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1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
15-06-2007	Master's Thesis	31-07-2006 to 15-06-2007

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The Wrong Target	
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)	5d. PROJECT NUMBER
Rasmussen, Robert E.	
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Joint Forces Staff College Joint Advanced Warfighting School 7800 Hampton Blvd Norfolk, VA 23511-1702	JFSC 25789

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release, distribution is unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT
See attached file.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE	Unclassified		
Unclassified	Unclassified	Unclassified	Unlimited	75	19b. TELEPHONE NUMBER *(include area code)* 757-443-6301

JOINT FORCES STAFF COLLEGE
JOINT ADVANCED WARFIGHTING SCHOOL

THE WRONG TARGET

THE PROBLEM OF MISTARGETING

RESULTING IN FRATRICIDE AND CIVILIAN CASUALTIES

by

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

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13 May 2007

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Abstract

Despite a considerable effort since Operation Desert Storm, the Services have yet to reduce the likelihood of mistargeting – the engagement of friendly forces and non-combatants by friendly fire. Mistargeting has always occurred but has historically received little scrutiny. The numbers of mistargeting casualties have gone down dramatically, but the *rate* has gone up since World War II. When tactical mistargeting occurs today, the effects can be enormous and are increasing, particularly given modern global media.

There are thousands of U.S. military entities that potentially require Combat Identification (CID), plus coalition partners and neutrals. CID of aircraft and ships has historically received proportionally more attention compared to ground units, which suffer the greatest cost of mistargeting.

Despite impressive technological advances, there is currently no universal system for positive identification of friendly forces or hostile targets. U.S. and coalition forces have an increasing reliance on the accuracy of information to locate and positively identify targets. Aircraft are more dependent on external sources for precise targeting data, and weapons are increasingly being dropped "on coordinates" provided by off board sensors and sources, increasing the risk of mistargeting. Modern precision weapon capabilities have outpaced the military's ability to differentiate positively between friend, neutral, and foe, and to locate desired targets precisely.

Mistargeting is not a crisis, but a serious, long-term, joint approach to allow aircrew to distinguish enemy from friendlies and non-combatants is possible and must be pursued.

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Chapter 1: Introduction

Thesis

Precision targeting – consistent surgical placement of weapons on positively identified targets – is not likely to be achieved fully, but remains an important endeavor.

Approach to the topic

The methodology of this study is primarily historical, narrative, and highly selective. The scope of this research is limited primarily to air to ground targeting, identification and fratricide involving U.S. aircraft. An analysis of lessons learned in mistargeting incidents, and a past, present, and future look at procedures and systems for avoiding the same is included. Research in this thesis examined materials that have been documented in open, unclassified sources. It id not address naval, surface-to-air, or ground-to-ground mistargeting.

Definitions

- Mistargeting: an attack on an inappropriate target, specifically resulting in friendly (fratricide) or neutral (collateral damage) casualties or damage.

- Fratricide (from the Latin "frater," meaning: brother, and "cide," meaning: to kill) as "the murder of one's own brother."[1] The military definition, from the 1991 General Officer Steering Committee holds that fratricide "is the employment of friendly weapons and munitions with the intent to kill the enemy or destroy his

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[1] *Microsoft Encarta* Dictionary (North America), 2007 ed., "Fratricide," accessed at
http://encarta.msn.com/encnet/refpages/search.aspx?q=fratricide on 4 Jan 2007."

equipment, or facilities, which result in unforeseen and unintentional death or injury to friendly personnel."[2] Also called "friendly fire."

- Collateral Damage (CD): Unintentional or incidental injury or damage to persons or objects that would not be lawful military targets in the circumstances ruling at the time. Such damage is not unlawful so long as it is not excessive in light of the overall military advantage anticipated from the attack.[3]

- Blue forces: friendly, coalition, allied units.

- Red forces: legitimate military targets; enemy, combatants, insurgents, etc.

- White: non-legitimate targets; civilians, non-combatants.

- Blue on Blue: the unintentional targeting of friendly forces. Equivalent to fratricide, except that fratricide can also result from Blue on Red targeting.

- Blue on White: the unintentional targeting of civilians or non-combatants; distinguished from CD because CD can also result from Blue on Red targeting.

- Shooter: The aircraft and/or aircrew that ultimately releases a weapon.

- Victim: Blue or White positions (units, vehicles, troops, individuals, etc.) that have been mistargeted.

- Combat Identification (CID): the timely and accurate ability to discriminate between friend, foe, and neutral. CID results from the fusion of multi-source data and, ideally, occurs at ranges commiserate with the maximum employment ranges of Blue weapons.

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[2] U.S. Department of the Army, *Military Operations: U.S. Army Operations Concept for Combat Identification*, *TRAGGW Pam 525-58* (Fort Monroe, Va: Training and Doctrine Command, 1993), p1.
[3] U.S. Department of Defense, *Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms*, (Washington: GPO, 2001), p19.

- <u>Precision Targeting</u>: While there is no agreed upon Joint term, for the purposes of this paper "precision" is defined as the engagement of enemy units or positions using one weapon for one aimpoint, with no fratricide or collateral damage. "Precise" weapons generally have an accuracy of less than 30 feet.

Glossary

ACO	Airspace Control Order
AOR	Area Of Responsibility
ASCIET	All-Service Combat ID Evaluation Team
ATO	Air Tasking Order
AWACS	Airborne Warning And Control System
BCIS	Battlefield Combat ID system
BVR	Beyond Visual Range
C2	Command and Control
CAOC	Combined Air Operations Center
CAS	Close Air Support
CCD	Camouflage, Concealment, and Deception
CDE	Collateral Damage Estimate
CEP	Circular Error Probable: a measurement of average weapon accuracy
CID	Combat Identification
FAC (A)	Forward Air Controller (Airborne)
FLIR	Forward Looking Infra-Red
FSCL	Fire Support Coordination Line
GGW	GPS Guided "drop on coordinates" Weapon
GPS	Global Positioning System
ID	Identification
IFF	Identification Friend or Foe
IR	Infra-Red
JDAM	Joint Direct Attack Munition
JHMCS	Joint Helmet Mounted Cueing System
JTAC	Joint Terminal Air Controller; joint term for FAC
JTIDS	Joint Tactical Information Distribution System
JTTP	Joint Tactics, Techniques, and Procedures
LGB	Laser Guided Bomb
NFA	No Fire Area
NFZ	No Fire Zone
NVD	Night Vision Device
OEF	Operation Enduring Freedom (Afghanistan)
OIF	Operation Iraqi Freedom
PGM	Precision Guided Munition
PLRS	Personnel Location Reporting System
RECCE	Recognition or Reconnaissance
ROE	Rules Of Engagement
SA	Situational Awareness
SINCGARS	Single Channel Ground and Airborne Radio System
SOF	Special Operations Forces
STANAG	Standard Agreements
TACP	Tactical Air Control Party
VID	Visual Identification
WGS	World Geodetic System – the current DoD standard coordinate system

Chapter 2: The Problem of Mistargeting

On 5 December 2006, an FA-18C on a Close Air Support mission in Helmand Province, Afghanistan, mistakenly attacked a trench where British Royal Marines were dug-in during a 10-hour battle with Taliban fighters.[4] The pilot was experienced, well-trained, and using the most sophisticated equipment, procedures and information available to him, including Global Positioning System precision coordinates provided by the Joint Terminal Air Controller (JTAC[5]). Although procedures were followed and the pilot had been "cleared hot" to release ordnance prior to firing, he dropped ordnance on the friendly position, killing one Royal Marine.[6]

Despite a considerable effort since Operation Desert Storm, recent events like this imply that the US military has not yet to reduced the likelihood of mistargeting – the engagement of inappropriate targets, such as friendly forces (fratricide) and non-combatants (collateral damage), by friendly fire.[7]

Although it has occurred throughout history, mistargeting has historically received little scrutiny because, when compared to total casualties, it is relatively infrequent and the number of resultant casualties has been impossible to determine with any accuracy.[8]

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[4] Bruce Rolfsen, "F/A-18C Linked to British Marine's Death," *Navy Times Online*, 08 December 2006, accessed at http://www.navytimes.com/legacy/new/1-292925-2412022.php on 11 Jan 2007.

[5] The term JTAC is used generically throughout this paper to describe ground forces in control of Close Air Support aircraft; includes Forward Air Controllers (FACs), Tactical Air Control Parties (TACPs), etc.

[6] "Incident Pilot," interview by author, 1 February 2007, Norfolk, Va, author notes.

[7] The Department of Defense Final Report to Congress regarding the conduct of the Persian Gulf War (Operation Desert Storm) concluded, "Ways of detecting and targeting mobile and concealed targets on the rapidly changing modern battlefield must be found." U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to the Congress,* (Washington: Department of Defense, April 1992), p424.

[8] The numbers, however, are not insignificant. As a reference point, sources usually attribute mistargeting for approximately 2 percent of all casualties in battle. In World War II there were nearly 774,000

Fratricide is widely cited to account for between 2% to 20% of Blue (friendly force) casualties. While the raw numbers of mistargeting casualties have gone down dramatically, the *rate,* depending on what is used for the denominator (total deaths, friendly deaths, etc.) has gone up considerably since World War II. This is due to the relative increase in "efficiency" since World War II with which U.S. forces have been able to kill the enemy without killing neutrals or suffering large U.S. losses. Figures from World War II, Korea, and Vietnam, for example, indicate that the rate of fratricide was relatively low compared to Operations Desert Storm, Enduring Freedom, and Iraqi Freedom, even though the numbers actual fratricide casualties were much higher. The more recent rates of fratricide are higher mostly because the total number of casualties is relatively low. In summary, mistargeting incidents are largely subsumed in major combat operations.

When tactical mistargeting occurs today, the strategic effects can be enormous and are ever increasing. In fact, a number of trends in modern warfare, discussed in the following paragraphs, have increased the chance of mistargeting and made the consequences more significant.

The overwhelming advantage enjoyed by Blue forces in precision targeting has created extremely high (some would argue unrealistic) expectations of perfection by the American public and military planners, and as a result, there is little tolerance for friendly or civilian casualties.

In World War II, the percentage of precision weapons was essentially zero, and the average Circular Error Probable (CEP – a measure of weapon accuracy) was over

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total U.S. casualties; 2 percent of that is about 15,480 casualties, or the equivalent of a full infantry division.

3,300 feet.[9] By Desert Storm, precision weapons accounted for roughly ten percent of ordnance dropped, and the overall CEP was approximately 100 feet. Operations in Afghanistan and Iraq after 2001 saw precision weapons account for over 70 percent of aerial ordnance, and average CEP had dropped to less than ten feet.[10]

News media of the past was vastly different than the global news media of today, which has the ability to place every incident in war under nearly instantaneous and sustained microscopic inquiry. Now, mission recorders and unique weapon footprints have vastly improved the ability to assign blame for incidents. Both of these factors force (and allow) the military to conduct more detailed and intense investigations than in the past.

When the (broken) expectation of precision is combined with modern media magnification of errors, public perceptions can quickly be swayed. This has led civilian leaders and military commanders to imposed heavy restrictions on weapons, capabilities, tactics and training in order too avoid the dangers of mistargeting.

There are literally thousands of U.S. military entities that potentially require Combat Identification (CID), plus coalition partners and neutrals. Because of their relative value, relative ease in identification and ability to dynamically change boundaries, the CID of aircraft and ships has historically received proportionally more attention compared to ground units. Not surprisingly in Operation Desert Storm for example, ground forces were the victims in some 97 percent of all fratricides, the

[9] Richard Hallion, *Precision Guided Munitions and the New Era of Warfare,* Air Power Studies Centre Paper Number 53, (Fairbairn, Australia 1996), p7, accessed at http://www.fas.org/man/dod-101/sys/smart/docs/paper53.htm on 11 December 2006.
[10] Ronald O'Rourke (Ed), Report for Congress, *Iraq War: Defense Program Implications for Congress* (Washington; Congressional Research Service, The Library of Congress 2003), p26.

majority of which were of the ground-to-ground type.[11]   Ground victims also constitute

the vast majority of neutral casualties since World War II (the shoot down of an Iranian

airliner by USS *Vincennes* in 1988 being a notable exception), a percentage that has only

increased over time.[12]   U.S. Air Force Colonel Charles Shrader's rough analysis of

fratricide incidents from World War II through Operation Just Cause (Panama) in Table 1

show where the problem of misidentification is greatest and can suggest where additional

efforts should be made, primarily in Air-to-Ground and Ground-to-Ground CID.[13]

Additionally, incidents of mistargeting by aircraft are much more lethal relative to ground

incidents because of the great destructive power of air-delivered ordnance.

Victim	Shooter	% of Incidents	Factors
Ground	Aircraft	37	Close Air Support Urban targets / CCD Speed/Vulnerability of Shooter Aircraft Coordination Destructive power / Lethality
Ground	Ground (indirect/Arty)	36	Large Number / Types Of Vehicles Procedural Control / Avoidance Maneuver Warfare Increasing (incl. helos)
Ground	Ground (direct)	22	Large Number / Types Of Vehicles Procedural Control / Avoidance Maneuver Warfare Increasing (incl. helos)
Aircraft	Ground	5	Dynamic boundaries High Value Vehicles Common Red/Blue Assets
Ship	Aircraft	<1	Small Number; High Value White Shipping

Table 1

Despite impressive technological advances, there is currently no universal system

for either target identification or identification of friendly forces. In theory, avoiding

mistargeting is simple, particularly when striking ground targets where collateral damage

(CD) is not a concern or supporting friendly forces when a threat is not present: maintain

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[11] U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to the Congress*, Appendix M, p. M-1, M-2.

[12] Charles R. Shrader, "Friendly Fire: The Inevitable Price," *Parameters*, 22 (Autumn 1992), p5.

[13] Ibid., p5.

situational awareness (SA) on Blue forces; maintain SA on Red and White positions; positively identify potential targets; kill Red without committing fratricide or causing collateral damage. Putting theory into practice, however, is quite difficult, particularly when striking targets in close proximity to (or intermingled with) neutral sites, or conducting Close Air Support (CAS).[14] As Colonel Charles Shrader noted, "It is too much to hope that a pilot, diving at 600 mph through smoke while taking evasive action and attempting to deliver ordnance accurately, could instantaneously and correctly identify camouflaged friendly ground troops making maximum use of available cover and concealment."[15]

Warfare has changed from the large-scale, linear battlefields of the Twentieth Century to more limited conflicts, combat in ill-defined fire zones, on vast open areas or dense urban areas. Our current enemies have learned how to asymmetrically counter the effects of Western weapons by hiding among civilians and non-combatants. There is also an increasing tendency for opposing forces to use similar (or identical) assets and equipment. Modern conflicts have a greater variety of participants, including joint and multi-national combat units, different enemy factions, civilians and non-combatants. In this environment of indirect fires, rapidly moving forces and modern weapons, the difficulties of command and control have increased, resulting in a greater chance of targeting errors.

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[14] CAS, by definition, is attacks against hostile targets that are in close proximity to friendly forces on the ground, and requires detailed air/ground integration. U.S. Department of Defense, *Joint Publication 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, (Washington: GPO, 2003), p11.

[15] Shrader, p5.

U.S. and coalition forces also have an increasing reliance on the accuracy of information in these complex environments to locate and positively identify targets, which increases reliance upon the human-technology interface. Increasingly, air-to-ground attack aircraft are more dependent on external sources for precise targeting data and weapons are being dropped "on coordinates" provided by off board sensors and sources. As emphasized in Joint Publication 3-09.3, Global Positioning System (GPS) guided weapons (GGW) require extremely accurate target location, and if that information is not available to the weapon, accuracy and effectiveness drop and potential dangers to friendly forces (and neutrals) go up dramatically.[16]

Today more people are able to call for supporting fires from an ever-increasing list of non-traditional CAS providers (such as B-52s). There are often insufficient tactics, training and integration of service systems. All of these interdependencies of modern joint and multi-national operations have increased the risk of mistargeting. "The problem (is one) that falls between the services – in this case, primarily Army ground troops and Air Force and Navy fliers – and therefore a matter that is not the immediate responsibility and priority of any single service bureaucracy."[17]

Finally, the technological advances of modern precision weapons have outpaced the U.S. (and NATO) military's capability to differentiate positively between friend, neutral, and foe, and to locate desired targets precisely. Modern weapons are employed at increasingly long ranges that make positive identification of targets by aircrew more challenging, impossible, or unnecessary. As was stated by the U.S. Army Training and

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[16] U.S. Department of Defense, Joint Publication 3-09.3, *Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, (Washington: Department of Defense, 2001).

[17] David Wood, "Study: Lack of Training, Equipment Causes Errant Bombs," *Air Force Times*, 10 Dec 2001, p21.

Doctrine Command a decade and a half ago, we still need an "improved ability to identify targets out to the maximum range of weapon and target acquisition with much lower probabilities for error than is now possible."[18]

Although fratricide and collateral damage incidents will never be completely eliminated, the problem of mistargeting is not a crisis. A serious, long-term, joint approach to better allow aircrew to distinguish enemy from friendlies and non-combatants is possible and must be pursued. The development and procurement of improved technology combined with well thought out Tactics, Techniques, and Procedures (TTP) must be mandated for joint forces.

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[18] U.S. Department of the Army, *Combat Identification Program Interim Report* (Fort Monroe, Va: Training and Doctrine Command, 1991), p2.

Chapter 3: History of Air to Ground Mistargeting

This chapter gives a brief history of the most significant air-ground mistargeting events and focuses on the "Who, What, When and Where?" The list is by no means all-inclusive. An analysis of "Why" mistargeting occurs will be conducted in Chapter 5.

Since aircraft have been used to deliver ordnance, mistargeting has occurred. The shear, indiscriminate destructive power of aircraft peaked in World War II. As aircraft became more technologically sophisticated, the ability to discriminate targets improved, however, mistargeting incidents continued. Most mistargeting has occurred during Close Air Support and in urban operations.

World War I saw the introduction of the armed military airplane, but only on a very limited scale. Although friendly units were occasionally bombed and strafed, mistargeting by aircraft was relatively rare.

Mistargeting events grew substantially in World War II as airpower was used extensively in all theaters. Many unintended casualties were largely due to U.S. (and other) aircraft inadvertently mistargeting because of poor coordination, identification failure, or navigation errors.[19] CID procedures were virtually non-existent at the beginning of the war. Visual panel markers and colored smoke were eventually introduced as CID recognition signals, although they were often difficult for pilots to distinguish from the air. Later, radio beacons were used to mark friendly positions with limited success.

Examples of mistargeting in Europe were the most thoroughly documented. In November 1942, U.S. Navy planes bombed allied units during the final advance on

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[19] It was not unusual for air forces in World War II to *intentionally* target civilians, a subject that is outside the scope of this paper.

French positions at Morocco, resulting in severe disorganization of the troops. As a result, the planned advance was postponed until the following day.[20] During Operation COBRA (the breakout from Normandy at St-Lo), Allied aircraft inadvertently bombed forces for over two days, killing hundreds of friendly soldiers, and injuring over 750.[21] At the Battle of the Bulge, the First Infantry Division suffered numerous casualties due to heavy Allied bombing.[22] During the battle of Monte Casino in March 1944, allied aircraft bombed friendly troops (including a French corps headquarters) in the town of Venafro, killing 57 Allied soldiers and friendly civilians, and wounding 179.[23] The French submarine *Surcouf* was reportedly sunk by U.S. planes after being mistaken for a German U-boat, as was the USS *Dorado* (SS-248).[24] On several occasions, allied aircraft accidentally bombed neutral Swiss cities causing severe diplomatic ramifications.[25]

Two of the best-documented incidents of this type occurred at Malmedy, Belgium on 23 December 1944 when B-26s dropped bombs killing at least 37 American soldiers and a number of civilians. [26] Two days later B-26s again mistakenly bombed Malmedy. In both cases poor navigation and inability to properly identify the target were to blame.

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[20] George Howe, *Northwest Africa: Seizing the Initiative in the West. U.S. Army in World War II*. 1957. Reprint. (Washington: Office of the Chief of Military History, U.S. Army, 1970), p162.

[21] Stephen Badsey, *Normandy 1944, Allied Landings and Breakout*, Osprey Campaign Series #1; (Oxford, UK: Osprey Publishing, 1990), p109.

[22] Larry Doton, "Integrating Technology to Reduce Fratricide," *Acquisition Quarterly Review*, (Winter 1996), p3.

[23] James Huston, "Tactical Use of Air Power in World War II: The Army Experience," *Military Review* 32 (July 1952): p441.

[24] U.S. Department of the Navy, Commander Submarine Force, U.S. Pacific Fleet web page, accessed at http://www.csp.navy.mil/ww2boats/dorado.htm. on 29 Dec 2006.

[25] Jonathan E. Helmreich, "The Diplomacy of Apology: U.S. Bombings of Switzerland during World War II," *Air University Review* 28 (May-June 1977), p19-37.

[26] Royce L. Thompson, "Malmedy, Belgium Mistaken Bombing, 23 and 25 December 1944," unpublished manuscript, 5 June 1952, accessed at http://history.sandiego.edu/cdr2/BYRD/BATTLE_O/GREEN_BO/CHAP_16.TXT. on 5 January 2006.

The Pacific Theater had several examples as well. In 1944 the battle for Guam and the Philippines saw numerous U.S. air strikes on American ground troops, prompting a pointed message from General Walter Krueger of the Eighth Army to General George Kenney of the Far East Air Force:

> "I must insist that you take effective measures to stop the bombing and strafing of our ground forces by friendly planes… These repeated occurrences are causing ground troops to lose confidence in air support and are adversely affecting morale."[27]

Korea and Vietnam

Korea saw the introduction of the helicopter and jet aircraft, both used extensively for air to ground attack. Although not well documented, American forces fighting in both wars reportedly suffered friendly fires from aircraft.

In 1951 in Korea, a U.S. Marine platoon was mistakenly bombed with napalm by U.S. air.[28] In 1968 in Viet Nam an F-4 flying in support of friendly forces near Ban Me Thuot accidentally dropped napalm on a church, killing thirteen civilians and wounding six.[29] In 1968 an F-4 conducting CAS apparently misinterpreted the JTAC's description of a friendly troop position and mistakenly bombed the friendly forces, killing three and wounding twelve. Also in 1968, two F-100s under JTAC control mistakenly strafed a

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[27] Robert Ross Smith, *Triumph in the Philippines. U.S. Army in World War II.* 1963. Reprint. (Washington: Office of the Chief of Military History, U.S. Army, 1973). p41.
[28] Doton, p3.
[29] Shrader, p18.

friendly position, wounding five.[30] Finally in 1968, a Navy A-7 attacked a 101st

Airborne Division Headquarters in the Shau Valley, resulting in 55 casualties.[31]

Operations Urgent Fury / Just Cause

Mistargeting has marred even limited, pre-planned operations. On 25 October

1983, during Operation Urgent Fury in Grenada, Navy A-7s strafed a mental hospital and

a U.S. Army brigade command post, causing 17 American casualties.[32] During

Operations Just Cause in Panama in December 1989, an AC-130 gunship responding to a

request for fire accidentally fired on a friendly ground unit causing 21 casualties.[33]

Operation Desert Storm

Operation Desert Storm provided a showcase for relatively new Precision Guided

Munitions and weapon system video that transfixed the American public. However, the

new technology did not eliminate the problem of mistargeting, and in many ways made it

worse. Operation Desert Storm was characterized by an expansive battle front, a rapidly

changing and complex environment, with often ill-defined battle lines, making

maintaining the location of friend, foe and neutral extremely difficult. Foreseeing the

problem, lights and panels (presumably) visible to aircraft targeting pods were quickly

procured during Desert Shield. However, the fratricide rate in Desert Storm rivaled that

of all conflicts in this century and collateral damage was extensive.[34] All of the Blue

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[30] Ibid.

[31] Ibid.

[32] Ronald H. Cole, *Operation Urgent Fury: Grenada*, (Washington: Office of the Chairman of the Joint
Chiefs of Staff, Joint History Office, 1997), p4–5.

[33] U.S. Department of the Army, *Fratricide: Reducing Self-Inflicted Losses*, Newsletter, No. 92-4 (Fort
Leavenworth, Ks.: Center for Army Lessons Learned, U.S. Army Combined Arms Command,
1992), p. 5.

[34] Doton, p5.

fratricides during Desert Storm were ground units, nearly all of which were combat vehicles, and 77 percent of all coalition vehicles destroyed were a result of fratricide.[35]

Several mistargeting cases received wide media attention prompting the American people to demand an explanation – and a solution. In the first case, U.S. A-10s mistook British Armored Personnel Carriers (APC) for an Iraqi armored column, killing nine British soldiers (equaling the total number killed by enemy fire during the war). In the second, an A-10 engaged a U.S. Army light armored vehicle killing seven soldiers and wounding two.[36] On 17 Feb 1991, a U.S. AH-64 Apache destroyed a U.S. Army Bradley Fighting Vehicle and an APC, killing two soldiers and wounding six.[37] Finally, a Marine AH-1 Cobra shot and disabled an American M1-A1 Abrams, injuring its crew.

Though the new technology employed was impressive, the message that mistargeting incidents must be reduced in future conflicts was clear. The war was over so quickly and U.S. combat casualties were so low that the public and the media could literally focus on every death and the reasons why. Those deaths by friendly fire created great concern and calls for finding responsibility.[38]

Operations Southern Watch to Allied Force

In the years after Desert Storm, the U.S. military sought to reduce cases of mistargeting through improved CID systems, weapons, and procedures (discussed in Chapter 5). There were many more cases to come, however. On 14 April 1994, two U.S.

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[35] U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to the Congress,* Appendix M, p. M-1, M-2.
[36] James P. Coyne, *Airpower in the Gulf*, (Arlington: Air Force Association, 1992), p103.
[37] United States General Accounting Office, *Operation Desert Storm, Apache Helicopter Fratricide Incident*, (Washington: Report to the Chairman, Subcommittee on Oversight and Investigations, House of Representatives, June 1993).
[38] U.S. Department of Defense, *Conduct of the Persian Gulf War, Final Report to the Congress*, p102.

Air Force F-15s shot down two U.S. Army UH-60 Blackhawks in the Northern No Fly Zone (NFZ) over northern Iraq.[39] All 26 people on board the two helicopters, including 15 U.S. citizens were killed in one of the worst U.S. air-to-air fratricide accidents in military history.[40]

The time period saw the wide introduction of GPS guided weapons (GGW) that allowed greater stand off, and the elimination of the requirement for aircrews to acquire targets with onboard sensors prior to release. This "drop on coordinates" system also introduced new elements to mistargeting: poor coordinate quality and no "man in the loop" after weapon release. The first major GGW mishap occurred on 7 May 1999 during Operations Deliberate Force/Allied Force in Yugoslavia, when the Chinese embassy in Belgrade was mistakenly targeted with a GPS guided Joint Direct Attack Munition (JDAM), killing three Chinese journalists and injuring more than 20 other personnel. There were several other cases of mistargeting and, despite improvements in technology and concerted efforts to avoid collateral damage, more civilians died on a per capita basis during that NATO air campaign than died during Desert Storm.[41]

The hazard of GGW mistargeting again surfaced during a massive attack on Iraqi air-defense sites in February 2001, when over 20 GPS guided Joint Stand Off Weapons (JSOW), missed their targets in the same direction and by the same distance.[42]

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[39] Scott A. Snook, *Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq*, (Princeton: Princeton University Press, 2002), p1.

[40] Ibid.

[41] Carr Center for Human Rights Policy, *Understanding Collateral Damage, Project On The Means Of Intervention*, (John F. Kennedy School of Government, Harvard University, Cambridge, MA , 2002), accessed on 2 February 2007 at www.ksg.harvard.edu/cchrp on 2 February 2007.

[42] Cliff Lawson, "JSOW strong on fleet support," *The Weaponeer* (Pacific Ranges and facilities Business Development Office, 19 July 2001), accessed on 12 February 2007 at http://www.nawcwpns.navy.mil/~pacrange/s1/news/2001/JSOW2.htm on 12 February 2007.

Operation Enduring Freedom / Operation Iraqi Freedom

During the initial phases of battle in OEF and OIF, targeting was relatively simple. As the operations progressed, targeting issues became more complex as dispersed forces, fearing fratricide, established literally thousands of no-fire zones around themselves and their allies. These zones did not move with the forces and were often left in place, cluttering aircrew's pictures. After the first few days of operations, the overwhelming majority of U.S. air strikes were conducted against "emerging" or "time sensitive" — typically mobile targets. Unlike pre-planned targets, these could not be accurately predicted and required immediate attack. Attacks against these emerging targets greatly increased the chances of mistargeting.

Precision munitions (including cannon/strafe, Laser Guided Bombs, and GPS guided weapons) accounted for all of the air-to-ground mistargeting events in both operations. Airborne cannon fire was used in several incidents. During Operation Anaconda in March 2002, an AC-130 broke contact with a convoy it was escorting to respond to calls from other ground units. When the AC-130 returned to the convoy, the aircrew mistakenly attacked the lead element, believing it to be an enemy unit ahead of the convoy. One soldier was killed and several were wounded.[43]

A-10s have been particularly lethal in mistargeting incidents. On 19 January 2002, an Air Force A-10 strafed a building in a no-fire zone near a U.S. unit accepting the surrender of Taliban fighters. In this case, there were no casualties. On 23 March 2003, up to 10 Marines may have been killed by friendly fire from an A-10 in Nasiriyah, Iraq,

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[43] Joe Pappalardo, "Afghanistan Taught U.S. "Hard Lessons" In Close Air Support," *National Defense Magazine*, August 2005, accessed at http://www.nationaldefensemagazine.org/issues/2005/Aug/Afghanistan_Taught.htm on 2 Dec 2006.

though exact causes of death were impossible to determine because of heavy fighting.[44]

Again in four separate incidents in February, March, and April 2003 and again in Sept

2006, USAF A-10s attacked various coalition convoys in both theaters, destroying

numerous vehicles.[45] Casualties included 4 Brits and 2 Canadians killed and at least 41

wounded.[46]

Laser guided weapons were used in at least four mistargeting incidents in

OEF/OIF. On 17 April 2002, two U.S. F-16s mistakenly engaged a Canadian light

infantry unit conducting a live-fire exercise in the vicinity of Kandahar, Afghanistan.

Four Canadians were killed and eight were wounded in one of the most highly charged

and publicized events of the operation.[47] On 2 April 2003 a USMC Cobra mistakenly

attacked an M1-A1 tank with a Hellfire anti-tank missile. There were no casualties.[48] A

day later an F-15E, called in to bomb an Iraqi tank, mistakenly bombed a convoy of U.S.

Special Operations Forces and Kurdish allies. Three Americans, a journalist, and 18

Kurds were killed, and 45 were wounded.[49]

The use of GPS weapons and unconventional aircraft (such as B-52s) for CAS

situations allowed the U.S. military to rain ordnance upon targets with unprecedented

timeliness and precision, but also caused additional cases of mistargeting. GGW tactics

were used for the first time in CAS, and in the majority of other attacks as well. On 26

November 2001, a U.S. Navy FA-18 dropped a 500-pound JDAM on coordinates near

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[44] U.S. Central Command, News Release as reported in *Air Force Magazine*, June 2004 Vol. 87, No. 6.
[45] O'Rourke, p54.
[46] "Canadian killed in 'friendly fire' incident," CBS News Online, 4 September 2006, accessed at
     http://www.cbsnews.com/stories/2005/09/26/friendly/main886284.htm. on 21 January 2007.
[47] Maurice Baril (General Canadian Air Force, Retired), *President Tarnak Farm Board of Inquiry – Final
     Report*, (Ottawa, 2002), p2.
[48] Ralph Nichols, *Avoid the Blues*, (Joint Readiness Training Center, Center for Army Lessons Learned,
     Fort Polk, LA 2003), p3.
[49] O'Rourke, p57.

Mazar-e-Sharif, wounding five Americans. On 5 Dec 2001, in the deadliest fratricide incident of OEF, three U.S. Special Forces soldiers and 23 Northern Alliance fighters were killed, and about 50 were injured when a U.S. B-52 dropped a 2,000-pound JDAM near the Blue forces that called for the fire in Northern Afghanistan. There was another near miss during Anaconda when a 2,000-pound JDAM was dropped nearly on top of an American position (of over 70 personnel), but luckily failed to explode.

The Appendix gives additional, more detailed examples of mistargeting incidents. Clearly, from 1917 to the present, mistargeting by aircraft has always been an issue. The combination of technology, media and other circumstances brought the problem to the forefront after Operation Desert Storm and created an exceptional level of concern. The problem, however, has not been solved.

Chapter 4: Consequences of Mistargeting

Mistargeting has not determined the outcome of past conflicts, and will not likely do so in the future. The ramifications of errant precision weapons are significant, however, and are likely to grow. Some of these effects are tangible, such as direct losses of personnel and equipment. Many others are intangibles – hard to quantify, but no less real consequences that can reduce fighting effectiveness.

At the highest level, sensitivity to mistargeting contributes to the political impulse to constrain military operations through strategy, Rules of Engagement, and centralized execution. Policy micromanagement of air operations, in particular the extent of target vetting at the highest levels, is the direct result of fear of mistargeting incidents. Mistargeting incidents can limit graduated-response options for leaders, and can lead to conflict escalation. Finally, the physical destruction of infrastructure dramatically affects increased reconstruction costs after major combat operations.

Media Expectations and Public Confidence

Prior to operation Desert Storm, mistargeting incidents left all but the victims anonymous, and media coverage was essentially non-existent. Units might have been identified, but individuals responsible were rarely made public. During Operation Desert Storm, sensational media coverage broadcast impressive video of weapons impacting targets all over Iraq. When those same weapons missed their mark, the public reaction was alarm and anguish.

Overmatched adversaries of the U.S. have become masters of Information Operations, and they know and exploit the U.S. vulnerability of mistargeting. This significantly increases the value of a favorite adversary technique: hiding among the

innocent.[50] Every time a dead child is portrayed as having been killed by U.S. air strikes,

an image of indiscriminate attack is created. When U.S. aircraft attacked structures in Al

Anbar Province housing foreign fighters in July 2003, for example, Arab media reported,

"Wedding Party Guests, Including Women and Children Killed in U.S. Attack."[51] The

famous "baby milk factory" incident during Desert Storm was another stark example.[52]

Fratricide mistargeting events demand the same scrutiny. In a peacetime

fratricide incident on 12 March 2001, a Navy FA-18 conducting CAS training bombed a

friendly observation post on the Udairi Range, northwest of Kuwait City. Five

Americans and one New Zealander were killed, and eleven individuals were injured.

There was extensive media coverage, little public understanding, and demands for

accountability. Colonel Charles Schrader explains typical public reaction:

> The news media have a tendency to blow friendly fire incidents out of proportion,
> and an ill-informed public reacts with distrust, demands for retribution, and
> remedies, which are generally unhelpful. The families of victims of friendly fire
> display excusable anguish and suspicion, which are often translated into demands
> for investigations and explanations which cannot be provided with any degree of
> speed or accuracy and thus often lead to unwarranted charges of cover-up and
> malfeasance."[53]

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[50] U.S. Joint Forces Command, *A Joint Concept for Non-Lethal Weapons, Doctrinal Implications of Low Collateral Damage Capabilities*, (Norfolk: Joint Non-Lethal Warfare Directorate, The Joint Warfighting Center Joint Doctrine Series Pamphlet 2, 2003), p4.

[51] "Wedding Party Guests, Including Women and Children Killed in U.S. Attack," *Al Jazeerah*, 25 May 2004, accessed at http://www.aljazeerah.info/News%20Photos/2004%20News%20/May/25-27.htm. on 21 January 2007.

[52] "Was It a Baby Milk Factory?" *The Washington Post*, accessed at http://www.washingtonpost.com/wp-srv/inatl/longterm/fogofwar/vignettes/v4.htm on 29 March 2007.

[53] Shrader, p29.

Political Limitations on Military Operations

There can be enormous political ramifications due to mistargeting incidents, as was the case after the accidental bombing of the Chinese Embassy in Belgrade during Operation Deliberate Force. That incident strained relations between China and NATO countries, and provoked angry demonstrations outside Western embassies in Beijing. The episode afforded China an opportunity to press for concessions from the West on issues such as the terms for China's World Trade Organization accession, human rights, Tibet, and nonproliferation.[54]

Mistargeting can result in the loss of training ranges or capabilities. On Vieques Island off the coast of Puerto Rico, a Marine Corps FA-18 on a training mission in April 1999 mistakenly bombed a target observation post, killing a civilian security guard and injuring four others. Immediately following the accident, the Department of the Navy temporarily suspended its use of Vieques, the U.S. Navy's premier East Coast Air-to-Ground target complex.[55] The Governor of Puerto Rico wrote to the President and the Secretary of Defense requesting the "immediate and permanent cessation of United States and Allied activities that entail the use of weaponry anywhere in the vicinity of the Municipality of Vieques, Puerto Rico."[56] Local civilians and political activists seized upon the event, ultimately ending military exercises there permanently.

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[54] Testimony by the Assistant Secretary for East Asian and Pacific Affairs before the Subcommittee on East Asian and Pacific Affairs, Senate Committee on Foreign Relations, (Washington: 27 May 1999).

[55] Congressional Research Service Report for Congress, *Vieques, Puerto Rico Naval Training Range: Background and Issues for Congress* (Washington: The Library of Congress, 17December 2001).

[56] The Special Panel on Military Operations on Vieques, *Report to The Secretary of Defense*, accessed at http://www.defenselink.mil/news/Oct1999/viq_101899.html on 11 Jan 2007.

Over-sensitivity

As Joint doctrine states, "Traditional military weapons require commanders to make difficult "trade off" decisions regarding the proper balance between mission accomplishment, force protection, and the safety of noncombatants."[57]

"Over-sensitivity" is when the balance shifts too far to the safety of non-combatants and Blue forces – excess fear of additional fratricide or collateral damage. Leadership can lose confidence in entire units, second-guess units or individuals, or micro-manage subordinate units. Overly restrictive ROE often result from mistargeting, thus limiting weapons employment options or pushing employment decision authority to higher levels. Superior Blue technologies are often constrained by ROE in order to avoid mistargeting. Implementing restrictive ROE to reduce mistargeting, however does not necessarily result in a reduction in the total number of friendly or neutral casualties. If ROE are tightened to the point that mistargeting is completely avoided, the enemy is likely more effective at inflicting greater casualties on Blue forces.

Strict ROE Limits were put in place during the Tet Offensive in 1968, when American and South Vietnamese troops attempted to retake Hue City. Because of fear of civilian casualties and damage to the city's historic artifacts, U.S. Marines were constrained against employing CAS, despite the fact that they lacked adequate artillery[58].

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[57] U.S. Joint Forces Command, *A Joint Concept for Non-Lethal Weapons, Doctrinal Implications of Low Collateral Damage Capabilities*, p4.
[58] Shrader, p29.

In Grenada, fear of civilian casualties led to the use of Cobra gunships for the attack on Fort Frederick over Naval gunfire or fixed wing aircraft despite the threat to helicopters. Two Cobras were shot down and three crewmembers were killed.[59]

Ground force commanders tightly controlled air operations in Panama. Clearance to employ tube or rocket launched weapons from AC-130s was restricted to ground commanders with at least the rank of lieutenant colonel. CAS in civilian areas required approval from at least Division level, and only the Operation Just Cause Joint Force Commander himself could authorize fighter aircraft air strikes.[60]

Limits on Ordnance Used in Combat

In CAS or in urban areas with high concentrations of civilians, targeteers and aircrew must make tough decisions about what type of munitions to use. Often, less effective ordnance is used in order to reduce the effects of mistargeting. Low collateral damage (CD) weapons are typically employed, even going so far as to use inert (concrete) bombs in combat. Before attacking emerging targets, aircrew must take additional time to perform CD effects analyses. Strafing targets with cannon is often employed to limit CD. While strafing is very precise, pilots must get very close to the target (and expose themselves to enemy fire) to employ it.

Increased Risk to Personnel and Equipment

The most basic consequence of mistargeting is that a valuable weapon has been expended without being effective against the enemy. In order to achieve the desired effect, the target has to be re-attacked, submitting friendly forces to additional risk.

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[59] Ronald H. Cole, *Operation Urgent Fury: Grenada*, (Washington: Office of the Chairman of the Joint Chiefs of Staff, Joint History Office, 1997), p 4–5.

[60] Jennifer Morrison Taw, *Operation Just Cause: Lessons for Operations Other Than War*, (Santa Monica, Calif.: RAND, MR-569-A, 1996), p. 24.

Fratricide mistargeting results in a loss of Blue combat power rather than a reduction of Red combat power. The effect on friendly forces causes disruption from the tactical to the operational, and even at the strategic level.

Mistargeting can have immediate and lasting psychological effects for both victims and shooters. Surviving ground victims of fratricide can suffer from confusion, loss of initiative and decisiveness, a loss of confidence in supporting arms/close air support, loss of confidence in processes (ROE, procedures, etc.) and leadership, and hesitancy to carry out orders. Ground troops, for example, are often unable to understand why friendly aircraft could not see and identify their positions. The diminished morale effects of fratricide can be devastating to fighting troops.

The physiological effects on individual(s), shooters or third parties responsible for mistargeting can be nearly as devastating. The fear of committing a targeting error and the resultant repercussions can result in a loss of initiative, self-doubt, and aggressiveness at the individual and unit levels, as well as degraded unit cohesion.

While not necessarily decisive on the battlefield, mistargeting in modern warfare can have enormous implications. These include oversensitivity by leaders, self-imposed limitations on capabilities, over-restrictive ROE, and loss of confidence. Given the modern media and high public expectation for precision, these consequences are likely to grow.

Chapter 5: Precision Targeting Processes and Systems

Precision targeting (PT) consists of locating, identifying, and engaging appropriate targets. First, a target must be acquired by some sensor, and then information about the target must be managed and fused by either a human or automated process, ultimately ending up with a shooter and weapon. The target must, at some point, be declared hostile, friendly, or unknown. ROE must be applied, and a decision to engage, or not, must be made. The process for correct PT from the air is complex, and can take anywhere from weeks (or longer) to mere seconds.

The toughest part of PT is the timely development of raw data into Situational Awareness, distributed through a Common Operating Picture (COP), and positive identification of the target immediately prior to weapons employment – a process known as Combat Identification (CID). The COP and CID are closely related, mutually supportive and increasingly interdependent, but there are differences. A COP seeks consistent and accurate shared SA on the position and movement of Blue and Red forces (as well as White positions), and can be as simple as a common language or reference system, or as complex as sophisticated digital networks and displays. CID emphasizes real time weapons employment information. Combining the capabilities of both results in a reduction of mistargeting and increased combat effectiveness.

According to joint doctrine, precision targeting does not result from a single process or system but from the combination of many sources including "carefully written ROE; thorough intelligence operations; careful planning; sophisticated collateral damage estimates; knowledge of relative force positions; standardized procedures and systems;

and precision weapons to increase the probability of hitting the intended targets."[61] Stated differently, precision targeting relies on achieving a COP and CID, which result from a combination of <u>processes</u> (such as pre-mission planning, control measures, ROE and standardized procedures) and <u>systems</u> (physical electronic devices, networks, and weapons) that are necessarily very closely linked and interrelated.

Processes

In many cases, the processes by which information gained and passed have not changed much since World War II. Procedural control measures for aircraft are promulgated through wings and squadrons, to flight leads and their wingmen, primarily through the Air Tasking Order (ATO), the Airspace Control Order (ACO), standard procedures and ROE. The ATO provides basic planning coordination information such as aircraft callsigns, target assignments and times on station. The ACO deconflicts competing demands upon airspace, providing detailed descriptions of special use areas such as aircraft orbits, No Fly Zones (NFZ), No Fire Areas (NFA), and Terminal Movement Areas (TMA). These are particularly important when battle lines become ambiguous and fluid, with intermixing of friendly and hostile forces. Aircrews and mission planners need to reference these documents *on a daily basis* in order to maintain SA on friendly forces, and avoid mistaking friendly force activity for hostile actions.

ROE are among the primary control measures available to commanders and they serve several purposes, including restricting the use of force by friendly forces, ensuring subordinates act within the commander's intent, minimizing collateral damage, and

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[61] U.S. Joint Forces Command, *A Joint Concept for Non-Lethal Weapons, Doctrinal Implications of Low Collateral Damage Capabilities*, p2.

preventing fratricide. ROE must balance the necessity to achieve military objectives while avoiding attacking friendly forces and neutrals.

Processes work very well when the fusion of data has been accomplished *pre-flight*. When aircrew must launch without vital information, such as in airborne intercept or Close Air Support missions, they must obtain that vital information prior to weapons employment. In years past, targeting information was gained primarily through the pilots' eyes, or other onboard sensors, often aided by "third parties" (such as AWACS and JTACs). Today, those third parties have an increasing role in building a COP and CID because they can fuse large amounts of information or are in a much better position to differentiate friend from foe.

The key (and challenge) to successful precision targeting in a dynamic battlefield lies largely in the quality of information aircrews receive from third parties. One of the biggest problems is the simple mechanics of communicating complex data from the sender through the aircrew and into the weapons systems. Traditionally, the process by which targets are communicated to aircrew has been done through voice communications: air controllers or JTACs (often under fire) find a target, then radio data to the pilot in a standardized format. The pilot processes the data and makes manual inputs to his targeting system. While doing this, he is also likely flying formation, navigating, and avoiding enemy fire. There are many opportunities for friction in this process.

As stated previously, CAS missions, by nature do not allow detailed pre-flight knowledge of targets or Blue troop locations. Because of this, CAS is extremely "process intensive," and requires an extensive airborne information exchange. JP 3-09.3, Joint

Tactics, Techniques and Procedures for Close Air Support, addresses the process requirements for minimizing fratricide: "Items such as detailed mission planning, standardized procedures for friendly force tracking and supporting immediate air requests, realistic training/mission rehearsal, use of friendly tagging or tracking devices, and effective staff, forward air controller/air officer and air liaison officer coordination, and sound clearance of fire procedures can significantly reduce the likelihood of fratricide."[62]

In addition to voice communications, JTACs also use visual "marks" (such as rockets, artillery, IR pointers or lasers) in communicating a COP and target information (including CID) to CAS aircrew. The mark is put as close to the intended target as possible, and then the JTAC adjusts the intended aimpoint for the aircraft's bombs by radioing a distance and direction from the mark (e.g. "bomb 200 meters west of the mark"). Often, aircrews must rely on unaided vision, hand-held binoculars, or NVDs to find and identify their targets. If marking methods are unavailable, JTACs must use a "talk on" method to describe the intended target to the aircrew. They typically start with an easily recognized terrain feature (e.g. a bridge) as a reference point, and then describe the target's position relative to that.

Ordnance Delivery

Eventually the JTAC and aircrew must "agree" that they are looking at the same thing and the aircrew begins his terminal attack. Communication between the JTAC and the pilot is not finished, however. There are three types of terminal attack control (Type

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[62] U. S. Department of Defense, *Joint Publication 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, p21.

1-3) provided by the JTAC. Type 1 control is the most restrictive and is used when JTACs must visually acquire the attacking aircraft and the target under attack. Once the bombing aircraft rolls in on the target, the JTAC must visually assess the aircraft's geometry and where he thinks the bombs will impact. Once satisfied that friendlies will not be targeted, he then clears the aircraft "hot" to release. The JTAC then transmits "cleared hot," wherein he is assuming responsibility for the avoidance of fratricide and collateral damage from the aircraft's bombs. This coordination is much more art than science, and errors of the mark, combined with communication and visual errors often led to mistargeting. Type 2 control is less restrictive (and thus higher risk for fratricide) and is used when either visual acquisition of the attacking aircraft or the target (by the JTAC) at weapons release is not possible, or when attacking aircraft are not in a position to acquire and positively identify the target prior to weapons release. Type 3 control is used when there is a low risk of fratricide. In any case, the pilot is relying on the JTAC to build a solid COP and to perform CID.

Systems

Numerous systems have been developed since World War II to help build a COP and provide CID. Initially, these were aimed primarily at the Air-to-Air environment, but are increasingly being employed for ground units. Most COP and CID systems are classified as being *cooperative* between the shooter (or third party) and friendly units, and can only provide friendly or absence of friendly indications.[63] Systems for identifying friendly forces include the simple to the sophisticated. Simple systems include paint

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[63] *Non-cooperative* techniques rely on profiling target characteristics, and thus can provide a "positive hostile" indication (rather than an "absence of friendly" indication).

schemes, lighting systems (including pulsed IR beacons that can be seen using NVDs), and Combat ID panels (designed to emit thermal signatures that can be seen using IR sensors.

Sophisticated systems often digitize data (voice, text, tagging, maps) allowing a picture that was once seen only by C2 units or JTACs to be passed and visually displayed by other ground and air units. Many of these systems, conceived to improve C2 situational awareness, synchronize fires, and collect intelligence, also contribute immeasurably to PT. They include Blue Force Trackers, such as the legacy Identification Friend or Foe (IFF) system, the Joint Tactical Information Distribution System (JTIDS), and Force Battle Command Brigade and Below (FBCB2), as well as other technologies like target cuing and digital communications systems, GPS navigation and GPS Guided Weapons (GGW).[64]

The most ubiquitous cooperative method used for COP and CID is the IFF query/response system first developed in World War II. IFF is a radio system widely employed for SA and C2 both military and civil aviation users. An interrogator on the shooter (or third party) sends a coded query message to the target (aircraft, ship, vehicle, etc.). The cooperative target then electronically responds to the query with a coded data reply. Because it is a cooperative system that is capable of sorting targets into only two categories, those responding friendly and those that do not reply, IFF is somewhat of a misnomer. Those that do not reply are not necessarily foe – they might well be Blue

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[64] There are a number of technology-based COP and CID systems, both cooperative and non-cooperative, including electronic signature matching, electro-optical imaging/image matching, JEM, Optical, IR, and Precise Position Location and Identification (PPLI) inherent to the Joint Tactical Information Distribution System (JTIDS). These systems will not be discussed in detail due to classification.

units with inoperable IFF, or White units without IFF. The system has grown in sophistication over time, and there are several modes used by military and civilian aircraft. IFF was first introduced on some ground units during the Vietnam War, and there was a NATO Battlefield IFF effort in the late 1970s and early 1980s. Ground proliferation has been extremely limited, however for a number of reasons, including cost, size, and weight. Off the shelf aircraft IFF systems do not work well on ground vehicles because of ground interference and difficulty in target discrimination due to the dense ground environment.

A much more modern system is the Joint Tactical Information Distribution System, introduced in the late 1990s. JTIDS is a tactical, jam resistant, digital data link that provides a COP and an additional CID layer for *equipped and participating systems* by automatically attaching a "friendly" reply after position reporting. Despite JTIDS' ability to provide a good idea of force location, the system has some latency and accuracy problems, and is currently installed only on fighter aircraft and C2 platforms.

While IFF and JTIDS are mature systems, equivalent ground systems have been slower in development and fielding. Connecting the troops on the ground with the same picture available to air and C2 units was identified as a critical shortfall after Desert Storm. Since that time, at least a dozen systems have been proposed, tested, partially fielded, and in most cases, cancelled. The Army fielded a ground system called EPLRS (Enhanced Position Location Reporting System). Similar to JTIDS, this system also determines the position of participants and contributes to SA and CID, and can also be data-linked to CAS aircraft, permitting Blue units to be displayed along with the target. Additionally, a number of modern versions of IFF technologies, including millimeter

wave and a new satellite-based tracking and communication system mounted in U.S. Army and Marine vehicles were introduced during OIF/OEF. Current efforts are to reduce the number of different disparate systems, and improve their interoperability and effectiveness.

Currently, the most widely used ground blue force-tracking system is the Force Battle Command Brigade and Below (FBCB2), a hybrid Army/Marine system of ruggedized laptop computers and communications software that uses satellite links and ground stations to form a wireless battlefield Internet. FBCB2 has been extremely successful, but the system is not widely fielded and, as with JTIDS, there are problems with latency and accuracy. Joint Surveillance Target Attack Radar System (JSTARS) aircraft are tied into FBCB2, but strike aircraft are not.

Target cuing and communication systems have made great progress over the past decade and can help tremendously in ensuring that the pilot and third parties are sharing the same picture. The Joint Helmet Mounted Cueing System (JHMCS) can put visual cues in the pilots display over target coordinates and friendly positions, greatly enhancing aircrew's ability to see what is being described by the JTAC. This information, however, is only as good as the data entered into the system. The Remotely Operated Video Enhanced Receiver (ROVER) system allows ground forces to view aircraft sensor video via data link to laptop computers. JTACs can draw circles and arrows on their screen that then appear on the pilots' display. This ability to real-time view their surroundings from a god's eye view bridges the JTAC-aircrew communications gap, and ultimately provides better target identification.

The Single Channel Ground and Airborne Radio System (SINCGARS) can transmit and receive voice and tactical data between ground and air platforms. The system allows JTACs to enter target coordinates and other information that then get electronically transferred straight to the pilot's display, thus avoiding potential voice communication and data transfer errors. Pilots essentially accept or reject target coordinates. If accepted, they are automatically transferred into the aircraft mission computer, and the weapon's guidance system. The pilot also sees a cue representing the target on his displays. SINCGARS is also being used for CID on an experimental basis, wherein equipped aircraft can "interrogate" SINCGARS radios on the ground, that automatically respond with a "friendly" signal.

GPS and GPS Guided Weapons

Accurate position keeping is an essential component of building a COP and of CID, and no other technology competes with GPS for providing accuracy at low cost. GPS has become ubiquitous throughout the battle space, accounting for a large number of modern Air-to-Ground weapons, and nearly every soldier having a hand-held receiver.[65]

The introduction of stand-off, GPS Guided Weapons (GGW) eliminate the requirement (and usually the *ability* as well) for the aircrew to visually acquire and identify targets – they need only get close enough to release the weapon, and then let it guide to programmed coordinates. GGW have proven to be extremely reliable and extremely accurate when weapons are programmed and function correctly. However, this new technology also introduces new problems. Because GGWs are only as accurate

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[65] There are initiatives to attach GPS location data "tags" onto current and future integrated data link and communications systems. This capability will be quite helpful to CID, but should be a redundant capability in case it is GPS denied.

as their programming, high quality "mensurated" target coordinates, using a standardized

format and common datum, are absolutely critical. Mensurated coordinates are obtained

through imagery analysis, and then programmed into weapons using mission-planning

systems, typically before flight. Mensurated coordinates generated in the pre-planned

environment have a reputable "pedigree." Data errors, from the initial analysts, to

targeteers, to planners, to aircrew, and ultimately to the weapon, can make an enormous

difference in where the weapon impacts. To allow for this pedigree to be established

prior to flight, JP 3-09.3 cautions, "If the commander allows the use of these weapons the

decision must be made early in the planning cycle."[66]

In the CAS environment *that is not possible*, because targets and their locations

are not known in advance (thus mensurated coordinates are not available), and due to the

nature of GGW delivery, JTACs are unable to provide Type 1 terminal control. When

mensurated coordinates are not available, such as in CAS, target coordinates are

generated from the best available means, typically GPS receivers and laser range finders,

which produces a much larger Target Location Error (TLE) than does mensuration.

Target position relative to friendly forces and acceptable TLE, given the tactical situation

on the ground, are critical. The JTAC passes the target coordinates to the aircrew, who

then loads them into the weapon guidance system. Once the information is entered, the

bomb theoretically goes wherever it is programmed to go.

Unfortunately, the processes so long in effect to avoid mistargeting in CAS have

not kept pace with many of these modern systems. Standardization of coordinate

information continues to be problematic. Each service, and even different units or

[66] U. S. Department of Defense, *Joint Publication 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, (Washington: GPO, 2003), p11.).

platforms within the same service have historically used a variety of coordinate formats.

Ground forces were most familiar with the Universal Transverse Mercator (UTM) Grid

Reference System, but aircrew and GGW typically use geographic coordinates in

latitude-longitude format. GPS receivers and aircraft mission computers and can convert

between formats, but there is often some loss of accuracy.[67]

The second process problem introduced when GGWs were added to the CAS

environment is the inability of the JTAC to assess where the ordnance will land based on

aircraft geometry. The JTAC thus assumes additional risk in allowing aircrews to attack

targets by releasing ordnance without positive Type 1 control. The use of GGW in CAS

is still not a routine procedure, and precise TTPs have not been established.[68]

Even with the emphasis on COP and CID technology since Operation Desert

Storm, COP and CID processes have not kept pace with the technological systems. In

some cases, weapons have outpaced the ability to CID targets prior to release. Aircraft

employing GGW, with little or no sensor or "man in the loop" input are extremely

dependent on others in the kill chain - planners, targeteers, ground forces, and other third

parties – to get the process right. The complexity of all of this has made the detailed

integration of ground and air elements and adherence to doctrine and TTPs imperative.

To facilitate the accurate and timely passing of critical COP and CID information,

processes and systems must be interoperable, promulgated, understood, and employed

between the services and between ground and air units. Although the U.S. Joint Forces

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[67] To alleviate this disparity, JP 3-09.3 now dictates that the WGS-84 datum be used as the standard for all Joint operations. Because local maps are not always available in WGS-84 and conversion is costly and time consuming, CCDRs retain the flexibility to use of other datums as circumstances dictate. U. S. Department of Defense, *Joint Publication 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, p11.

[68] U.S. Department Of The Navy, *MCWP 3-23 Offensive Air Support*, (Headquarters United States Marine Corps Washington, 2001), p53.

Command has the responsibility for joint CAS doctrine, training, and Joint Combat ID, the task is far from complete, leading to continuing cases of mistargeting. The next chapter will discuss why, with all of the technology, tactics, techniques, and procedures in place, we continue to mistarget precision weapons.

Chapter 6: Causes of Mistargeting: Why?

Despite the evolution of technology to avoid fratricide and collateral damage, mistargeting continues – the causes are multiple and cover a wide spectrum of conditions. One of the major challenges in documenting mistargeting mishaps lies in comprehensively defining all of the causal factors involved, a process that is becoming less difficult as incidents are much more likely to be investigated, analyzed, and adjudicated now than ever before. Historically, determining the actual amount of mistargeting, who caused it and why it occurred, has been very difficult. Active combat conditions are typically not conducive to timely, thorough, and accurate investigations. This substantially changed on the modern battlefield during and after Desert Storm, when the Allied forces (especially U.S. and UK) gained a clear and accurate accounting of fratricide events through mission recorders and the analysis of unique signatures (such as depleted uranium rounds) that were indisputably from U.S. weapons. The short duration of Operation Desert Storm also allowed for immediate operational evaluations.

Mistargeting events often have the same characteristics as safety mishaps, and can be analyzed the same way. Once it is determined that someone (WHO) did something (WHAT) at a certain place (WHERE) and time (WHEN), the most importantly factor: WHY? must be determined. Numerous WHY's can be defined for every causal factor.

WHEN does mistargeting typically occur? Historically, mistargeting incidents have most often occurred in the early stages of combat, during periods of reduced visibility (night, poor weather) and periods of dynamic change on the battlefield.

WHERE is mistargeting more likely to occur? Historically, supporting fires (air and artillery) account for almost 75 percent of fratricide incidents, typically between the

seams (along shared Blue unit boundaries, or between Blue/Red. Collateral damage occurs when Red/White positions are commingled).

WHO is responsible for mistargeting? Responsibility falls to one or more of the following entities: the shooter, the victim, a third party, or supervisory authority. The "Shooter" refers to the individual(s) that ultimately releases a weapon. The "Victim" is that person, unit or position that suffers the impact of a mistargeted weapon. A "Third party" refers to any individual (e.g., coordinator, targeteer, Forward Air Controller, AWACS Controller, etc.) or entity (e.g., a targeting cell) that directly impacts the placement of a weapon onto a target. Supervisory authority refers to individuals or entities that provide over-arching leadership, guidance, or policy that has a direct impact or contributes to a mistargeting incident. Responsibility can also be placed with the enemy, in some cases, such as when he intentionally operates in, or in close proximity to, White positions.

WHY do precision weapons to hit the wrong target? There are many factors that can lead to mistargeting, but they are almost always due to one (or a combination) of two reasons: loss of situational (or positional) awareness (bad COP) and/or target identification failures (poor CID). CID technology has advanced somewhat beyond the shooters' unaided vision, but has not kept up with modern forces' ability to detect, track, and engage targets at range. When deciding to shoot or not, modern forces rely more and more on their Situational Awareness – knowledge of their own location, other Blue/White locations, and target locations or *where they are supposed to be.* The Army Training and Doctrine Command articulated this in 2000:

Lack of positive target identification and the inability to maintain SA in combat environments are the major contributors to fratricide. If we know where we are and where our friends are in relation to us, we can reduce the probability of fratricide. If, in addition, we can distinguish between friend, neutral, and enemy, we can reduce that probability even more."[69]

Joint Publication (JP) 3-09, Doctrine for Joint Fire Support, lists the causes of fratricide as "target misidentification, target location errors, target locations incorrectly transmitted or received, and loss of situational awareness by controllers or aircrew or requestor".[70]

Target identification errors refer to the shooter having a clear picture and good SA, but for some reason he identifies a Blue or White entity as a Red target – misidentified friendly troops, vehicles, or civilian positions are mistakenly attacked in the belief that they are enemy. Target identification errors occur when CID systems or processes fail.

Loss of Situational Awareness

Situational Awareness is defined as accurate information regarding one's own location (and orientation), as well as the locations and activity of friendly, enemy, neutral, and noncombatants. SA can be "lost" by shooters, victims, or third parties, leading to mistargeting, especially when combined with long-range weapons (i.e. position errors become increasingly irrelevant in a close in fight). Either the shooter or the victim might be "out of position" for lack of a common operational picture (COP), failure to

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[69] U.S. Army Training and Doctrine Command (TRAGGW). TRAGGW-AMC *Combat Identification Interim Report*. (TRAGGW, Ft Monroe, Va, 2000).

[70] U.S. Department of Defense, *Joint Publication 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support (CAS)*, p49.

adhere to the plan, or navigational errors. Good SA is dependent upon planning, control measures and the expectations of participants, and can compensate for other shortfalls (equipment failure, poor communication, etc.).

Obviously, good SA – when an individual's perception equals reality – is preferred, and more is better. When an individual either never gains, or has and then loses, SA that is acceptable so long as that individual realizes his lack of understanding (e.g. "I'm clueless, and I know it."). What is by far worse, is the individual who *thinks* he's got good SA when in fact he does not.

Nearly every incident of mistargeting can be attributed to several contributing factors or preconditions, and they are usually inter-related forming a mistargeting chain of events. Contributing factors are numerous, but can they be grouped into four major categories: environmental, technical/equipment, organizational/procedural, and individual.[71]

Environmental

The physical environment plays a significant role, complicating war through poor visibility due to darkness, weather, smoke and other obscurants.[72] Modern "battlefields" can be anything from immense desert expanses with large, fast moving formations, to complex urban settings with large civilian populations and extensive enemy camouflage, concealment, and deception (CCD). The burden on CID capability is taxed considerably

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[71] Fratricide and collateral damage can also be the result of weapon guidance failures or excess weapons effects beyond the target objective (i.e., "too lethal" – they achieve the objective, but also cause fratricide or collateral damage), but these are not targeting failures per se, and will not be discussed.

[72] These obviously also impact the enemy, and in many cases give the U.S. a distinct advantage.

by the relatively unfocused nature of many hostile situations, combined with the lethality of enemy weapons.

Environmental factors can cause units to become disoriented, stray outside their boundaries, or assume wrong locations for themselves or their targets. Friendlies intermixed with enemy, isolated friendly units, or units not where they are expected to be are much more likely to be mistakenly engaged by friendly forces. On a dark, rainy night during Desert Storm, for example, two armored vehicles engaged with Iraqi forces became disoriented. They inadvertently maneuvered behind enemy vehicles and were hit by friendly fire resulting in several casualties.

Environmental factors can also render some of the most sophisticated equipment unusable. For example, lasers, Infrared and TV become increasingly ineffective with airborne obscurants, and IR beacons designed to identify Blue positions cannot be seen during the daylight.[73]

Technological / Equipment

Technological advances have certainly enhanced the performance of PGMs, CID and COP systems in modern combat. However, these technological advances bring their own problems, such as an over-reliance on that technology (without sufficient redundancy or backup), misused equipment, and equipment malfunctions. Also considered a technology failure is the basic fact that weapon effective range capability has largely eclipsed CID and Blue force location capability. These are cases of processes not keeping up with systems.

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[73] To alleviate problems with Laser Guided Bombs, new guidance kits are equipped with GPS guidance backup.

As discussed in the previous chapter, GPS technology has infinitely enhanced Blue force's ability to know their own position and stay oriented on the battlefield. But GPS integration to nearly every unit on the battlefield has also brought a new set of challenges.

Prior to GPS, coordinates were used to give general locations of units and to help find targets using other sensors (eyeball, infra-red, etc.). When done improperly, the capability to use GPS for targeting - to "bomb coordinates" without any other means of target acquisition or identification - can be disastrous. There have been several documented cases of GPS guided weapons being mistakenly programmed with "precision" GPS coordinates for *friendly* positions. Interoperability issues, as well as the lack of standardized TTP have contributed to the problem.

Central to the OEF case on 4 December 2001 was GPS coordinates, when U.S. Special Forces operating north of Kandahar called for a JDAM delivery to air strike the Taliban forces they were engaged with.[74] The fratricide incident was blamed on the JTAC, who improperly used a laser range finder, transmitting his own coordinates as the target coordinates to the B-52 crew.

Poor communication among shooters and victims, shooters and third party, or victims and third party can result in messages not sent, messages not received, messages received but not processed, misunderstood, or not implemented, or messages not received in a timely manner. Radios that are incompatible with those of other units, language barriers, and non-standardized or ambiguous terminology, and "noise" have often contributed to communication failures and mistargeting.

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[74] Carol Morello, Carol and Vernon Loeb,. "Bomb Kills Three U.S. Soldiers; 20 are Injured 'Friendly Fire.'" *The Washington Post*, 6 December 2001.

Such was the case in the April 2003 incident in which U.S. Special Forces and Kurdish fighters were mistargeted by F-15s in northern Iraq. The ground element could not abort the jets because the SOF and the jet's radios were not compatible.

Location errors can also result from battle reporting or tracking errors. Units at often fail to produce accurate, timely and complete reports or track their subordinates as positions and tactical situations change, leading to a breakdown in SA. The modern technological equivalent is for sophisticated data link battle management systems to mis-position or mis-label units. Equally as bad is for shooters to assume that their high-tech COP and CID systems are fully functioning and giving them perfect SA. What they do *not* know, can often lead to mistargeting. A good example of this will be discussed in a follow-on section.

Automated CID technology systems, while incredibly capable, are not infallible. Cooperative systems, such as IFF, can fail and non-cooperative systems are occasionally prone to false readings. This all necessitates the requirement for redundant systems and processes such as a "man in the loop" to make the final fire decision.

Organizational / Procedural

While technology is important, the U.S. is largely able to clear the "fog of war" because of good processes and procedures. The break down of these has led to numerous cases of mistargeting. Inconsistent or incomplete Common Operational Pictures are the modern "fog of war" and can be caused by poor plans, inadequate ROE/SOP, battle plans not progressing as planned, incompatible coordinate systems, or systematic breakdowns. Inadequate equipment, equipment not installed, or requirements not foreseen, also constitutes organizational failures.

Contradictory coordinate datums, formats, and conversions have been primary contributors to the degradation in accuracy of COPs. Each Service acquired multiple systems for describing and communicating positions, and interoperability of these systems was often lacking.

CAS during Operation Urgent Fury in Grenada, for example, exhibited insufficient control measures (ROE, ACO) and procedural guidance. Air components were not operating from the same reference system as the ground elements, and were often unable to even communicate with each other. The ground element used a grid system overlaying the best map they could find: a tourist map. Thus, ground forces (when they were able to communicate with air) were not able to accurately describe their positions or target positions to supporting pilots. This lack of a COP likely contributed to the strafing of a U.S. Army command post. One analyst remarked, "Ground units experienced difficulty in orienting themselves and in directing supporting gunfire and air strikes. This inadvertent air strike…has been blamed partly on this chart confusion problem."[75]

Things did not improve markedly during Operation Just Cause in Panama. During a gun battle between Navy SEALs and Panamanian Defense Forces at Paitilla Airport, the JTAC was unable to make radio contact with the AC-130 gunship that had been assigned to provide CAS. And again, pilots and ground forces were using maps with different reference systems. [76]

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[75] David T. Rivard, *An Analysis of Operation Urgent Fury*, (Defense Technical Information Center, Philadelphia, 1985), p24.

[76] Thomas Donnelly, Margaret Roth, and Caleb Baker, *Operation Just Cause: The Storming of Panama*, (New York: Lexington Books, 1991), p. 152.

The Chinese Embassy bombing in Belgrade can be blamed on faulty maps and human error.[77] There were several crucial errors, including "a flawed approach in attempting to locate the intended Serbian military target; inaccurate or incomplete sources of information used to prevent precisely this type of incident; and a faulty review process that did not catch the error."[78]

Insufficient supervisory level coordination between units as they move about the battle space (particularly on separate radio nets) is another organizational cause of fratricide. Operation Enduring Freedom presented a good example, as conditions in Afghanistan severely challenged U.S. CAS tactics and procedures. Aircraft were often told "to go to Afghanistan" and wait for further instructions, and nearly every ground unit had their own JTAC, often working on common radio frequencies.   Another new aspect of CAS was the amount and variety of available air coverage. Never before had B-52s, B-2s, or F-15Cs, been asked to routinely perform CAS.

Even with the most experienced and qualified CAS participants, the lack of a COP can cause tragedy. In the March 2003 An Nasiriyah incident in which U.S. Marines were targeted by Air Force A-10s, many factors contributed, including problematic communications links and a battle that did not develop as planned. Ultimately, the JTAC who called in the air strike was found to be at fault for the friendly fire – he believed no

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[77] DCI Statement on the Belgrade Chinese Embassy Bombing for the House Permanent Select Committee on Intelligence Open Hearing,. 22 July 1999, accessed at. https://www.cia.gov/cia/public_affairs/speeches/1999/dci_speech_072299.html, on 29 Dec 2006.

[78] Oral Presentation by Under Secretary of State Thomas Pickering on June 17 to the Chinese Government regarding the accidental bombing of the PRC Embassy in Belgrade, released July 6, 1999, accessed at. http://www.un.int/usa/99prc617.htm on 28 Nov 2006.

friendly forces were in front of his unit, and, although he could not see the target area or the A-10 aircraft, he directed the A-10s to strike.[79]

Individual

The "human element" is probably the most prevalent factor leading to mistargeting, and it has caused far more incidents than have organizational or technical failures. This goes not only for the individual that "owns" the bomb – that makes the decision to release ordnance – but also with victims and third parties as well, and can take many forms. As Col Shrader noted, "No other single factor produces as many instances of friendly fire as does the stress of combat... from the nervous soldier who fires his rifle before properly identifying his target to the commander who orders his tanks to turn the wrong way in the confusion of an operation."[80]

Individual errors are self-explanatory, but range from the very basic (like pushing the wrong button at the wrong time) to the very complex (like excess or misplaced motivation). Psychosocial factors include anger, fear, anxiety, confusion, apprehension, fatigue, panic, and elation, leading to things such as channelized attention, over-confidence and lack of self-discipline. These human failings are often difficult to pin down, but contributors include environmental factors, perceived pressure, inadequate training/proficiency/standardization, high operational tempo, sleep deprivation, stress, organizational climate/culture, poor unit discipline, unrealistic expectations, and lack of experience. Most of these things cannot be eliminated in combat, but must be accounted for with CID Tactics, Techniques, and Procedures.

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[79] U.S. Central Command, *Investigation of Suspected Friendly Fire Incident Near An Nasiriyah*, Iraq, 23 March 03, (MacDill Air Force Base, 2004).

[80] Shrader, p39.

The abundance of information often presented can be difficult for individuals to fuse and process, a factor that can lead to cognitive saturation. When one receives "too much information" it often leads to channelized attention, or "fixation" on one thing to the exclusion of other inputs. Psychologists call this information overload the "Glass Cockpit Syndrome" where the combination of a vast amounts of technical data combined with high stress can lead to major judgment errors.

Throughout history, the shooter's eye has been the most prominent ID sensor, and errors have always been common. Visual identification errors can come from people seeing what they *want* or *expect* to see, unfamiliarity with enemy and friendly platforms, or when there is simply not enough visual distinction between platforms. Even in the best visibility conditions, modern aircraft flying close to their mark can mistake friend for foe due to speed alone. Add battlefield threats, obscurants or weather, and distinguishing between civilian vehicles fitted with clear fluorescent-orange markings from old tank hulks is nearly impossible.

Poor judgment, lapses in individual or unit discipline, or violations of ROE can all lead to mistargeting. An individual's judgment forms the foundation upon which he makes decisions. In that process, he fuses and processes information, applying filters (such as experience and ROE) to form a response. If information is insufficient or inaccurate, or if filters are misapplied, then judgments (and thus decisions) made are subject to error. Poor judgment results from negligence, inexperience, and intentional violations of established rules. Failing to consider or opt for other courses of action is a common manifestation of poor judgment. Poor judgment discipline can quickly lead to mistargeting.

Technology developed to build a COP and achieve end-game CID to avoid fratricide and collateral damage has not eliminated mistargeting. The causes are multiple and cover a wide spectrum of conditions. Historically, mistargeting incidents have most often occurred in the early stages of combat during periods of dynamic change on the battlefield. Supporting fires account for the vast majority of fratricide incidents, typically between the seams. Responsibility for mistargeting generally falls to the shooter, the victim, a third party, or supervisory authority. There are many factors that can lead to mistargeting, but they are almost always due to a chain of events including a loss of situational awareness and target identification failures.

Chapter 7: Conclusions / Recommendations

Despite extensive activity in the area since Operation Desert Storm, current Precision Targeting remains fragmented. Mistargeting has always been a part of warfare, and aerial mistargeting likewise has been around since the first weapon was taken aloft. Although the raw numbers were much higher in World War II, Korea and Vietnam, the *rate* of Blue and White casualties due to mistargeting has steadily gone up with the use of precision weapons. The problem became so prominent during Desert Storm that an intensive reassessment of the priority given to preventing mistargeting was begun. The problem continued to escalate during the Balkans Conflict and has not subsided during Operations Enduring Freedom and Iraqi Freedom. The increasing use of high-technology weapons and rapidly moving forces had made the U.S. very lethal to her opponents, but Situational Awareness and Combat Identification technology have not kept up. The operational environment has changed: the weapons intended for large conventional forces are being used against unconventional adversaries. Conditions have created situations where mistargeting is a major news item and a significant factor of morale and cohesion.

The consequences of mistargeting have increased dramatically since World War II, when tens of thousands of allied troops and civilians were killed by errant weapons. Consequences range the spectrum from effects on the individual soldier up to U.S. national strategy. Direct loss of (innocent) personnel, equipment and infrastructure is the basic, tangible result of mistargeting. Forces can loose their initiative, lose trust in the system or themselves, and suffer any number of other intangible impacts. Rules of Engagement can be made overly complex as commanders become more sensitive to

mistargeting, and loss of training ranges and capabilities can result. Ultimately, decision making at the highest levels and American's will to fight can be adversely affected.

As Chapter 6 and the Appendix show, the two key reasons for mistargeting are a loss of situational awareness and/or target identification error. Primary contributing factors include environmental, technological/ equipment, organizational/systemic, and individual. There is nearly always a combination of several factors completing a "chain of events" leading to a mistargeting incident.

The operational environment is getting more complex because forces move quicker, weapons are more lethal, and enemies are more likely to exploit urban terrain. Over the last decade, technology and equipment have received the most attention in combating mistargeting. But as we have seen, technology alone cannot solve the problem and can bring new difficulties. Organizational processes, some of which have been in place for decades, can play a key role in mistargeting, particularly when they are out of sync with new systems. Whether an individual shooter pulls the trigger or not, could easily be decided by the climate of his command or his understanding of complex ROE. Finally, the most complicated data fusion, identification and decision system there is: the individual that makes the final decision. As we have seen, there are myriad complex factors that determine what an individual does when faced with a highly stressful "shoot/don't shoot" combat situation.

Current efforts to reduce mistargeting incidents focus on processes and systems to build situational awareness and provide target identification. The process starts with procedural control measures from the command element, such as Rules of Engagement and Airspace Control Orders. Controls for the use of common coordinate systems and

standardized Close Air Support procedures are other examples of processes. Systems

include those dedicated to identifying friend from foe and those designed to increase Blue

force situational awareness. They vary from the very simple fin flash markings painted

on equipment, to IFF technology that was first introduced in WWII, to very advanced

non-cooperative CID and force tracking technology. Current GPS guided weapons also

play a key role in mistargeting, because they rely so heavily on the targeting process to

get them to the correct aimpoint. The man in the loop with these systems is quite often

not the pilot, but a third party.

Since there is little that can be done about the environment, efforts to improve the

technical, procedural, and individual aspects of precision targeting must be pursued.

Shooters need to know what they are aiming at, and good shoot or don't shoot decision

tools. Maintaining SA and CID of land forces is the most serious CID shortfall,

especially as ground units increasingly exhibit the same rapid movement characteristics

as those of aircraft. From a technical perspective, fratricide is a "fixable" problem but

collateral damage is more difficult to solve.[81]

CID in the future should be made up of multiple layers – processes and systems –

that build situational awareness and ensure target identification prior to engagement.

Any new processes and systems, whether technical or organizational, must be:

- Interoperable between forces (air / ground), services, and coalition partners, and

  relevant information must be widely disseminated across boundaries. Aircraft

  must have access to filtered battlefield tactical SA networks to provide real-time

[81] Sandra I. Erwin, "Experts Weigh Technologies to Help Identify Friend and Foe," *National Defense Magazine*, August 2003. accessed on 9 Feb 2007 at: http://www.nationaldefensemagazine.org/issues/2003/Aug/Experts_Weigh.htm

locations of friendly troops. With the U.S. nearly always operating as part of a coalition, interoperability with allies is fundamental. Achieving interoperability of U.S. forces has taken decades, and is a mission not yet complete; multinational interoperability is even more of a challenge. While USJFCOM has a formal program to integrate all the separate service CID projects into a Joint system, they must continue to aggressively identify and resolve potential interoperability issues.

- Fused with other information. SA and CID come from a variety of sensors, individuals and platforms. Information must be consistent, relevant, and verified. Firing decisions are made after merging inputs from various sensors, and as CID techniques become more numerous and sophisticated, the burden on human data fusion and decision-making is becoming extreme. Automated SA and CID systems cannot totally prevent mistargeting, but they can substantially reduce the likelihood of human error if they build and distribute a clear COP free of stale, redundant or false information. Target coordinate quality, from mensuration to weapon programming, must be flawless.

- Layered with redundant cooperative and non-cooperative approaches. Query / response systems are generally easy to implement (from a technical perspective), but these systems only provide a binary answer: friend or ambiguous, not a positive hostile identification. Non-cooperative approaches must also be used.

- All-weather and capable of sustained operations in all environments.

- Over-the-horizon capable so that ground forces can maintain connectivity with each other and the tactical link. This can be done via line of sight or satellite communication.

- Secure and resistant to enemy countermeasures, exploitation and spoofing.

- Portable across platforms, so that capabilities can be quickly installed where needed.

- Backward and forward compatible and/or re-programmable so that technology is not quickly obsolete.

- Affordable: Given the history of CID programs, many of which have been cancelled due to cost, affordability must be carefully considered. It is not necessary to equip everyone alike. CID priority should be given to the most effective shooters and the most valuable friendly targets. Not every shooter needs an interrogator, for example, so long as CID information is available on the tactical network. Legacy equipment has a huge sunk cost and will be a critical CID element for the foreseeable future. Maintenance and upgrades should continue.

- Clearly and concisely communicated so that they are understandable by warriors down to the lowest level. They must be realistic and must account for all multinational participants. Information must be distributed and updated in a timely manner, such that participants can easily digest it. The key to organizational effectiveness at all levels is leadership.

- War-gamed, resourced and trained to. The Services should perform continual joint simulation and training exercises to practice building a COP and completing

successful CID, including attention to interfaces and handoff problems where a large proportion of errors occur. Tests and exercises are a critical element of CID.

Technology will not eliminate human error on the battlefield, and the responsibility rests squarely on the shoulders of the man in the loop – individual war fighters, from the tactical commander, other third parties, the shooter, to potential victims. The human dimensions of instinct, judgment, target discrimination and decision-making are dependent on good training, leadership, and discipline.

Mistargeting will never be completely eliminated, and the public needs realistic expectations in this regard. Leaders, both political and military, should assume more responsibility to that end. As General James L. Jones remarked, "Now more than ever, the minimal level of public tolerance for collateral damage and loss of human life, coupled with the tendency for the typical adversary to exploit our rules of engagement to his benefit, necessitates an effective and flexible application of force…"[82] When the processes, systems and individuals occasionally fail – as is inevitable in combat – and mistargeting results in tragedy, a fair accounting must be made. This does not mean, however, that those that have gone into harm's way should be second-guessed when the consequences of their well intentioned actions results in mistakenly striking THE WRONG TARGET.

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[82] General James L. Jones, Commander, United States Joint Forces Command, as quoted in The Joint Warfighting Center, Joint Doctrine Series Pamphlet 2, *Doctrinal Implications of Low Collateral Damage Capabilities*, 27 January 2003

Appendix: Case Studies of Mistargeting

Three examples will serve to illustrate how there is typically not one cause, but a number of contributing and interrelated factors that lead to mistargeting. In this incident numerous breakdowns in the COP and CID systems occurred, particularly an over-reliance on technology and the improper use of procedures.

Operation Northern Watch NFZ

During Operation Northern Watch, a northern No-Fly Zone (NFZ) was placed in Iraqi airspace north of the 36th parallel to protect Kurds in Northern Iraq. The NFZ was kept clean of Iraqi aircraft through regular USAF fighter patrols operating out of Incirlik air base in Turkey. AWACS aircraft supported the fighters. Within the AOR, coalition fixed wing flights were regulated by a daily ATO. Although they regularly flew within the AOR, most helicopter flights, including the two Blackhawks in this incident, were not accounted for in the ATO.

On the morning of 14 April 1994, the two helicopters launched from Diyarbakir, Turkey with 26 people aboard. Included were multi-national military personnel and civilian liaisons and linguists. The weather was clear, all systems were operational, and the aircrews were highly qualified and experienced. The Blackhawks' destination was Zakhu and then Irbil, both in Northern Iraq. Also airborne was an AWACS aircraft, with 19 crewmen aboard, including a Mission Commander that had flown only once in three months, making him not qualified for the duties he was performing.

The Blackhawks checked in with AWACS, who tracked and labeled them as "friendly." They requested and were granted permission to pass through a "gate" into the No-Fly Zone. The Blackhawks failed to change their IFF code from that used for aircraft

flying in Turkey to the designated NFZ code. They also failed to monitor a common frequency designated for all aircraft operating in the NFZ. Both discrepancies were noted, but not corrected by AWACS controllers. The helicopters landed at Zakhu, and after a 30-minute delay, they contacted AWACS and proceeded on toward Irbil. After the Blackhawks' departure from Zakhu, AWACS controllers had only intermittent radar and IFF returns as the helicopters entered mountainous terrain. When radar contact was lost, AWACS computers projected a track based on their previous course and speed. Labels on the intermittent contacts were dropped, as often happened.

The first USAF F-15 fighter patrol of the day launched from Incirlik to "sanitize" and patrol the NFZ. Both pilots were highly experienced, including a Lieutenant Colonel wingman. Normally, no aircraft were permitted into the NFZ until U.S. fighters had swept the airspace, so the F-15 pilots were not expecting any friendly aircraft to be in the NFZ. Two minutes after entering the NFZ, the F-15s acquired the Blackhawks on radar, but received no IFF response to their interrogation. As discussed earlier, this "lack of friendly" response did not necessarily imply that the target aircraft were hostile. The F-15s reported the contacts to the AWACS controllers. The AWACS was unable to see the contacts, however, due to the mountainous terrain, and reported the area "clean" (meaning that they had no radar hits there). The F-15 pilot repeated the location, altitude, and heading of his target over the NFZ frequency, which the Blackhawks should have heard and responded to had they been monitoring it. The F-15 flight made visual contact with the Blackhawks and then executed a visual identification (VID) pass to confirm that the targets were hostile. Unfortunately, the lead F-15 pilot reported what he wanted to see – what he thought were two Soviet-built Iraqi HIND helicopters. AWACS replied,

"Copy two HINDS." The F-15 wingman, when instructed to make his own VID pass, responded, "Tally 2" (meaning "I see two aircraft") but never confirmed that he had identified them as HINDs. Neither statement contributed much to the identification or to SA, but both statements tended to reinforce the F-15 Lead's misperception that he had seen enemy helicopters. Once the flight lead decided that the helicopters were enemy, he quickly engaged the helicopters with missiles. His wingman followed suit against the other helicopter with deadly accuracy. There were no survivors.

After extensive investigations by accident boards, legal teams, media reporters, and congress, no single cause was identified in the F-15 / Blackhawk accident that claimed the lives of 26 people. What went wrong was a combination of loss of SA and identification error, and all four primary factors: environmental, organizational/procedural, technical/equipment, and individual, contributed. The only real Environmental factors were the mountainous terrain, which masked the helicopters from the AWACS, and the fact that Iraqi Hinds were the only real threat to the Kurds. The only Technical/Equipment failure cited was the intermittent Blackhawk IFF – something that is not at all uncommon.

According to the Investigation, Organizational/Procedural factors included a "breakdown of clear guidance from the Combined Task Force to its component organizations"; a "lack of clear understanding among the components of their respective responsibilities"; a lack of "consistent and comprehensive (ROE) training"; poor airborne

communication; an unqualified AWACS mission crew commander; inadequate visual identification training; and a poor (F-15 squadron) command climate.[83]

Individual errors included an over-reliance on automated systems, such as AWACS mission computers and IFF; improper use of radios and IFF; visual identification errors; misplaced motivation and poor discipline.[84] The lead F-15 pilot did not wait for AWACS approval to engage the "hostile" helicopters as required by the ROE. The accident investigation indicated that the F-15 pilots, whose squadron had missed out on Desert Storm, hastily engaged the targets because this was "a rare opportunity for peacetime pilots to engage in combat."[85]

Defense Secretary William Perry was quoted after the shoot down: "what we have disclosed is deficiencies in the training... primarily relative to joint training, joint operations, and operations between fixed-wing and helicopters."[86]

Udairi Range CAS

Mistargeting incidents are not confined to stressful combat situations. The following example demonstrates how mistargeting can occur even in controlled training environments, particularly when conducting complex missions like CAS.
On the night of 12 March 2001, a flight of two Navy FA-18s was conducting CAS training on the Udairi Range, northwest of Kuwait City. The incident pilot was a highly

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[83] U.S. Air Force, *Aircraft Accident Investigation Board Report: U.S. Army UH-60 Blackhawk Helicopters*, 87-26000 & 88-26020, vol. 2 at 46-48 (27 May 1994), p4.Findings of Opinion.

[84] U.S. Air Force, *Aircraft Accident Investigation Board Report: U.S. Army UH-60 Blackhawk Helicopters*, 87-26000 & 88-26020, vol. 2 at 46-48 (27 May 1994), p31.) (hereinafter Aircraft Accident Board Report).

[85] U.S. Air Force, *Aircraft Accident Investigation Board Report: U.S. Army UH-60 Blackhawk Helicopters*, 87-26000 & 88-26020, vol. 2 at 46-48 (27 May 1994), p41.Findings of Opinion.

[86] John D. Morocco, "Fratricide Investigation Spurs U.S. Training Review," *Aviation Week & Space Technology*., July 18, 1994, p 25, 26 (quoting Secretary Perry's discussion of the results of the Accident Investigation).

experienced squadron commander, flying an aircraft equipped with the latest technology, including IR sensors and NVDs. On the ground were a highly qualified and equipped JTAC and a number of observers. Also present was a qualified Forward Air Controller (Airborne) in another FA-18.

Udairi Range had well known deficiencies at the time, including poor identification of the JTAC observation post (OP), ill-defined targets, and a general lack of definable features. Because of these, the incident pilot was having trouble maintaining SA of the target, but he eventually commenced his attack. As was doctrine, he was relying on both the FAC(A) and the JTAC to assess his aircraft's geometry and clear him to release ordnance. The combination of both a FAC(A) and a JTAC was not standard – usually, there is one or the other. During the ordnance delivery, the FAC(A) gave a non-standard radio call to the JTAC indicating that he thought the FA-18's "nose position looks good." Based on this call, the JTAC cleared the release of ordnance, thus assuming responsibility for where the bombs would hit.

Unfortunately, the pilot was unknowingly targeting the OP, and no one realized it. Despite the fact that there was no stress or "fog" of combat, five Americans and one New Zealander were killed, eleven individuals were wounded and three vehicles were destroyed.

Clearly the Environment played a factor, as it was a dark night and a featureless desert. The poor conditions of the range, as well as non-standard tactics are considered Organizational/Procedural factors. The safety investigation did not note any Technology/Equipment failures. There were a number of Individual factors that played a role, however. Probably the most significant was complacency on the part of the JTAC

and FAC(A), and an over reliance on technology. Clearly, three key players involved —

the CAS pilot, the JTAC, and the FAC(A) – did not share a Common Operational Picture,

and they thought they had situational awareness when they did not.

Tarnak Farms OEF

       Just after mid-night on 17 April 2002, two F-16s were returning to their home

base after a long patrol over Afghanistan. As they transited through the Kandahar region

ground fire from the Tarnak Farm attracted their attention. This site, formerly an Al-

Qaeda training camp, had been converted into a Multi-Purpose Range Complex, was used

regularly by coalition forces to conduct day and night training.

       As part of a planned exercise, a Canadian unit was conducting firing drills, using

small arms and shoulder-fired anti-tank munitions. Though visible from the air, small

arms were not a threat to the aircraft at their 18,000-foot transit altitude. The F-16 flight

made an initial contact report of surface fire to the AWACS airborne controller and asked

a command center for permission to strafe the area. ROE specified that they should

egress the "threat" area if possible, and permission was denied. The F-16s spent the next

three minutes turning, slowing, and descending toward what they perceived to be a AAA

threat, and attempting to verify — through the AWACS — that there were no friendly in

the area. AWACS controllers responded to the F-16s to "hold fire" pending details from

the surface fire. Inexplicably, and without further communication from the AWACS, the

F-16 wingman declared that he was "…rolling in, in self defense." Moments later, he

released a Mark 82 500-lb LGB on the Canadian's position. The resulting blast killed

four soldiers and injured eight others, one very seriously. Following the attack, the

aircraft returned to their home base without further incident.

Considerable media attention followed, and an international Investigation Board was appointed. The only Environmental factors found were darkness and extremely long flight times (nearly 10 hours) required of the F-16s. The Investigation Board found the "ambiguous ground situation to be neither causal nor substantially contributory to the incident." There were no Technological/Equipment or Organizational/Procedural errors noted. In fact, the ambiguous ground situation and attendant risk of fratricide was a major reason the ROE in effect were very restrictive.

The tragedy boiled down to individual errors on the part of the F-16 pilots - errors that amplified this "accident" into a crime, ultimately leading to legal ramifications against both pilots. They failed to comply with the restrictive ROE, which was designed to prevent just such an occurrence.

The right to invoke self-defense and respond with force was an inherent right of each of the pilots. But the ROE was very explicit and restrictive, requiring "necessity" and "proportionality." Because neither aircraft (or nearby friendly forces) was in danger, there was no necessity to respond. Additionally, the right to employ weapons in self-defense exists only as long as there is an imminent threat, and any response had to be proportionate to the threat. Finally, any response cannot be retaliatory in nature. In fact AFTTP 3-1.5, Tactical Employment F-16 C/D states,

> The pilot always retains the right of self-defense and the defense of other friendly assets unable to protect themselves. This right, however, should not be used as a planned work-around for solving poor tactics and decision trees. The F-16 pilot must make a conscious decision that the immediate threat outweighs the risk of fratricide. In situations where there is not an immediate threat, i.e., when SA on

friendly positions is unknown, maintain a conservative, defensive approach to the

situation until certain of compliance with the ROE. In the case of an invocation

of self-defense, the involved aircraft commander accepts authority.[87]

Flight Leadership was also faulted, because the flight lead failed to take control of

his highly experienced wingman throughout the engagement. He "deferred his lead

responsibilities, took a 'passive observer' role, and allowed the wingman to take actions

clearly not in line with accepted procedures and in violation of the Commander's Intent

and ROE."[88]

Lt. Gen. Bruce Carlson, 8th Air Force Commander, summed up the pilot's

failings when he found the incident pilot guilty of dereliction of duty for his role in the

incident, "You flagrantly disregarded a direct order from the controlling agency,

exercised a total lack of basic flight discipline over your aircraft, and blatantly ignored

the applicable rules of engagement and special instructions. Your willful misconduct

directly caused the most egregious consequences imaginable, the deaths of four coalition

soldiers and injury to eight others. The victims of your callous misbehavior were from

one of our staunch allies in Operation Enduring Freedom and were your comrades-in-

arms."[89]

Canadian General Maurice Baril, in the final report on the Tarnak Farm incident,

summarized, "This event has opened a new chapter on the study and understanding of the

mechanisms and preconditions surrounding fratricide. Furthermore, it is a study that is

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[87] U.S. Air Force, AFTTP 3-1.5, *Tactical Employment F-16 C/D*, Air Force Tactics Techniques and
        Procedures Manual 3-1.5, (GPO 2006), pIV, 4-299.

[88] General Maurice Baril (General Canadian Air Force, Retired), *President Tarnak Farm Board of Inquiry
        – Final Report*, (Ottawa, 2002), p8.

[89] Lt. Gen. Bruce Carlson, *Approved Punishment--Schmidt Art 15*, [letter] (INDEPTH: FRIENDLY FIRE
        U.S. Air Force Verdict, CBC News Online 2004) accessed on 7 Jan 2007 at:
        http://www.cbc.ca/news/background/friendlyfire/verdict.html

being undertaken in the context of ongoing joint and combined operations, wherein

Coalition forces of vastly differing capabilities and methods of operation are coming face

to face with both the vast potential and the great peril implied by high-speed, high-

technology warfare in a fluid and uncertain environment."[90]

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[90] Baril, p2.

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