decision-makers should also realize that it will be difficult to shift gears from this mode of operation to a more conventional mode. In Afghanistan, the complex but shallow command relationships that resulted from tight controls in the beginning were unable to adjust to a more intense mode of operations in Anaconda.

If the mechanism for success is uncertain or depends on adjustment among the military organizations (e.g. heavy cooperation between air and ground forces), then it will be better to follow the general formula we have laid out. In these circumstances the strategic level needs the military to accomplish military goals and adapt to the changing battle. Policy-makers should give the military goals and guidance, force them to come up with details on how they will perform, and then debate those details until they are satisfactory. They should then use sensor-communications loops to verify that the operations are going according to plan. In Desert Storm, when Secretary of Defense Cheney perceived the military was not taking the Scud Hunt seriously enough, he asked to see the ATO. When this was unsatisfactory, he demanded it be fixed—and it was, despite grumblings from the commanders. Abraham Lincoln had to fire four commanding generals until he found one that followed his strategy.

There is a subtle difference between this type of back-and-forth struggle and the outright stipulation of details. The former admits the difficulty of translating policy into action; the latter attempts to engineer the details of this translation. The former method forces the military to take ownership of the strategy; the latter invites them to lay blame for it.

3B) Trade-offs at the Theater Level

At the theater level, the JFC has the task of turning policy into military strategy. The JFC falls beneath the Secretary of Defense in the chain of command, but often receives the orders through the Chairman of the Joint Chiefs of Staff. The Joint Chiefs, though not as influential today as they were prior to the Goldwater-Nichols Defense Reorganization Act, still wield some influence since they are the ones who train and equip the services to do their jobs. The JFC has a staff of his own, but organizes component commanders to direct the forces in battle. According to our general formula, the JFC should organize the components, set up command relationships among them, give them objectives and guidance, force them to come up with plans to achieve these objectives, and grill them on the details until they are satisfactory. This should include ensuring the components develop depth in their command relationships by setting up Command and control nodes to provide authority and information at all the places where forces will come into contact with each other. Then he should use sensor-communications loops as a directed telescope to ensure the operations proceed as planned and to assess the results.

In reality, the JFC is subject to the constraints levied by the strategic level. He can use the arguments laid out above to lobby for the preferred method of control. But the military is and should be subject to civilian control and must in the end salute smartly. Under such circumstances, as in Kosovo and Afghanistan, it is understandable that the JFC may want to keep a tight authority for those aspects for which he is accountable to the strategic level. This calls for the JFC to keep a close eye on the targeting process and even the operations. But in doing so, the JFC risks ending up with component commanders who are uncertain of or even frustrated with their role in the command structure. These are components that will not be able to transition easily to more complex operations in the future. Uncertain of their authority, they will be unable to structure command relationships below them, so that at the pilot and troop level, the confusion will be great if this transition occurs.

The JFC needs to consider two similar questions about the military strategy: 1) whether it is possible to plan the precise actions that will achieve the objectives and 2) whether these plans will require tight coupling of the different components under the JFC's command. It is important to note that it is probably easier to have different strategies for different phases or objectives in the war than it is to change the nature of the war; therefore, the JFC may be able to adopt different methods of control in different phases of the war. The only caveat would be that this must be intentional, so that the change is properly conveyed to the subordinates.

If it is possible to plan the actions in advance, and the different components are loosely coupled, then it may be possible for the JFC to maintain control of these actions at his level. In these cases, there may be no need to have fully empowered components, because the JFC knows exactly what needs to happen—or not happen—and does not need to coordinate much at the tactical level. These would again

be narrow in scope, such as a missile strike without the potential for follow-on operations. Even in these cases, it may be wise for the JFC to empower components but place them in the same building as his staff—in a sort of Joint Operations Center. Then, in the case of a transition, the component commanders could relocate to their own headquarters, clearly marking a new phase.

If it is unclear how the operations will unfold after first contact, or if the plans require lots of adjustment among different components, then the JFC would be better served by the general formula. One the most important trends we have seen in our study is the trend toward bringing diverse players into contact with each other. Airpower working indirectly with foreign troops with whom they have no contact. Airpower working directly with special operations troops. Remotely-located analysts contributing to the kill chain. Pilots becoming information suppliers using their sensor capabilities. And all of this made more urgent by the realization that it has to occur as rapidly as possible. The result has been that many of the interactions that occur in the course of an attack may occur among people who are not familiar with each other and may not have practiced working with each other. In these cases, it is important to develop depth in the command relationships, so changes can be made on the scene without violating control procedures.

The JFC has the important job of ensuring these interactions occur in a way that strengthens command relationships. One way to look at this is that the JFC takes on the role of designer of the organization that is the joint team. As designer, he should figure out how all the players will be interacting and structure the relationships so these interactions happen in the right ways.[2] This appears to be what happened between Enduring Freedom and Iraqi Freedom, when Franks worked with his component commanders to smooth out the processes. He redesigned the targeting process so the air component was the lead, although Franks was still the approval authority. He designated supported and supporting commanders for each objective. He came up with a matrix that delegated decision authority for certain types of time-sensitive targets. It appears these moves had the effect of empowering the component commanders to work together better than they had in Afghanistan—although the fact that it was a different war makes this hard to say for certain.

This job becomes even more important as the war becomes less conventional. In the unconventional warfare that continues in both Afghanistan and Iraq to this day, the job of airpower is less the delivery of firepower than the delivery of troops, supplies, humanitarian aid, and information. There are often many non-governmental organizations involved, and they play an important part in the effort to make and keep the peace, although they do not fall within the typical military command structure. Airpower should often be put in a supporting role to the things that are happening on the ground. But there are times, like the night the AC-130s worked with the Marines in Fallujah, when the aircrew may be

[2] Senge, 298-300.

in a position to provide more. The JFC may not be able to foresee these types of interactions. Just like with strategy-making, it is not necessary that the JFC be able to see exactly what will happen. The job of the designer is to set up an environment where the lower commanders anticipate these situations and prepare for them—and then to prod them until the JFC is confident the commanders have thought the relationships through. Focusing on specific actions stunts this process; focusing on the command relationships that handle the actions fosters it.

With respect to airpower, the biggest indicator our study pointed to was the target approval process, both pre-planned and real-time. Managing the Joint Guidance, Apportionment, and Targeting (JGAT) process at the JFC level, as CENTCOM did in Enduring Freedom, was seen as micromanagement at the air component. The arrangement Franks set up in Iraqi Freedom was more like our general formula—the air component led the process, but CENTCOM approved the results, and reserved the right to interject a special category of targets. The story was similar with respect to approval of real-time targets. Holding approval for all time-sensitive targeting at the JFC level stifled the initiative of the air component in Enduring Freedom. In Iraqi Freedom, Franks delegated some of this authority to the air component. But at the same time, ADOCS made the air component's TCT Cell "think out loud" so CENTCOM could see what was happening.

3C) Trade-offs at the Component Level

The component commanders have to take this process a step further. At this level, the decision-makers are the C/JFACC, C/JFLCC, C/JFSOCC, C/JFMCC, etc. These are the functional component commanders under the JFC. There are also service component commanders for the Army, Air Force, Navy, and Marines who provide the forces and logistics for the functional component commanders. Often the service component commanders are also the functional component commanders—the Air Force service component commander becomes the JFACC, the Army or Marine service component commander becomes the JFLCC, etc. Underneath these component commanders are the smaller units, to whom the component commanders should theoretically pass authority to plan specific attacks.

For the JFACC, the questions to consider are: 1) is it possible to define the precise effects needed for specific missions, and 2) will these effects require tight coupling of the different players. At this level, it is definitely possible for the JFACC to use different levels of control for different missions.

When the mission can be planned in advance and requires little coupling, the details of the mission can be controlled by the AOC. Attacks on pre-planned targets using only assets of one service (or at least only air component assets) may fall into this category. The ATO can specify precise parameters for the desired mean point of impact (DMPI) and munitions for these missions. Many air mobility missions like re-supply and humanitarian relief may also apply.

But when the mission is uncertain, or will require close interaction of different organizations, the JFACC should use the general formula. In these cases, it is most important to develop enough depth in the command relationships that there is a command presence with situational awareness able to mediate among the different players and adjust the mission. Most examples of dynamic targeting, such as CAS and some types of air defense, should apply. Ideally, the JFACC would want to provide the resources—Push CAS and TST missions—and give guidance, then provide the authority for subordinate commanders to plan and execute the missions. In many of these cases, "planning" may be very short, since the missions deal with emerging targets.

But in the air component, subordinate commanders are not in a position to do this type of planning. In conventional ground combat, the component commander can often break down his guidance by geographical area; in these cases, it may be appropriate to empower the subordinate units develop their own strategy for their particular areas. This was the case in Iraqi Freedom, where V Corps worked the western attack axis and I MEF worked the eastern attack axis. Then the individual commanders just have to coordinate for the flanks and seams. Not so with airpower. Almost every air asset must be considered a theater-level asset, able to coordinate with almost any other air asset in a strike package depending on the situation. Each new sortie is a new battle fought with different teammates and in a new area. Wing and squadron commanders are not developers of operational strategy because they are called upon to execute different parts of that strategy on a day-to-day basis, as needed.

The way for the JFACC to develop the depth of command relationships we have called for is to invest in his TACS nodes a degree of command authority for portions of the air effort. In Iraqi Freedom, Moseley delegated some of this authority to the TCT Cell, which was located in the AOC. Right now it is not feasible to have them anywhere but in the AOC, because that is the only place where a digitized picture of the assets in the battlespace comes together with video from the sensors and the ability to coordinate collaboratively with other players. It is not possible to put the digitized picture and the videos together in a multimedia format and send them to an aircraft. However, the ASOC made steps toward getting a smaller version of this capability. The ASOC in Iraqi Freedom did not have working TBMCS, but did have ADOCS, Hunter and JSTARS video, and all the Army's digitized battlespace pictures.

The move to give the TACS nodes command authority would not be unprecedented. In Desert Storm, the AWACS had an Air Command Element (ACE) on board to make real-time decisions about changes to the ATO. This was usually someone who worked in the Plans division, familiar with the details of the planning process.[3] But AWACS crewmembers related the person was not usually seen as a command presence—more of an aid to understanding the ATO. It was a difficult position to man, and the

[3] Jeffrey Feinstein, Lt Col (retired), USAF, (Ace in Vietnam and Deputy Chief of Combat Plans in Desert Storm), personal interview with author, 25 March 2004, recording in author's possession.

program ended in the late 1990s. In Desert Storm and Iraqi Freedom, the AWACS was sometimes put in the position to run TST-like missions because that was the quickest way.[4]

Whether consciously or not, the air component has already started to make the move toward giving guidance and resources and letting the lower levels work the details. Air component planners still put as much detail as they can into the ATO when possible, because this ensures the strikes go more smoothly. The opening days of Desert Storm and Iraqi Freedom were acclaimed by flyers and planners alike for their efficiency.[5] Aircrews are much happier to have details to use in planning their routes, threat avoidance, and fuel consumption before the mission, so they can prepare for all the things that might go wrong. But in the last three wars, the percentage of missions with target details in the ATO after the first couple days has dropped significantly. After that, most missions became KI/CAS, TST, or other types of dynamic targeting missions. In Iraqi Freedom, the planners even put the mission intent in the ATO to guide the aircrews in using their discretion. The TCT Cell still handled the targeting for many of these missions, so it appeared as if the AOC was still involved. However, if the TCT Cell were moved away from the AOC with the authority it had in Iraqi Freedom, this would be a significant step in delegation to a lower level. This would also help the cell communicate with the strike aircraft more directly and rapidly.

If the technology were available, the next step would be to move mini-TCT Cells to airborne platforms, each of which has responsibility for missions with specific ground or special operations units or in specific areas. If the E-10A Multi-sensor Command and Control Aircraft (MC2A) were to attain the ability to give its crew the same digital picture, sensor pictures, and collaborative communications as the AOC, this would be an ideal place for these mini-teams. This would leave overall control in the hands of a single air commander but give the ground commanders the comfort that there was a command presence dedicated to their geographic area. It would be smart for them to even have a liaison aboard, as they did in the ABCCC. The JFACC's AOC would still have the ability to see what these mini-teams saw and did, but could push the authority to them where appropriate. In turn, these commanders could push authority to the aircrew where appropriate.

4) Where are these changes heading?

Let us extend the analysis into the future a bit. The trends we have seen in our brief period of airpower history can give us an idea what will happen as technological development continues. When set against the backdrop of the larger set of airpower history, none of our trends were unpredictable. After airpower was shown to be controllable in a central location during Desert Storm, the argument about

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[4] Jeffrey Hodgdon, Col, USAF, AWFC/DO (TCT Cell Chief in Enduring Freedom and Iraqi Freedom), email to author, 4 February 2005.

[5] Feinstein interview. Mark Cline, Lt Col, USAF, (Chief of MAAP Cell in Combat Plans during Iraqi Freedom), telephone interview with author, 11 November 2003, notes in author's possession.

breaking it into "penny packets" gave way to a new one about how high the central controlling authority should be. The development of ISR sensors to watch the surface of the earth was a shift from the earlier focus on the skies, but predictable if we take into account the position of relative dominance of the air that prevailed for U.S. airpower in the period under study. The development of the ability to transfer information digitally led to the ability of command centers to assemble the best picture of what was happening in the battlespace—a better picture than anyone in the battlespace had. The development of GPS-guided weapons was a continuation of efforts to overcome enemy sanctuaries like night, proximity to non-combatants, and now bad weather.

Many of these developments have added to the ability of the commanders to direct the details of ongoing operations. Yet commanders are learning to make decisions that push the authority for these details down. The technological capability for this decentralization will follow. We can expect the same pattern with other new information-related developments: use of the new technology first to enhance the ability of the commander; then, when the benefits become apparent, to enhance the ability to push authority down.

There is one area, however, where commanders cannot push authority down. Even in our idealized model of command and control, the commander at each level has the responsibility to determine how the chosen strategy will lead to success—the "mechanism" for success. We have proposed that the link from tactical actions to strategic success is so nebulous that the commanders should not undertake to specify this mechanism in too much detail. This would overly constrain the actions so they cannot adjust to reality if the mechanism is slightly off.

This difficulty in finding the mechanism for success has not gotten any easier during our period of study. Indeed, if we were to say there has been any development in this area, it has been the realization that airpower must become more effective at denying enemy ground forces sanctuary—the sanctuaries of night, weather, hiding places, and time. Because airpower is not as limited geographically as land forces, it can be used to affect the enemy throughout the theater of conflict, instead of merely at the point where friendly ground forces can physically make contact with the enemy. But this realization came about through experimentation. It occurred while commanders were trying to figure out some way to accomplish their objectives amid constraints from the policy-makers. It was the Scud Hunt in Desert Storm, the hunt for Serb troops in southern Kosovo, and the link between SOTACs and airpower in Enduring Freedom that showed this reality. None of these was the primary mechanism for victory in the mind of the air commanders at the time.

The difficulty is increased by the fact that concentrating on emerging targets makes it more difficult to assess whether the strategy is working. In fact, it becomes difficult to even assess the effectiveness of the attacks at hitting their targets. Pre-planned attacks lend themselves well to

assessment, because there is a list of places to look for effects. When the primary method becomes adjustment in real time, it becomes difficult to even determine what happened, much less how successful it was.

Therefore, we can say that the Information Age has not brought the U.S. military any closer to the ability to determine how to affect the enemy. Strategy development and assessment is still the primary problem with which commanders must wrestle. So we would have to disagree when the Air Force Transformation Plan predicts that,

> "Before long, Joint Force Commanders will be able to select the precise targets necessary to achieve desired effects and they will focus on the quality, not the quantity, of targets attacked. They will be able to identify an adversary's key centers of gravity and relay that information to combat forces in near real-time to attack the centers of gravity in the particular sequence that will be most devastating to the adversary."[6]

The Air Force still has not found—and likely will not ever find—a way to win wars by finding the magic targets that produce the disabling effects on the enemy.

Thankfully, Air Force leaders have not acted as if that is all they are after. While they have always put forth a plan to win the war with airpower alone, they have striven to find and use whatever works, even though in most cases it is not what the air component was prepared to do. In Desert Storm, the opening air campaign arguably brought Iraq to the point where its army was impotent. In Allied Force, the increase in attacks on Milosevic's sources of individual wealth and power in Belgrade arguably had a great effect on his decision to capitulate. But in both these cases, airpower also took part in other efforts that contributed to the final outcome. The planning for Iraqi Freedom was a decidedly joint venture, where the components learned how they would support each other rather than searching for the magic plan that would negate the need for each other. Although it probably would have helped to catch Saddam Hussein in one of the over 50 leadership attacks, and the effort arguably made him less effective at commanding his forces, it is now obvious that his absence did not spell the end of the war.[7] Though airpower was a major contributor to the rapid success in the conventional part of the war, the enemy was able to turn the war into an insurgency in which airpower's strengths are not as advantageous. Airpower must now play a largely supporting role in helping the troops on the ground by gathering information, providing platforms for command and control and communications, and moving and re-supplying the ground troops.

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[6] HQ USAF/XPXC, Future Concepts and Transformation Division, The U.S. Air Force Transformation Flight Plan 2004, xii. Available at http://www.af.mil/library/posture/AF_TRANS_FLIGHT_PLAN-2004.pdf, accessed 16 February 2005.

[7] One cannot dismiss the idea that if Saddam Hussein had been caught or killed early in the war, the insurgency would not have gotten started, but neither can one reliably count on it.

So in the end, nothing has changed or will change about the fundamental challenge of command and control of airpower. Airpower must still be flexible and responsive enough to adapt to what is happening in the battlespace but precise and obedient enough to avoid creating undesirable incidents that foil the whole strategy. Let us take a look at some ways that technological development could aid in this quest for balance, based on the lessons we have discovered.

The increased use of unmanned vehicles increases the amount of airpower that is automated and controllable from a central location. In 2003, Boeing and Northrop entered a competition to design an unmanned, combat aerial vehicle, the X-45. The plans for the X-45 are dynamic, but may include air-to-air combat for self-defense as well as dropping bombs. The Defense Advanced Research Projects Agency has begun a five-year, $4 billion effort to make UAVs more independent of human control yet more capable of sharing data by network—although the plans are still to always have a human in the loop.[8]

The generally-accepted strengths of UAVs are endurance, persistence, and expendability. Endurance, because they can be made much lighter without consideration for human inhabitants; therefore, they can remain aloft longer. Persistence and expendability are related: they can remain in an area longer without risking a human life. Thus, every experienced commander sees in them the ability to penetrate and soften enemy defenses prior to sending in the more risky and expensive manned aircraft.

But there is another strength: they do nothing but follow orders (right now, at least). They are not subject to the morale issues and need for empowerment that we have addressed in this study. In fact, unmanned systems would be a good choice where the object is to avoid mistakes rather than react quickly. When unmanned vehicles are involved, the decision-makers can view the video rather than having to assemble information from a radio conversation. There is no human being in the vehicle loitering over hostile territory and getting frustrated while awaiting the decision. If the unmanned systems were armed, the decision-makers would not waste time trying to talk an aircrew onto the target. Manned aircraft could be concentrated in those areas where discretion can be allowed. Of course, those are usually the more dangerous areas, since they are the ones where the enemy is most concentrated.

The idea of using the UAVs to perform the precision tasks while humans perform the more dangerous ones seems to run counter to common sense. But it solves many problems. It preserves the warrior culture of the aircrew and allows them increased discretion where mistakes do not hold as high a potential for collateral damage and initiative is a necessity. In putting humans at risk, it also solves a potential moral dilemma—the potential that a state that relies on remote control warfare will become more warlike. The willingness to put humans at risk should be an important filter for the decision to go to war, since this decision necessarily involves the potential for loss of innocent life. If something is not

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[8] David Talbot, "The Ascent of the Robotic Attack Jet," *TechnologyReview.com*, 2 February 2005, accessed through U.S. Air Force Aim Points, http://aimpoints.hq.af.mil/display.cfm?id=667.

important enough to put one's own people at risk, it should not be important enough to endanger innocent bystanders in the war zone. The issue is more complicated than this, but this is the surface-level perception policy-makers will face as warfare becomes remote control. This by itself is not reason enough to give humans the most dangerous missions; it is, however, significant support for assigning humans to those missions where their initiative and adaptability overshadow their potential for mistakes.

The unmanned vehicles will always need to be supervised by humans for accountability and to make them more flexible. The supervision can be done at the "centres." But this puts an extra burden on the AOC staff, just when the Air Force is trying to reduce the size of this critical node. The air component had been working on allowing the Predator controllers to work directly with the strike aircraft, beginning with the modification to the AC-130s and then training the Predator operators to control fighters. But if the MC2A aircraft takes over some of the dynamic targeting duties as we discussed previously, it could also be a logical place to control the UAVs in its area. The multi-sensor aircraft would have the surveillance capabilities of both the AWACS and the JSTARS aircraft, so it would have the air and ground pictures. The MC2A could then receive the fine-tuned ISR information from the other sensors like Predator, Global Hawk, U-2, and even fighter aircraft with sensor pods.[9] The staff on board would still have the option of allowing the individual Predator operators to work directly with the strike aircraft.

The MC2A aircraft is not the final word in developing depth of command. It will not be able to operate in threat environments, so it may not be useful in some scenarios. As technology matures, there should also be plans to reproduce a portion of this capability in more tactical aircraft. For example, there may be a need for fighter aircrew to lead a flight of UAVs on a mission in enemy territory where coordination with ground forces is involved.

Munitions development may blur the line between manned and unmanned systems. There are new developments in weapons that can loiter in an area, detect targets, and selectively attack the targets after launch. The CBU-105 sensor-fused weapon is an example. Right now, these weapons do not take inputs from off-board sensors after launch, so they are dependent on pre-launch positioning and post-launch sensor performance to find targets. As the munitions become smarter, they will need increasingly sophisticated fail-safe modes, probably including datalink of the information the sensor is using for discrimination. This would indeed make them similar to UAVs, except for the inability to control their flight path.

Space sensors are another area where automation will increase. The capability of these systems did not seem to increase appreciably over the period of our study. However, the use of the information

[9] Briefing, Joseph Smyth, Col, USAF, "MC2A: Multi-sensor Command and Control Aircraft," 5 December 2002. Available at http://esc.hanscom.af.mil/esc-mc2a/1, accessed 16 February 2005.

from them did. In the last two conflicts, space was a consideration in the earliest stages of planning, when policy-makers bought all the available bandwidth over the theaters of war. It will increasingly become an operational consideration, now that the precedent has been set to give the JFACC the ability to control tasking of the assets in theater. This was a command relationship similar to putting Marine aircraft on the ATO, only in a much bigger way.

The future may, of course, hold more of a role for space. There is the potential for force applied from space—to deny an enemy's ability to use its space systems or even to create effects on the earth. This would be full remote control warfare, and would therefore be controllable at very high levels. In the beginning, it would no doubt receive attention from policy-makers because of the lack of precedent. Force from space to create effects on the surface would be especially subject to this scrutiny.[10] But as far as command and control is concerned, weapons deployed from space are little different than weapons launched from a CIA Predator. There are organizational barriers to setting up the command relationships, but these should be overcome just as they were with the Predator. The use of both sensors and weapons from space could eventually be delegated to the same levels we are recommending for the Predator—the AOC or the on-scene battle management aircraft.

This, of course, requires much better information-sharing capability than is possible today. The Air Force is experimenting with the ability to create an airborne network as part of its Command and Control Constellation. At Hanscom Air Force Base, the Air Force's Electronic Systems Command in conjunction with Mitre Corporation are working on a testbed 707 aircraft called Paul Revere for this purpose. The plans are to integrate the airborne network with the entire constellation so all information systems, including TBMCS, can talk to each other. This also relies heavily on the ability to build machine-to-machine interfaces using XML and Web Services technology as we discussed.

As we have already pointed out, even if the network succeeds, this will not guarantee data integration. Undoubtedly, the people in the AOC will still have trouble getting the correct information to assess results. In fact, now that part of the AOC will be broken off, out of sight, they may be even more likely to develop their own local work-arounds that cause the assessors headaches when they try to reconstruct the battlespace actions.

It will, however, provide command and control nodes closer to the battlespace with direct access to all the information and to the players. The ability to fuse the information will be one level closer to the strike aircraft, in physical proximity and direct communications with the aircrew engaged in combat

[10] In World War II, both Great Britain and Germany had doctrine and capability that allowed them to bomb each other's cities, based on World War I and the Spanish Civil War. But neither did during the initial period of the Battle of Britain, because neither wanted to set off the chain reaction. Then, when errant German bombs missed their sea port targets and hit a British city, the British retaliated by bombing Berlin. The Germans in turn retaliated by bombing London, and the strategic bombing campaign was in full force.

missions. For aircrews, who regularly converge from geographically remote locations to perform a mission together, the MC2A would be a command presence, as opposed to a communications relay.

This will increase the importance of making decisions about delegating authority to strengthen command relationships. The AOC will have to use our control principles to give the MC2A crew guidance, maintain awareness of their actions, and assess the results. The MC2A crew will have to make similar decisions about releasing authority to the strike aircraft and allowing strike aircraft to work directly with the other sensors.

Ground troops could, in certain situations, benefit from having a command presence on the aircraft. For example, when the AC-130 was working with the Marines in Fallujah, the Gunship crew was under the control of the troops on the ground, even though they had more information on the relative location of the enemy and friendlies. What they lacked was the command authority for the mission of the ground troops. A ground commander with the authority to intervene and access to the AC-130 crew's information in this case could have reversed the supported/supporting command relationship temporarily to allow the aircraft to become more effective. Again, the toughest part would be defining the extent of this person's authority.

Finally, many analysts propose that the future of command and control is nodeless. The goal, they say, is to achieve "self-synchronization" of forces, where two or more networked entities with a shared awareness and a rule set can execute a value-adding interaction without the need to waste time with formal requests for support and communication of position information.[11] It is true that such a capability would be helpful, particularly in those areas, like CAS, where different entities are performing mutually supportive roles.

But this overlooks some of the lessons we have learned about command and control in the Information Age. Even if it is possible to develop common physical representations of the battlespace, "shared awareness" is a long shot. The technology that was developed and employed during the period of our study brought information to more people—it did not help these people think the same way about the information. When different players bring different solutions to the same situation, there is the potential for system accidents. This is only growing more distinct as the number of participants increases. The development and employment of technology is increasingly breaking the overall task of conducting military action into smaller, more focused tasks that must be combined. Many of the people whose work is combined in a single engagement do not even know what others are involved. Fewer of the humans working in the system have a complete grasp of the overall sequence of events that leads to the accomplishment of an engagement. This combination of tasks does not happen automatically—and it

[11] David S. Alberts, John J. Garstka, Fred P. Stein, *Network Centric Warfare: Developing and Leveraging Information Superiority*, 2nd Ed. (revised), Department of Defense C4ISR Cooperative Research Program (CCRP), 1999, 175-7.

would be dangerous to make it so. If humans will always be accountable for the actions, then humans must be given better visibility into why the actions are occurring.

War is an ugly thing. It is started, commanded, and fought by humans, with all their passions and shortcomings. During war, humans have to motivate other humans to do things that are against their nature. In one case, this means getting them to put aside the natural survival urge and risk death for some distant cause. In another, this means keeping them from being too violent where this violence violates moral or practical considerations. Command and control must handle both of these, while also realizing its own shortcomings. Even if the technology becomes available to make the CAOS nodeless, it cannot be. Even if the technology becomes available to give the commander perfect information, he cannot always act on it. Command and control must balance the need to empower people to adapt and overcome new situations with the need to hold them accountable. The way to do this is by developing depth in the command relationships that tie people together. Technology has enhanced the visibility of this imperative, making it increasingly important to make decisions about who can make decisions.

Epilogue

While writing this book, I had the opportunity to take part in a couple real-life experiments that showed me the principles had broad applicability. My church put me in charge of several programs to extend services to the community and promote growth in the church. In each case, the duties involved building an ad hoc "organization" to accomplish one particular, time-limited program. One of these was a summer basketball camp designed to teach elementary school kids about basketball and faith simultaneously. To run the camp, we had to get kids to come to it, find and set up a place to hold the camp (the church did not have a gymnasium), coach them, teach them lessons, and a whole bunch of other "stuff" involved in taking care of the kids' needs while they were there. I recruited leaders to take charge of each of these areas.

But the differences in the way I interacted with each of these individuals seemed, in retrospect, to have a huge impact on the performance of these "subordinate" leaders. In the case of the coaching, I had intimate knowledge of how I wanted it done. I had already recruited many of the coaches by the time I recruited the lead coach. I was intimately familiar with several peculiar rules we had designed to ensure the kids got equal playing time against roughly equivalent-level opponents. So I handed the lead coach a list of the people he would be leading, the rules they had to follow, and a schedule he had to meet for training them. His job was to keep in contact with them and set up the training sessions where he would impart on them the knowledge I had given him. To make things worse, when this busy individual did not immediately begin making contact with the coaches, I took it upon myself to call some of them up and start the training process.

It was much different with the person in charge of the other "stuff." I knew only that I wanted some way to get the kids interested in being there right at the start time, and I also wanted to lessen the burden on the coaches for teaching the faith lessons. The leader of this area asked for more guidance, but I was unable to supply it—I did not have a budget figure in mind, could only give her vague suggestions about appropriate prizes, and did not know how she should help the coaches with the lessons. I encouraged her to go figure something out and let me know what she could do.

Inexperience, not experimentation, led to this state of affairs; yet the two individuals responded as if I had paid them to collect data for my research. The lead coach, a competent manager who is used to working with teams of people, never really got actively involved with making the coaches part of a team. He developed the training materials, but relied on me to set up the meetings and make contact with the other coaches. In the process, overloaded by my own managerial duties, I did a poor job of this and several of the coaches dropped out for lack of motivation. The other leader took ownership of the responsibilities I gave her and more. She quickly found out the coaches would be overloaded, so she

developed the curriculum that allowed her to teach the lessons herself, but gave the coaches instructions for easy team-building drills that emphasized the main points. She set up a daily raffle that made all the kids want to be there on time every day. Where I used specific constraints and managed the details of my "subordinate's" tasks, that individual became less proactive. Where I empowered the individual to create the plan, that individual became more proactive.

This was not a technologically-enabled system, so I was unable to get involved in the ongoing operations during the camp—I was unable to see what the coaches were doing and make decisions for them. But there were occasions when the different coaches came into contact and had to have mediation. The teams we set up were unbalanced, and one coach wanted to trade players to even them out. By the time the coach suggested it, the players had made friends, so his unilateral attempt to trade caused some upset feelings among the kids. But we had not set up authority relationships to handle situations where mediation was required.

It should not surprise anyone that the principles we uncovered in this book apply to another human-centered system, even though that system is not particularly facilitated by technology. The lessons uncovered by the analysis decidedly warned the humans involved in command and control that they still need to take human tendencies into consideration. Humans either rebel or retreat to the shelter of constraints if they are not empowered; humans drift from established procedures in favor of local efficiency if they are not held accountable; humans develop organizational cultures which play a large part in how they respond if they are given a task. But are the results applicable to all human systems? Do any of them apply to systems whose architecture is dominated by programmable machines?

After all, we did see many attributes in the CAOS that were similar to other systems. The Network Centric Warfare prophets correctly pointed out that traditional supported-supporting relationships are not sufficient to keep up with the ability of the different components to contribute services to each other's attack sequences. The authority structure has to much more agile. We saw that the distributed teams that accomplish the military actions have much in common with the corporations who have interlinked their value chains by contracting out some of their services—sometimes even to competitors.

But despite this tendency toward using technology to link the disparate organizations we found it was still necessary to develop an adaptive organization through depth in the command relationships. We said commanders had to inculcate in subordinate commanders, through rigorous empowerment and accountability, a way of thinking that allows the subordinates to make decisions in line with overall strategy without the central commander's direct involvement. The factors that made this necessary can in the CAOS can help determine what other systems should heed the same warnings.

The two factors that defined the trade-offs for commanders at each level in the CAOS were the uncertainty and the potential for tight coupling. Let us expand on these to apply the principles to other systems.

In any system that depends on the social interaction of people, the principles in this study will apply to some extent, because of the uncertainty involved. Human organizations often do not perform the way a rational decision-maker would; but they can often overcome some situations unforeseen by the decision-maker. Efforts by central decision-makers to make organizational performance more coherent often also eliminate the adaptation if they do not take into account the unintended consequences. In situations where this learning characteristic is important for adaptation, it is important not to squelch the initiative of the organization.

One type of uncertainty is the degree of unpredictability of the actions necessary to achieve the system's goals. If it is possible to boil the actions down to "business rules" in the form of a decision tree or if-then statements, then they can be prescribed by a central controller. For example, financial transactions can be often performed by web services, because the same actions will be repeated many times over. But if there is potential that the actions will require innovation during the system's performance, then it is important to be able to provide the ability to do this adjustment in real time—and as quickly as possible. One of the purposes of depth in command relationships is to recognize when the situation is ripe for exploitation.

Tied to this factor is the very real potential that the central decision-makers may be unable to specify the desired outcome for the system; or, at least, to measure the progress toward the desired outcome. The military's strategy-to-task methodology is fine if there are clear, achievable goals. In real conflicts, the goals are often anything but clear. In other systems, similar problems arise. For a transportation system, it may be difficult to resolve the competing demands of the many stakeholders, so the goals may be a resultant of different bureaucratic agendas rather than a clearly-stated vision. Long-range strategy often has to adjust to the demands of the short-range actions instead of vice versa.

The inability to specify goals and assess progress towards these goals is therefore another type of uncertainty which points to the need for depth in the command relationships. Without clear goals and the ability to break these into tasks, the actors have less definition to their plans and more need to adjust during operations.

Of course, the risk in allowing the parts to adjust their actions is that they may make the "wrong" decisions—especially with social interactions among humans. Social interactions are relatively unpredictable—the parts of the system are not as programmable as machines. They can be trained to respond to certain situations, but in most systems there will be a great deal of uncertainty involved. When humans are interacting with humans, it is often difficult to recognize and categorize a given situation in

order to select the appropriate response. The different cultures of the different organizations color the way they categorize the situations and the responses they select as appropriate.

But I hesitate to say that the principles in this book are not applicable to machine-based systems simply because they are made of programmable machines. Even when the parts of the system are programmable, it is often difficult to determine the appropriate response to a given situation. In some cases, the software driving the machines is so sophisticated that actions by one may trigger unforeseen actions by another. Humans and machines may both have inadequate models of the system stored in their "software," and if allowed to make decisions based only on their limited input, may take actions that have unintended consequences. If doctors were to automate a patient's intravenous medicine dispenser based on sensors attached to the patient, the controller would be dependent on the programmed responses and the information fed by the sensors. If either was inadequate, the dosage could be wrong.

That is why the humans at higher levels in some systems are often held to strict levels of accountability. Humans can be punished for making mistakes; this provides a way to control their behavior but also a scapegoat in case of failure. In military matters, there are human lives on the line—the lives of the friendly troops, the lives of the enemy troops, and the lives of non-combatants. It is doubtful our culture would accept this killing without the ability to attach responsibility to individual people. Nor are military matters the only case where this occurs. Certainly there are lives at stake in police work, rescue and medical work, and many transportation issues. Other issues, like money, also evoke strong needs to assign accountability.

Therefore, a third type of uncertainty that determines the extent to which the system must develop depth in command relationships is the degree of unpredictability of the actions of the parts in the system—the degree to which we can predict the response to a given stimulus.

Some of the technological development we studied in the CAOS has allowed central decision-makers to have increased visibility into these detailed actions. Of course, whether the central controller can act on this visibility is in part a question of scale—up to a certain limit, the central controller (whether human or machine) can probably directly manage the actions as long as there is sufficient visibility into the details. With machine-based architecture, it may be solely a matter of scale. But with humans, it is also a matter of creating an adaptive organization, as we discussed. The central controller—in this case a human—must consider not only whether he or she can handle the scale of actions involved but also the effect on the rest of the organization.

Besides the uncertainty in the actions, the adaptive organization is also important because the dynamics of the situation may change. In the CAOS, we saw one of the important dynamics was the degree of coupling among the diverse organizations, a factor that changed with the situation. In the CAOS, we saw this shift when the intensity of the interaction among the "parts" increased. Operations

that involved diverse organizations, like CAS on a dense battlefield, make the situation more tightly coupled. If, in a particular system, operations are homogeneous enough that this shift does not occur, there would be less need to develop depth in the command relationships. But as we saw in the basketball camp example, it does not take much to make this shift. Operations that touch the seams of organizations increase the level of coupling.

It is not the coupling itself, but the potential for a change in coupling, that calls for the type of depth described in this book. We saw that other theorists claimed tightly coupled situations called for centralized control to ensure adherence to the global policies, while loosely coupled situations allowed decentralized control to take advantage of adaptive capabilities. If the system clearly remains in one or the other type situation, then specifying centralized or decentralized control is possible. If not, then the job of the central controller is to provide guidance on how to make decisions about exploiting opportunities, not to directly exploit those opportunities.

Thus, the principles in this book are most certainly applicable to many systems. There is a need to create an adaptive organization by developing depth in the organizational relationships in any system where there is uncertainty in the goals, the actions necessary to meet those goals, or the way policy will be translated into action. There is also a need to create this adaptiveness through depth where the situations can shift from loosely coupled to tightly coupled. These conditions probably apply mainly to systems whose architecture is mostly human-centered; but in many systems whose architecture is machine-centered, humans are required to perform supervisory roles, making it increasingly necessary to give these humans the ability to see what is going on and become actively involved. In these systems as well, there must be significant attention given to making decisions about how to make decisions.