# AIR GROUND INTEGRATION AND THE BRIGADE COMBAT TEAM

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Over the last 12 years of combat many hard lessons were learned on the importance of integrating air and ground operations. The U.S. Army Brigade Combat Team became the principal fighting formation with the responsibility of conducting operations in a non-linear battlefield with limited resources to integrate air and ground forces to achieve the commander's intent for operations. As the number of airspace users increased with the proliferation of unmanned aerial systems and increased reliance on fixed-wing and rotary-wing air support, synchronizing operations and controlling airspace became extremely complex. In response to the challenges of conducting air ground integration, the U.S. military developed new doctrine, adopted new organizations, and updated command and control systems to facilitate efficient air ground integration from the Joint Forces Command down to the Brigade Combat Team. This thesis examines current U.S. Joint and Army doctrine, the organization of the Armored Brigade Combat Team, and the current materiel systems used to conduct air ground integration in order to determine if the Brigade Combat Team can conduct efficient air ground integration.

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

AIR GROUND INTEGRATION AND THE BRIGADE COMBAT TEAM, by MAJ Aaron M. Thomas, 93 pages.

Over the last 12 years of combat many hard lessons were learned on the importance of integrating air and ground operations. The U.S. Army Brigade Combat Team became the principal fighting formation with the responsibility of conducting operations in a non-linear battlefield with limited resources to integrate air and ground forces to achieve the commander's intent for operations. As the number of airspace users increased with the proliferation of unmanned aerial systems and increased reliance on fixed-wing and rotary-wing air support, synchronizing operations and controlling airspace became extremely complex. In response to the challenges of conducting air ground integration, the U.S. military developed new doctrine, adopted new organizations, and updated command and control systems to facilitate efficient air ground integration from the Joint Forces Command down to the Brigade Combat Team. This thesis examines current U.S. Joint and Army doctrine, the organization of the Armored Brigade Combat Team, and the current materiel systems used to conduct air ground integration in order to determine if the Brigade Combat Team can conduct efficient air ground integration.

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TABLE OF CONTENTS

Page

# ACRONYMS

| | |
|---|---|
| AAGS | Army Air Ground System |
| ABCT | Armored Brigade Combat Team |
| ACA | Airspace Control Authority |
| ACM | Airspace Coordinating Measure |
| ACO | Airspace Control Order |
| ACP | Airspace Control Plan |
| ADAM | Air Defense and Airspace Management |
| ADP | Army Doctrine Publication |
| ADRP | Army Doctrine Reference Publication |
| ADSI | Air Defense System Integrator |
| AFATDS | Advanced Field Artillery Tactical Direction System |
| AGI | Air Ground Integration |
| ALO | Air Liaison Officer |
| AMA | Airspace Management Authority |
| AMD | Air and Missile Defense |
| AMDWS | Air and Missile Defense Workstation |
| AMPS | Aviation Mission Planning System |
| AO | Area of Operations |
| ATO | Air Tasking Order |
| AWACS | Airborne Warning and Control System |
| AWS | Airspace Workstation |
| BAE | Brigade Aviation Element |
| BAGIC | Brigade Air Ground Integration Cell |

| | |
|---|---|
| BAO | Brigade Aviation Officer |
| BCD | Battlefield Coordination Detachment |
| BCT | Brigade Combat Team |
| BFT-A | Blue Force Tracker-Aviation |
| C2 | Command and Control |
| CAOC | Combined Air Operations Center |
| CAS | Close Air Support |
| CENTCOM | Central Command |
| CGRS | Common Grid Reference System |
| COP | Common Operating Picture |
| CPOF | Command Post of the Future |
| CRC | Control and Reporting Center |
| DACT | Dynamic Airspace Collaboration Tool |
| EPLRS | Enhanced Position Location Reporting System |
| FAAD | Forward Area Air Defense |
| FM | Field Manual |
| FOUO | For Official Use Only |
| FSCM | Fire Support Coordination Measure |
| GARS | Global Area Reference System |
| HIDACZ | High Density Airspace Control Zone |
| ISR | Intelligence, Surveillance, Reconnaissance |
| JAGIC | Joint Air Ground Integration Cell |
| JAOC | Joint Air Operations Center |
| JFACC | Joint Force Air Component Commander |
| JFLCC | Joint Force Land Component Commander |

| | |
|---|---|
| JOA | Joint Operations Area |
| JP | Joint Publication |
| MTTP | Multiservice Tactics Techniques and Procedures |
| SADL | Situation Awareness Data Link |
| SPINS | Special Instructions |
| TACP | Tactical Air Control Party |
| TACS | Theater Air Control System |
| TADIL-J | Tactical Digital Information Link-J |
| TAGS | Theater Air Ground System |
| TAIS | Tactical Air Integration System |
| TBMCS | Theater Battle Management and Core System |
| TC | Training Circular |
| TOE | Table of Organization and Equipment |
| TOC | Tactical Operations Center |
| TRADOC | Training and Doctrine Command |
| UAS | Unmanned Aerial System |

ILLUSTRATIONS

Page

# CHAPTER 1

# INTRODUCTION

The transformation of the U.S. Army to a modular force, with the Brigade Combat Team (BCT) as the principal tactical formation increases the responsibility of the brigade staff to plan, coordinate, synchronize, and execute operations. These tasks are complicated by the nature of conflict over the last ten years, with a nonlinear battlefield and brigades controlling large areas of operations (AOs). The Army does not own the airspace within each element's AO, and is required to coordinate and synchronize with the Airspace Control Authority (ACA) (U.S. Department of the Army, Marine Corps, Navy, and Air Force 2007, I-2). As the number of fixed wing, rotary wing, and unmanned aerial systems (UAS) increases within the BCT's area of operations, it is becoming increasingly difficult to deconflict the airspace and still maintain the ability to provide situational awareness and simultaneous effects on a target.

This study will analyze how the Brigade Combat Team conducts air ground integration (AGI) utilizing current doctrine, organization, and materiel. First, it will analyze current Joint and Army doctrine to see how doctrine defines the roles and responsibilities, and the principles guiding the integration of air and ground operations. Second, it will analyze the current organization of the Brigade Combat Team and how the Fires Cell, Air Defense and Airspace Management/Brigade Aviation Element (ADAM/BAE) Cell, and Tactical Air Control Party (TACP) conduct Air Ground Integration based on current doctrine. Finally, it will analyze the effectiveness of current materiel systems in providing near-real-time control of air and fire support assets.

## Research Questions

This thesis will attempt to answer the primary research question: Can the U.S. Army Brigade Combat Team conduct efficient air ground integration with current doctrine, organization, and materiel? In order to answer this question several secondary questions must be answered. First, what is air ground integration? The answer to this question will establish the principles of air ground integration, and how the U.S. Joint community and the U.S. Army define this concept. Second, how do U.S. Joint and Army Doctrine guide the integration of air and ground operations? The answer to this question will establish consistencies between U.S. Joint and Army Doctrine, and identify how clearly doctrine outlines how to conduct air ground integration. Third, what is the organizational structure within the BCT that is responsible for air ground integration? Identifying the organizational structure within the BCT will help determine if the BCT can conduct the tasks associated with AGI as outlined in doctrine. Finally, what materiel systems enable air ground integration and how are they used? The answer to this final question will identify if current technology provides the necessary tools to conduct near-real-time procedural and positive control of airspace within the BCT area of operations.

## Background

The need to integrate air and ground forces is nothing new to military operations. Since World War II commanders have sought the synchronization of air power to support the ground scheme of maneuver. The development of AirLand Battle doctrine in the 1970s placed an increased emphasis on the integration of air and ground capabilities in order to address the modernization of the battlefield (Romjue 1984). The focus of Air Ground Integration was at the U.S. Army Division and higher, with the majority of the

airspace command and control system at the Corps level. This structure led to a system that worked well in a linear battlefield within a conventional, high intensity conflict.

After the wars in Iraq and Afghanistan began, the U.S. Army completed the transformation into a modularized force based on the Brigade Combat Team as the primary tactical fighting formation. The Corps and Division remained the primary headquarters responsible for the command and control of airspace, while tactical operations were conducted on a non-linear battlefield by the BCTs. As the number of aircraft and UASs increased, and as the battlefield became more complex, it became clear that the BCT needed an improved method of controlling the airspace within its own AO. BCTs operating in urban areas in Iraq quickly found out that it was increasingly difficult to maintain positive and procedural control of aircraft, and relied more and more on ad hoc procedures to deconflict airspace (James 2010, 27). Similar lessons were learned by BCTs operating in Afghanistan, and units continue to develop unique solutions to integrating air and ground operations in heavily congested airspace.

The U.S. Army is undergoing a transformation in the organization of its doctrine. The traditional field manuals are being replaced with a hierarchical structure of Army Doctrine Publications, Army Doctrine Reference Publications, Field Manuals, and manuals on Tactics, Techniques, and Procedures. Through this transformation the Army has an opportunity to address many of the lessons learned throughout the wars in Iraq and Afghanistan, and provide conceptual as well as detailed guidance on how to conduct air ground integration. This study will analyze this new doctrine to see how it guides this process for the future.

## Assumptions

There are several assumptions that must be made in order to maintain the focus of this thesis in a rapidly changing environment, and as the Army evaluates the future threats to the nation and the required force structure to meet those threats. These assumptions are:

1. The Army will remain in its current modular design for the next five years.

2. Joint Doctrine will remain unchanged by the current transformation of Army Doctrine.

3. The number of airspace users operating in the BCT area of operations will continue to increase; making air and ground integration more difficult.

4. The current materiel systems used to conduct airspace management and fire support coordination will remain the same for the next two years.

## Terms

Airspace Control**:** A process used to increase operational effectiveness by promoting the safe, efficient, and flexible use of airspace. (JP 1-02)

Airspace Coordinating Measure**:** Measures employed to facilitate the efficient use of airspace to accomplish missions and simultaneously provide safeguards for friendly forces. (JP 3-52)

Mission Command**:** The exercise of authority and direction by the commander using mission orders to enable disciplined initiative within the commander's intent to empower agile and adaptive leaders in the conduct of unified land operations. (ADP 6-0)

Positive Control**:** A method of airspace control that relies on positive identification, tracking, and direction of aircraft within an airspace, conducted with electronic means by an agency having the authority and responsibility therein. (JP 3-52)

Procedural Control**:** A method of airspace control which relies on a combination of previously agreed and promulgated orders and procedures. (JP 3-52)

## Limitations and Delimitations

This study will focus on how the Brigade Combat Team conducts Air Ground Integration. The Theater Air Ground System (TAGS) and Army Air Ground System (AAGS) will be discussed in order to provide the framework of airspace control that the BCT works within. The U.S. Army Division and Corps will only be discussed to provide contextual information. The focus will be on Joint and Army Doctrine, and will not consider Marine, Navy, or Air Force Doctrine since the relevant methods are encompassed in Joint Doctrine. The analysis of the organization of the Fires Cell and ADAM/BAE Cell will be within the Armored Brigade Combat Team. The Infantry BCT and Stryker BCT have similar organization at the BCT level, with only a few personnel differences. The analysis of materiel systems and lessons learned will focus on 2008 to present. Earlier lessons learned and systems are already covered by other studies, and this will limit the study to the last five years of combat operations. This study focuses on the doctrine, organization, and materiel aspects of the Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities (DOTMLPF) approach. The training, leader development, personnel, and facilities aspects are covered by other studies and changes are being implemented based on recommendations from working groups and lessons learned. Finally, this study will not use Classified or For Official Use Only

(FOUO) information. Lessons Learned and trends from the Combat Training Centers offer valuable insight into issues that units are facing while in combat or training, but are not necessary in order to analyze the principles of airspace control and AGI within the BCT. By not using Classified or FOUO information this thesis will be available for unlimited distribution.

This study will focus on the Mission Command Warfighting Function, and not on the philosophy of mission command. The Mission Command Warfighting Function is the related tasks and systems that develop and integrate those activities enabling a commander to balance the art of command and the science of control in order to integrate the other warfighting functions (U.S. Department of the Army 2011, 13). The study of doctrine, organization, and materiel will focus primarily on how the commander and staff exercise the science of control to integrate air and ground operations. Joint Doctrine does not identify mission command as a Joint Function. The Command and Control Joint Function is related to the Army's Mission Command Warfighting Function, and focuses on the exercise of authority and direction by a commander over assigned and attached forces to accomplish the mission (U.S. Joint Chiefs of Staff 2011, III-2). This study discusses air ground integration as part of the Army's Mission Command Warfighting Function and the Command and Control Joint Function.

## Significance of the Study

This study seeks to identify any gaps in the current doctrine, organization, or materiel that supports the integration of air and ground operations. The ability of the Brigade Combat Team to safely and effectively integrate air and ground assets will determine the success of the Army's primary tactical formation on the future battlefield.

As the U.S. ends the wars in Iraq and Afghanistan it is imperative to apply the lessons learned into how we organize, equip, and fight on future battlefields.

## Summary

This chapter introduced the topic of this study and provided the primary and secondary research questions that will be answered by this thesis. It provided a brief background of the problem as well as some assumptions that this study makes. Key terms were defined in order to provide clarity on some important terms that will be used throughout this study. Finally, this chapter provided the limitations and delimitations as well as the significance of the study to establish the scope of the thesis. In chapter 2 existing literature on air ground integration and airspace command and control will be reviewed. It will be organized by the secondary research questions and focus on common themes found in existing literature and current gaps in research as it relates to the secondary research questions. Chapter 3 will provide the research methodology for this thesis. It will establish the process this study will take in answering the secondary research questions, and how this study answers the primary research question. Chapter 4 will provide analysis of the data collected and evaluate the current doctrine, organization, and materiel systems within an Armor Brigade Combat Team in order to answer the primary and secondary research questions. Finally, chapter 5 will provide conclusions and recommendations. In this chapter the research questions will be answered, and recommendations will be made on how the BCT conducts air ground integration, as well as recommendations for future research.

# CHAPTER 2

# LITERATURE REVIEW

The last chapter provided a brief introduction to the topic of air ground integration and the primary and secondary research questions that this thesis will answer. This chapter will review the current relevant literature on air ground integration, and is organized by the secondary research questions. The first section, "what is air ground integration?," will cover current publications and literature directly relating to AGI, and will show the topics that fall within the broader topic of air ground integration. The second section, "U.S. Joint and Army Doctrine guiding the integration of air and ground operations," will discuss the current doctrine governing air ground integration, as well as recent articles and research relating to this doctrine. The third section, "organizations within the BCT," will discuss the current doctrine and literature on the organization of the ADAM/BAE Cell, Fires Cell, and TACP within the BCT, as well as literature discussing airspace control and Fires organizations above the brigade level. The last section, "materiel systems that enable air ground integration," will focus on literature discussing the Tactical Airspace Integration System (TAIS), Air Defense Systems Integrator (ADSI), and communications networks for aircraft such as Link-16 and Situation Awareness Data Link (SADL).

## What is Air Ground Integration?

There is plenty of literature on the topic of air ground integration, however, there is no doctrine that clearly neither defines nor outlines the concepts and guiding principles of AGI. There are two major categories of literature discussing AGI: Studies discussing

aspects of air ground integration, primarily focusing on issues integrating Air Force and Army operations from a Joint Force level; and articles discussing issues integrating Close Air Support (CAS) and rotary wing aviation into the BCT scheme of maneuver. This section will look at each category and show the consistent themes, and identify gaps that this thesis will discuss in chapter 4.

Several RAND Corporation studies as part of their Project Air Force discuss issues relating to AGI. The monograph, "Beyond Close Air Support: Forging a New Air-Ground Partnership," focuses on how the Air Force and Army view air power in support of ground operations. This monograph primarily looks at clearly defining the missions that the Air Force conducts to support ground operations in order to increase the interdependence of the two services. These missions include CAS, Air Interdiction, and Strategic Air Attack. The authors of the monograph argue that the strategic air attack needs to be clearly defined and that the air interdiction definition is too broad (Pirnie et al. 2005, 77). The current definition of air interdiction includes any counterland operation that is not CAS, and this leads to confusion on whether the Air Component Commander or Land Component Commander controls air interdiction operations (Pirnie et al. 2005, 81).

Another RAND monograph, "Enhancing Fires and Maneuver Capability Through Greater Air-Ground Joint Interdependence," again focuses on issues at the Joint level, primarily on lessons learned after Operation Iraqi Freedom in 2003. The authors argue that improved air ground integration requires a joint mandate to change doctrine and service culture (Jacobs et al. 2009, 17). The Air Force and Army have different views on the use of air power, and improved methods of managing battle space will increase the

effectiveness of operational and strategic fires and maneuver. The monograph suggests two different methods of managing battle space. The first option is to modify current battlefield management through improved management of Kill Boxes and Fire Support Coordination Measures (FSCMs) (Jacobs et al. 2009, 35). The second option is to use Surface Maneuver Areas that greatly shrink the current ground Area of Operations, and increases the flexibility of Joint Force Air Component Commander (JFACC) to control airspace during counterland operations (Jacobs et al. 2009, 35).

Both of these studies address issues between the Air Force and Army during operations supporting a Joint Force Commander. They recommend more clarity on who is the supported and supporting commander during operations, and how to better manage airspace coordinating measures (ACM) and FSCMs to improve flexibility of air assets to attack ground targets. The two monographs do not clearly define what air ground integration is, nor what systems or activities are involved in integrating air and ground operations. These monographs are primarily for Air Force and Joint policy makers, and do not provide detail on integration of air and ground operations below the operational level.

Journal articles provide the other major source of information on air ground integration. *Fires* is the professional journal of the Fires Center of Excellence at Fort Sill, OK. “Embracing the Joint Training Enterprise,” is an article from the March-April 2008 issue of *Fires* addressing the need to incorporate other services into training in order to prepare for operations in Iraq and Afghanistan. The article discusses the BCT air-ground integration training concept, which is an initiative by the Army Training and Doctrine Command (TRADOC) and the Air Force Air Combat Command to reduce proficiency

gaps in operational planning and using joint air-ground resources (Rierson 2008, 13). The goal of the training concept is to improve the use of CAS and Intelligence, Surveillance, and Reconnaissance (ISR) assets, and to maintain persistent interaction and training with air-ground assets (Rierson 2008, 13).

"Force Multiplier: How to Integrate Aviation Support" is an article found in the September-October 2009 issue of *Fires*. This article focuses on how ground maneuver commanders use air ground integration to synchronize aviation support into their concept of maneuver and communicate information to their supporting aviation assets (Taylor 2009, 44). The audience for this article is primarily company commanders within a BCT in order to stress the importance of clearly communicating the commander's intent for aviation support and the ground scheme of maneuver. Clear communication of what a company commander wants from aviation assets improves mission planning for the aircrew, and enhances situational awareness prior to the aircraft arriving on station (Taylor 2009, 44).

The *Air Land Sea Bulletin* provides information on air-ground integration in several issues since 2007. *Air Land Sea Bulletin* is a professional journal published by the Air Land Sea Application Center to address issues that affect multiple services within the U.S. military. The May 2007 issue, *Air Ground Integration*, was written in response to the need to effectively integrate air and ground operations during "The Surge" in Iraq in 2007 (Givens 2007, 3). The articles focus on integration of Air Force assets in an asymmetrical battle, but do not provide any information on how the tactical ground commander can use those assets to support his scheme of maneuver.

In the September 2008 issue of *Air Land Sea Bulletin*, several articles address air ground integration, particularly the use of FSCMs and ACMs to integrate fires and aircraft. “Artillery Integration for CAS Fighters,” discusses the need for CAS fighter pilots to understand the ground scheme of maneuver and current situation by receiving a detailed brief from the Ground Liaison Officer, and from the maneuver Tactical Operations Center (TOC) prior to checking in with the Joint Terminal Attack Controller (JTAC) (Rickard 2008, 9). The author also discusses the methods of deconflicting airspace with indirect surface to surface fires by using Airspace Control Areas (ACA) and how the control measure is a restrictive FSCM for indirect fires, but a permissive ACM for aircraft (Rickard 2008, 9).

Two articles address the development of techniques to improve integration of air and ground operations. The article “Kill Box Update” provides information on the process of developing the *Multiservice Tactics, Techniques, and Procedures (MTTP) for Kill Box Employment*, which was updated in 2009. The article outlines the considerations for developing a Kill Box and defining it as a FSCM, and the possible change to a Joint Fires Area instead of using Kill Boxes in a future MTTP (Neuenswander, Bielinski, and Smith 2008, 12–13). The other article, “CAS Assessments and Fire Support Mentalities in Iraq,” discusses the different methods of assessing the success of air support to ground operations. LTC Ott argues that an integration mindset rather than one of deconfliction is needed to meet the needs of the ground commander (Ott 2008, 24). Developing a common assessment between air and ground commanders will ensure better integration. The author defines integration as getting assets close to each other while deconfliction is keeping assets separate from each other; and integration is necessary to focus efforts to

achieving a single objective in support of the ground commander's intent (Ott 2008, 26). These articles provide information on how to use air assets and surface fires to meet the commander's intent.

"Effective Airspace Management to Facilitate Fires–Establishing an Airspace Management Authority (AMA)," provides an argument to establish an intermediate airspace coordination point to provide airspace management across lateral agencies below the Combined Air Operations Center (CAOC), and to facilitate the ground commander's integration of air into his scheme of maneuver (Habas 2008, 18). This agency would address the issue of a ground commander controlling the air medium above his AO to support his combat operations, but the airspace is managed by the Airspace Control Agency (ACA). This causes confusion on which airspace control node the ground commander needs to coordinate with to ensure the necessary freedom of maneuver (Habas 2008, 17). The AMA provides a single coordination point for the ground commander, and facilitates the ground scheme of maneuver, while maintaining airspace control by the ACA.

The RAND Project Air Force monographs and articles in *Fires* and *Air Land Sea Bulletin* provide important information on air ground integration. Issues with doctrine, training, the use of control measures, and confusion over airspace management are identified throughout these publications. The term air ground integration is used throughout the literature, however, there is not a single definition provided by any of them. It is important to establish a clear definition and scope of what is involved in air ground integration. Since there is not a definition provided in doctrine nor in the above literature, this study will outline the actions associated with air ground integration and

provide a logical definition in order to determine if the BCT can effectively conduct air ground integration.

## U.S. Joint and Army Doctrine Guiding the Integration of Air and Ground Operations

This section will briefly outline the doctrine associated with elements of AGI, and review existing literature that analyzes the doctrine. The doctrine review establishes the relevant doctrine and organizes it by topic; starting with joint doctrine, then the corresponding Army doctrine. The discussion of doctrinal publications within this chapter will only provide a brief summary of each of the manuals, and the analysis of the doctrine will be in chapter 4. The review of existing literature will identify common themes relating to doctrine, and establishes how this study fits into the current body of work associated with AGI.

The first category of doctrine is the publications on Command and Control (C2), as it is known in the joint community, and Mission Command, as it is known in the Army community. Joint Publication (JP) 1, *Doctrine for the Armed Forces of the United States*, is the capstone joint doctrine publication that provides doctrine for unified action by Armed Forces of the United States (U.S. Joint Chiefs of Staff 2013b, i). The importance of Joint Publication 1 to AGI is the discussion of command relationships, and it establishes the framework of the command and control of joint forces. JP 3-0, *Joint Operations,* provides the doctrinal foundation and fundamental principles guiding joint operations across the range of military operations (U.S. Joint Chiefs of Staff 2011, i). JP 3-0 outlines the related tasks and key considerations of the Joint Functions (U.S. Joint Chiefs of Staff 2009, III-1). The Command and Control, Fires, and Movement and

Maneuver functions play a key role in AGI since they are the primary integrators and synchronizers of joint fires and operational maneuver. Army Doctrine Publication (ADP) 3-0 and Army Doctrine Reference Publication (ADRP) 3-0, *Unified Land Operations*, are the Army's publications that provide overarching guidelines for doctrine and the conduct of operations (U.S. Department of the Army 2011, ii). ADP 3-0 outlines the role of doctrine for the Army, and defines the tenets of Unified Land Operations. ADP/ADRP 3-0 both define the six Army Warfighting Functions, which are related to the Joint Functions outlined in JP 3-0. The final publications relating to C2/mission command are ADP 6-0/ADRP 6-0, *Mission Command*. These publications outline the principles of mission command and the related fields of the art of command and the science of control. For the purposes of this study, the science of control and mission command as a warfighting function will be the focus of analysis in chapter 4.

There are two publications that deal with command and control of component commands within a joint task force. JP 3-30, *Command and Control of Joint Air Operations,* provides the framework for establishing and exercising command and control of air operations, as well as the principles of planning and executing joint air operations. JP 3-31, *Command and Control of Joint Land Operations*, establishes the basis of command of control within a Joint Force Land Component Command (JFLCC). The publication outlines authorities, roles and responsibilities within the JFLCC, and command relationships. These two publications are essential in analyzing how the two component commands provide command and control, and in identifying key principles that cause friction amongst the commands.

The next major category of doctrine that relates to AGI is the collection of publications relating to airspace command and control. JP 3-52, *Joint Airspace Control*, prescribes doctrine for joint airspace control in the operational area (U.S. Joint Chiefs of Staff 2010b, I-1). The publication outlines the methods of control, positive and procedural, and the governing procedures of developing the Airspace Control Plan (ACP) and the Airspace Control Order (ACO). Key principles for airspace control and how to deconflict, integrate, and synchronize air assets and joint fires are found within this manual. Field Manual (FM) 3-52, *Airspace Control*, is the U.S. Army's publication governing how to conduct airspace control. This publication outlines the Army Air Ground System (AAGS), which is part of the Theater Air Ground System (TAGS). The FM provides fundamentals of airspace control, the location and function of airspace control elements, and key systems that provide connectivity amongst various elements to conduct airspace control. FM 3-52.1, *Multi-Service Tactics Techniques and Procedures for Airspace Control*, is a manual approved by the Army and Air Force to provide a single source reference for planners and operators to facilitate the synchronization and integration of airspace control at the tactical level (U.S. Training and Doctrine Command and Curtis E. LeMay Center for Doctrine Development and Education 2009, i). The manual clarifies the authorities for each component with the joint airspace control structure, and provides guidelines for planning, real-time coordination of airspace, and the use of complex airspace at the tactical level. Finally, FM 3-52.2, *Multi-Service Tactics Techniques and Procedures for the Theater Air Ground System* outlines all service components of the TAGS and how to conduct integrated combat air command

and control. This publication provides more detailed information than what is found in JP 3-52 and FM 3-52.

The last major category of doctrine relating to AGI is the publications on Joint and Army Fires. JP 3-09, *Joint Fire Support*, provides guidelines for the conduct of integrating joint fires into the Joint Force Commander's operations. The publication provides key definitions of joint fires and principles for conducting fire support and targeting. JP 3-09 outlines key considerations for planning, synchronizing, and integrating joint fires. JP 3-09.3, *Close Air Support*, establishes the principles and procedures for integrating CAS to support the ground commander's scheme of maneuver. Planning considerations and fundamentals for executing CAS are outlined in this publication. Two Army publications outline the purpose and function of the Fires Warfighting Function. ADP and ADRP 3-09, *Fires*, describe the roles, core competencies, critical capabilities, characteristics, and principles of fires (U.S. Department of the Army 2012c, iv). These manuals provide the framework for the organization of the Fires Warfighting Function and how it supports Unified Land Operations.

Doctrine is a key element in establishing a functioning system that can properly integrate air and ground operations for the supported commander. There are several discrepancies within doctrine that cause confusion. Several recent studies by students in the School of Advanced Military Studies and the Command and General Staff College discuss issues with defining who controls airspace and how to use control measures. Journal articles identify similar issues with command relationships and defining ACMs.

These consistent issues are discussed below in order to provide a framework for the analysis in chapter 4.

"The Army's Role in Airspace Command and Control of the Warfighter's Airspace" looks at the ambiguity of doctrine, the structure of the TAGS in Operation Iraqi Freedom and Operation Enduring Freedom, and issues with training airspace command and control. MAJ Randy James identifies three major reasons why Army airspace control is not adequate for current operations in Iraq and Afghanistan. He argues that joint doctrine does not clearly delineate who controls airspace when services consistently operate in airspace controlled by other services, a lack of integrated C2 systems cause a lack of a current operating picture, and that the Army does not effectively train airspace control since it is viewed as an issue for aviators, instead of an issue for commanders (James 2010, 2). In OIF and OEF the Army is given authority to control airspace below the coordinating altitude without doctrinal authority, this leads to confusion of who actually controls the airspace (James 2010, 26). MAJ James also identifies issues with joint doctrine deferring to service doctrine for airspace control, which causes problems when aircraft operate in other services airspace. Different service cultures on methods of control create friction amongst the various services and increases coordination time (James 2010, 10). Another monograph from the School of Advanced Military Studies address issues with joint doctrine and the airspace control system.

"Airspace Command and Control in the Contemporary Operating Environment" outlines the TAGS and the various service airspace control systems. MAJ Christopher Russell argues that the TAGS is not sufficient for today's operating environment since it is designed for a linear battlefield. The primary purpose of the TAGS is to fight a major

conflict in Western Europe and provides a means to initiate, receive, process, and execute requests for airspace (Russell 2009, 10). The system is not designed for controlling airspace in a nonlinear battlefield that is saturated with airspace users at increasingly lower altitudes. MAJ Russell discusses issues identified by an Air Force and Marine Tiger Team that toured U.S. Central Command (CENTCOM) in 2007. The Tiger Team found confusion about the joint C2 relationships caused by multiple Joint Force Commanders throughout CENTCOM, but only one JFACC established for the CENTCOM area of responsibility (Russell 2009, 8-9). This confusion and insufficient interaction between airspace control elements caused significant delays in processing requests for deconflicting airspace. The TAGS was not responsive to the needs of ground commander's due to the increase in airspace requirements and the inability to rapidly respond to changing situations. MAJ Russell recommended revising command relationships within doctrine, providing the Army the authority to control airspace in doctrine, and improving the technology within the airspace control system to increase responsiveness in handling complex airspace (Russell 2009, 35-41). Similar issues were identified in a 2010 thesis by MAJ Strokin.

"U.S. Army Airspace Command and Control at Echelons Above Brigade" by Salamasinaleilani Strokin identifies problems with authorities for airspace command and control within doctrine. No authority exists for horizontal component integration and a lack of clear supporting/supported command relationships hinders the ability to dynamically retask air assets (Strokin 2010, 56-58). Doctrine provides plenty of information on airspace control, but very little information exists on how systems interact and how to integrate these systems (Strokin 2010, 12). MAJ Strokin discusses the

airspace control issues within Iraq and makes recommendations on how to change doctrine to meet the challenges of today's operating environment. The author recommends updating doctrine to include best practices, as well as clearly define the roles, responsibilities, and authorities of airspace control cells (Strokin 2010, 68).

TRADOC Pamphlet 525-7-3, *United States Army Concept Capability Plan for Airspace Command and Control for the Future Modular Force 2015-2024*, provides a framework for changing the issues identified in the studies above. TRADOC PAM 525-7-3 discusses the issues with command relationships and the necessity to change doctrine in order to increase the effectiveness of the airspace control system. Problems with airspace users from multiple services transiting the airspace above a ground commander's AO are identified. Joint doctrine does not clearly address the authorities, responsibilities, and architecture necessary to link component C2 nodes for near-real-time coordination and decision making (U.S. Department of the Army 2009, 22). This lack of clarity and authority increases risk of fratricide and hinders operations within the ground commander's AO. The capabilities concept recommends changes to doctrine to provide authority to the ground commander to make decisions concerning airspace control when the majority of air assets are Army (U.S. Department of the Army 2009, 23). Several journal articles identify additional issues with defining control measures.

Several articles identify problems with airspace coordinating measures within doctrine. "Coordination Measures" in the May 2012 issue of *Air Land Sea Bulletin* provides a discussion on the need to deconflict ACMs and FSCMs in joint publications. FSCMs listed in JP 3-09 were also listed as ACMs in JP 3-52 (Roberts, Shafer, and Pope 2012, 4). This confusion is amplified by the numerous uses of ACMs identified in joint

publications. The Combat Airspace Conference in June 2010 established a working group to modify existing doctrine to limit the number of ACMs to five, and to develop a MTTP on airspace control in order to provide a "one-stop" TTP for airspace control instead of the proliferation of TTPs and doctrine currently found in publication (Roberts, Shafer, and Pope 2012, 5). "Earth, Wind, and Fire: The Experimentation Environment" found in the March-April 2008 issue of *Fires* identifies major discrepancies in approved joint and Army doctrine concerning ACMs and FSCMs. The authors recommend changes to doctrine and to establish a MTTP to manage a High Density Airspace Control Zone (HIDACZ) (Durham and Myers 2008, 23).

The review of current doctrine and literature relating to the use of doctrine in operations over the last five years of combat provides several common themes. The need for doctrine to clarify command relationships, authorities, and requirement for airspace control is consistent through almost all of the literature. Inconsistencies in how various services conduct airspace control and the use of control measures reduces the effectiveness of integrating air and ground operations in near-real-time. This study will focus the analysis of doctrine on how doctrine affects the ability of the BCT commander to integrate air and ground operations within his AO.

## Organizations within the Brigade Combat Team

The literature associated with the organizations within the BCT is primarily focused on the ADAM/BAE Cell, and how it functions as the primary airspace control element. The Fires Cell and the TACP are discussed in the context of its interaction with the ADAM/BAE Cell. This section will review the literature on the organization and function of the ADAM/BAE Cell, Fires Cell, and TACP in relation to synchronizing

aviation and fires in support of the BCT commander's scheme of maneuver. Several studies already discussed above and articles within professional journals analyze the functions of these cells.

The primary source of information on the ADAM Cell comes from FMI 3-01.50, *Air Defense and Airspace Management Cell Operations*. This publication outlines the structure, roles, responsibilities, and organization of the ADAM Cell from the corps down to the BCT level. Most of the information focuses on technical data on the digital equipment and how the ADAM Cell integrates within the BCT Tactical Operations Center (TOC). This publication is the doctrinal guide for how the ADAM Cell supports air defense and airspace management operations for various echelons within the Army. Another source of information on the ADAM Cell comes from articles within the *Fires* journal.

CPT Petrus Engelbrecht outlines the functions of the ADAM Cell in his *Fires* article, "Preparing the ADAM Cell: Are We Doing Enough?" He provides an overview of what the cell is supposed to do and the equipment that cell uses to provide situational awareness and airspace management. The ADAM Cell brings Sentinel radars and digital data links that enable the situational awareness of the third dimension (Engelbrecht 2010, 42). The critical function of the cell is to develop and display the air picture to help manage airspace for the BCT. CPT Engelbrecht outlines issues with doctrine, organization, and training in preparing the ADAM Cell for operations. FMI 3-01.50 is full of technical data, and does not provide pertinent information on the operations of the cell (Engelbrecht 2010, 43). The ADAM/BAE Cell is organized with two Majors with no clear delineation on who is in charge. This causes conflict, and the Aviation Center of

Excellence recommends establishing a position for a Lieutenant Colonel to run the ADAM/BAE Cell (Engelbrecht 2010, 43). Finally, the article states that young Air Defense officers lack combat arms experience and the current schooling for ADAM Cell operators is not sufficient to build proficiency in managing airspace for the maneuver commander (Engelbrecht 2010, 42). This lack of proficiency leads to the ADAM Major being tasked out due to a lack of perceived value to the BCT.

A review of how the ADAM Cell functions during operations in Iraq is found in the *Fires* article by CPT Melissa Viator, "Spartan Air Cell Lessons Learned." CPT Viator recounts the lessons learned of the 4th Brigade Combat Team, 25th Infantry Division during operations south of Baghdad. The ADAM Cell was critical in managing airspace to facilitate combat operations and the transit of supplies throughout the BCT's AO (Viator 2008, 20). CPT Viator highlights the technology used to provide situational awareness of the airspace above the BCT AO, and the interaction with Division and higher headquarters to coordinate airspace. The merging of the ADAM and BAE Cells provided the necessary manpower to conduct operations, and was critical in coordinating ACMs to support UAS launches and other aircraft (Viator 2010, 21).

The BAE is another cell found in the BCT TOC and provides critical capabilities in providing situational awareness of air assets, and coordinating operations with army aviation. Training Circular (TC) 1-400, *Brigade Aviation Element Handbook*, is the primary doctrinal reference for the BAE. It outlines the organization, mission, and fundamentals of the BAE. This manual provides information on all types of aviation support for ground operations, and the functions the Tactical Airspace Integration System

(TAIS). The BAE is focal point for synchronizing army aviation and ground operations in support of the BCT commander's operations.

MAJ Scott Dickey provides analysis on the BAE in his thesis, "The Brigade Aviation Element: Providing the Brigade Combat Team with the Ability to Plan and Synchronize Aviation Assets into the Ground Commander's Scheme of Maneuver." MAJ Dickey outlines the roles of each member of the BAE, and argues that it is adequately staffed to provide the proper synchronization of aviation assets within the BCT's scheme of maneuver (Dickey 2007, 16). The BAE interfaces with the Air Liaison Officer (ALO) within the TACP to link Army and Joint airspace control, and is the single staff element for the synchronization of joint and army fires, UAS, and army aviation elements (Dickey 2007, 19-20). This thesis argues that the BAE is sufficient to integrate air and ground operations for the BCT.

The most common theme in literature on AGI organizations is the new concept for the Joint Air Ground Integration Cell (JAGIC) proposed for the U.S. Army Division. The Joint and Combined Integration Directorate at the Fires Center of Excellence designed the JAGIC since there was no authoritative organization at the tactical level to facilitate horizontal component air and ground operations (Wertz 2012, 63). The JAGIC is comprised of elements of the Air Support Operations Center (ASOC), fires, intelligence, air and missile defense, and airspace management cells. This organization allows for the decentralized execution of joint fires and air assets by combining Army and Air Force airspace control elements at the tactical level. ASOC personnel would control assets that belong to the JFACC, while Army personnel would control Army assets. This process would increase both CAS and air interdiction targets (Wertz 2012,

64). The JAGIC is recommended by MAJ James and Strokin in their studies mentioned in the last section as a solution to address airspace control authorities within the Army (James 2010, 37; Strokin 2010, 69). Several articles and studies also recommend developing a Brigade Air Ground Integration Cell (BAGIC) that includes the ADAM/BAE Cell, Fires Cell, and TACP within the BCT TOC in order to provide the best situational awareness and synchronization of airspace.

## Materiel Systems that Enable Air Ground Integration

This section reviews the literature relating to systems used by the ADAM/BAE Cell to provide situational awareness and manage airspace. The primary systems are the Tactical Airspace Integration System (TAIS) within the BAE, the Air Defense Systems Integrator (ADSI) and Air and Missile Defense Workstation (AMDWS) within the ADAM Cell, and the use of various communications platforms to control aircraft within the BCT's AO. The current literature discusses the use of these systems and their effectiveness in providing a common operating picture (COP) of all airspace users from the BCT up to the Combined Air Operations Center (CAOC). Several studies mentioned in previous sections of this chapter discuss these systems, and additional journal articles provide insight into the use of technology in conducting airspace control.

The studies by MAJ Strokin and MAJ Russell discuss the need for a single system to provide an air COP. MAJ Strokin identifies issues with airspace control at echelons above the BCT due to incompatible equipment and poor communications (Strokin 2010, 4). MAJ Russell agrees that the current airspace control system is limited in providing near-real-time capabilities and an inability to provide a COP to all users due to incompatible equipment between the Army and the Air Force (Russell 2009, 2). The

radars used by the Air Force to provide situational awareness and positive control of air assets work well above the coordinating altitude, but are limited in low altitude tracks due to line of sight. Sentinel radars used by the ADAM Cell provide good situational awareness below the coordinating altitude, but the operators are overwhelmed by the high congestion at the lower altitudes (Russell 2009, 31). The different systems do not provide a single COP, especially as aircraft increasingly cross the coordinating altitude and move from one airspace control system to another.

The article, "Earth, Wind, and Fire: The Experimentation Environment," identifies similar issues during a simulation at the Fires Battle Lab at Fort Sill, OK. Airspace control operations were impaired by not having a single C2 system or designated COP between the services. It is imperative to have a single, fully functioning, automated airspace management tool at the BCT and battalion levels in order to provide near-real-time situational awareness (Durham and Myers 2008, 23). TRADOC Pamphlet 525-7-3 discusses the same need for a system that provides single COP for all airspace users. The lack of a high-fidelity, low-latency air picture, and shared information between C2 nodes inhibits the ability of controlling agencies and the ground AO owner to look at the same picture and make an informed decision based on priorities and acceptable risk (U.S. Department of the Army 2009, 20). The lack of a COP is an issue between the Army and Air Force airspace control elements.

CPT Viator and CPT Engelbrecht argue that the systems within the ADAM Cell in the BCT provide the necessary capabilities to maintain situational awareness and to request ACMs. The ADSI and AMDWS systems are robust and effective in managing airspace above the BCT AO, but a system is needed to correlate the air picture being

received from numerous sources (Engelbrecht 2010, 44). CPT Viator identifies TAIS as the primary interface between the BCT and Division airspace control element (Viator 2008, 20). The combination of all the systems within the ADAM/BAE is necessary to provide the capabilities to integrate air assets into BCT operations. These systems help establish a digital link to aircraft, and facilitate the attack of ground targets.

Over the last decade CAS became an important part of conducting ground operations. Communicating with aircraft to deconflict airspace and to pass targets is necessary to reduce risk of fratricide and to accomplish the mission. Digital CAS provides a means to maintain situational awareness of the air and ground picture. Two articles in *Fires* discuss the capabilities of digital systems to aid in CAS. “Digital Air Ground Integration” provides an overview of the capabilities of aircraft equipped with the Situation Awareness Data Link (SADL) and the ability to share positional information between the aircraft and ground troops equipped with Enhanced Position Location Reporting System (EPLRS). This creates the ability to share a common operating picture within an automated system, and to pass targets between the aircraft and ground operators and vice versa (Cox 2010, 16). “Digital Air/Ground Integration in Afghanistan: The Future of Combat is Here” describes the use of the SADL to pass target information to the ADSI in the ADAM Cell, but the target must be manually transferred to the Advanced Field Artillery Tactical Direction System (AFATDS) to engage with surface to surface fires (Turnham et al. 2012, 59). The capability of the SADL-ADSI digital link increases the effectiveness of CAS in support of the ground commander, but it is limited to SADL equipped A-10 and F-16B30 aircraft (Cox 2010, 16). The use of digital CAS is

an example how a common operating picture can facilitate AGI, but it is a limited capability for a specific mission.

The current literature on systems that enable AGI identify an issue with providing a single COP for all air users and airspace control elements. The different systems used by the Army and Air Force are incompatible and hinder the ability to provide near-real-time control of airspace above and below the coordinating altitude. There is a need for a single airspace control system that can provide a COP across services. The systems within the BCT are effective in providing situational awareness of airspace below the coordinating altitude, but it requires multiple systems within the ADAM/BAE Cell. This study will take a closer look at the capabilities of the systems within the BCT in order to determine if they are effective in facilitating air and ground operations.

## Summary

This chapter discussed the relevant literature relating to the secondary research questions. The review provides a foundation for the analysis in chapter 4, and identifies consistent themes found in current literature. The next chapter will outline the research methodology and discuss how the author will answer the primary and secondary research questions.

# CHAPTER 3

# RESEARCH METHODOLOGY

The last chapter reviewed the existing literature on AGI and airspace control. Current literature on each of the secondary research questions were reviewed, and consistencies and gaps in research were identified within each research question. Chapter 2 provided an understanding of the extensive amount of literature on AGI and airspace control within doctrine, journals, theses, and monographs. The majority of the information focused on the Joint, Corps, and Division level, and identified the need for research on AGI at the BCT level.

This chapter will outline the research methodology used to answer the primary research question: Can the U.S. Army Brigade Combat Team conduct efficient Air Ground Integration with current doctrine, organization, and materiel? In order to answer the primary research question, four secondary research questions must be answered: what is Air Ground Integration, how do U.S. Joint and Army doctrine guide the integration of air and ground operations, what is the organizational structure within the BCT that is responsible for air ground integration, and what materiel systems enable air ground integration and how are they used? This chapter will identify the type of research, the method for answering each secondary research question, and how this will help answer the primary research question.

## Type of Research

The research will be a qualitative study of current Joint and Army doctrine, the organization of the Brigade Combat Team that conducts airspace command and control,

and the materiel systems used to synchronize, deconflict, and control airspace. Qualitative research will identify the relationship between doctrine, organization, and materiel in order to help answer the primary research question. In order to determine how effective the BCT can conduct AGI, several evaluation criteria will be applied to the doctrine, organization, and materiel: consistency, simplicity, and synchronized. A definition of each evaluation criteria is below:

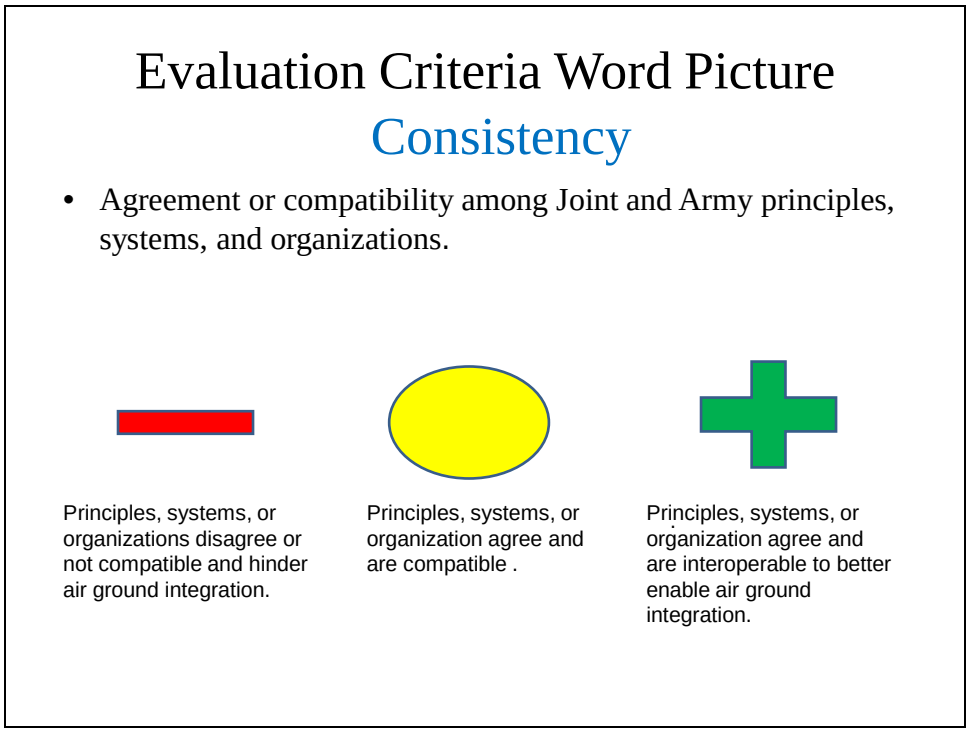


Figure 1. Evaluation Criteria Word Picture: Consistency

*Source:* Jack Kem, *Planning for Action: Campaign Concepts and Tools* (Fort Leavenworth, KS: Command and General Staff College, August 2012), B-6.

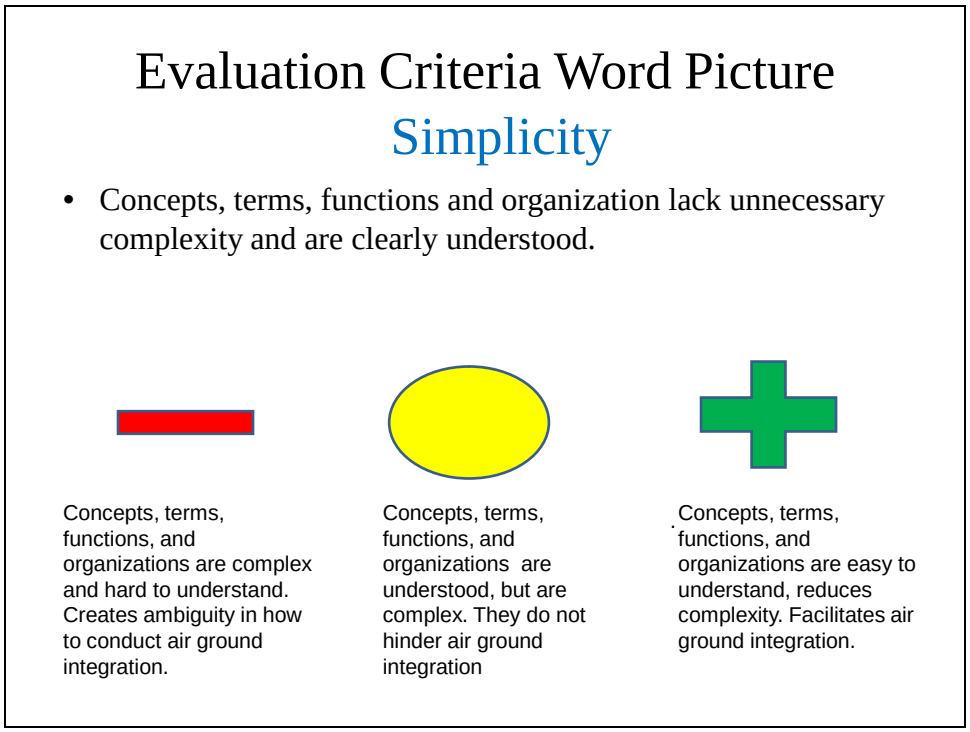


Figure 2. Evaluation Criteria Word Picture: Simplicity

*Source:* Jack Kem, *Planning for Action: Campaign Concepts and Tools* (Fort Leavenworth, KS: Command and General Staff College, August 2012), B-6.

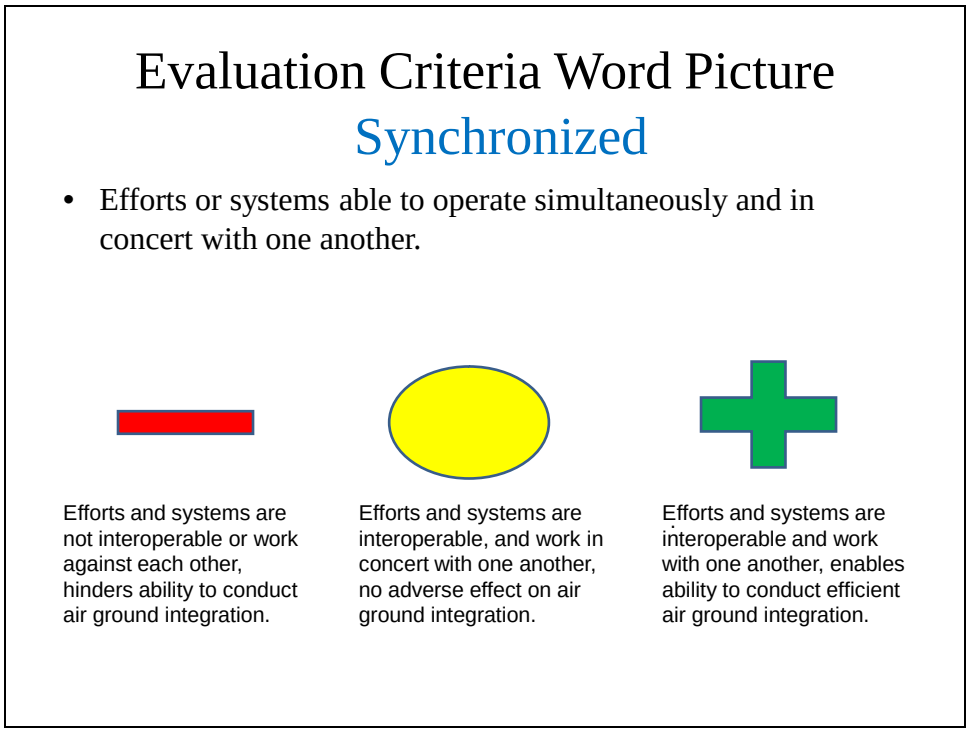


Figure 3. Evaluation Criteria Word Picture: Synchronized

*Source:* Jack Kem, *Planning for Action: Campaign Concepts and Tools* (Fort Leavenworth, KS: Command and General Staff College, August 2012), B-6.

## What is Air Ground Integration?

By answering the secondary research question, What is Air Ground Integration?, the author will provide the basis for answering the other secondary research questions. A review of doctrine will establish a clear definition, and outline the activities associated with AGI. An evaluation of doctrine will help establish key principles of AGI, and identify if there is a clear official definition of this topic. The author will provide a clear definition of Air Ground Integration by synthesizing information from various doctrinal publications in order to provide a framework for analyzing the other secondary research questions.

### How do U.S. Joint and Army Doctrine Guide the Integration of Air and Ground Operations?

The author will answer this secondary research question by analyzing current Joint and Army doctrine. Doctrine provides fundamental principles by which the military forces or elements thereof guide their actions in support of national objectives. It is authoritative but requires judgment in application (U.S. Joint Chiefs of Staff 2013a, 97). U.S. Joint and Army doctrine on airspace control, fires, mission command, and aviation operations provide the necessary principles of AGI. Analyzing current doctrine will allow the author to identify the systems, and principles that guide the integration of air and ground operations.

### What is the Organizational Structure within the BCT that is Responsible for Air Ground Integration?

U.S. Army doctrine, the Armored Brigade Combat Team Table of Organization and Equipment (TOE), and contact with the Fires and Aviation Centers of Excellence provide information to establish the structure of the Fires Cell, ADAM/BAE Cell, and TACP. These organizations form the nucleus of the brigade staff responsible for conducting integration of fires and airspace control. The author will outline the roles and responsibilities of each cell, and compare that to the functions required by doctrine. Analysis will identify whether the current structure within the BCT staff is capable of conducting all of the functions of integrating fires, and conducting airspace control. Journal articles provide information on how well the cells perform the required duties, and how the various cells synchronize and integrate to efficiently perform air ground integration.

## What Materiel Systems Enable Air Ground Integration and How Are They Used?

Materiel systems used to conduct AGI are identified by using current doctrine, the ABCT TOE, and information from the various systems' Program Managers. Analysis of the capabilities of each system compared to the requirements established in doctrine provides the basis for answering the secondary research question and ultimately the primary research question. Of primary importance is the location of these systems, and the effectiveness of each system to provide a means to conduct AGI. Information from journal articles and unclassified after action reports will identify how well these systems meet the requirements outlined in doctrine, and how well they integrate into the TAGS.

## Summary

This chapter outlined the research methodology by identifying the type of research, evaluation criteria, and how the author will answer each secondary research question. The analysis of current doctrine, information from the Army Fires and Aviation Centers of Excellence, and information from journal articles and after action reports provide the necessary data for analyzing and evaluating the ability of the Armored Brigade Combat Team to effectively conduct Air Ground Integration. Chapter 4 will provide the data, analysis, and evaluation of the materiel outlined in this chapter, in order to answer the primary and secondary research questions.

# CHAPTER 4

# ANALYSIS

The last chapter outlined the research methodology to include how each research question will be answered, and how the qualitative data will be analyzed to answer the primary research question. This chapter will focus on answering the secondary research questions in order to answer the primary research question, "Can the U.S. Brigade Combat Team conduct efficient air ground integration with the current doctrine organization, and materiel?" The first section will provide a definition of air ground integration and the associated processes necessary to conduct efficient integration of air and ground operations. The second section will provide a foundation of how current U.S. Joint and Army doctrine guides how to conduct air ground integration. The third section will outline the organization within the Armored Brigade Combat Team responsible for conducting air ground integration and analyze the organization. The fourth section will provide the capabilities of the materiel systems used by the BCT to facilitate air ground integration. At the end of each section analysis of the information found in the section will be evaluated against the criterion: consistency, simplicity, and synchronized. Finally, the primary research will be answered by consolidating the evaluation of doctrine, organization, and materiel.

## What is Air Ground Integration?

The term Air Ground Integration is a commonly used term within the U.S. military and several forums and working groups were established to resolve issues related to the concept of integrating air and ground operations. The *Air Land Sea Bulletin*

dedicated the May 2007 issue to Air Ground Integration, the Center for Army Lessons Learned provided a newsletter on Air Ground Integration in June 2011, and the Army Air Force Integration Forum provides a venue to discuss issues related to integrating air and ground operations between the two services. These publications and forums are valuable venues to improve integration, but they do not provide a common definition, nor does Joint or Army doctrine. This lack of a common definition causes confusion on what air ground integration is, and what processes and concepts support the integration of air and ground operations. A clear definition of air ground integration is necessary in order to answer the primary research question of, "Can the U.S. Army Brigade Combat Team conduct efficient air ground integration with the current doctrine, organization, and materiel?"

Joint Publication 1, *Doctrine for the Armed Forces of the United States*, defines integration as the arrangement of military forces and their actions to create a force that operates by engaging as a whole (U.S. Joint Chiefs of Staff 2013b, GL-8). Integration is the focal point of the term Air Ground Integration. It is the arrangement of air and ground forces and their actions to create a force that operates by engaging as a whole. Commanders must ensure that all operations are integrated, so that the force operates as a whole to achieve a common objective.

Field Manual (FM) 3-90.6, *Brigade Combat Team*, discusses the term Air Ground Integration as an integrating process and continuing activity. "Operations must be integrated so air and ground forces can simultaneously work in the operational environment to achieve a common objective" (U.S. Department of the Army 2010, 1-17). The manual further outlines fundamentals that enhance the effectiveness of air and

ground assets. These fundamentals are: understanding capabilities and limitations of each force, using standard operating procedures, developing habitual relationships, regular training, airspace control, maximizing and concentrating effects of available assets, employment methods, and synchronization (U.S. Department of the Army 2010, 1-17). The two key fundamentals are synchronization and airspace control, and are integrated into operations throughout the Mission Command Warfighting Function.

Mission Command is how commanders initiate and integrate all military functions and actions toward a common goal by enabling disciplined initiative within the commander's intent (U.S. Department of the Army 2012a, 1). The Mission Command Warfighting Function allows commanders and staffs to develop and integrate activities enabling commanders "to balance the art of command and the science of control in order to integrate the other warfighting functions" (U.S. Department of the Army 2012a, 9). This warfighting function provides the systems and processes to integrate all operations to achieve a common objective, and is the way in which the BCT performs air ground integration and other integrating processes. The commander drives the operations process by understanding, visualizing and describing the operation to the staff as well as other organizations to achieve unity of effort. The staff supports the commander by conducting the operations process through planning, preparing, executing, and assessing operations (U.S. Department of the Army 2012b, 1-3).

Through mission-type orders the staff determines the appropriate tasks and purpose for both ground and air assets. Clear task and purpose along with the commander's intent must be disseminated to all airspace users supporting the operation. Mission-type orders provide subordinate ground and air units the flexibility to

accomplish the mission through “disciplined initiative,” but the staff must develop necessary control measures to synchronize operations to achieve massed effects at the decisive point and to mitigate risk (U.S. Department of the Army 2012b, 2-12). Plans must be well-rehearsed in order to refine the plan and create a clear understanding of operations. Incorporating all assets, to include all air assets and fires, into rehearsals ensures that all elements understand how they fit into the overall plan, and facilitates disciplined initiative. Rehearsals also identify if established control measures properly integrate all assets, while providing the required level of safety to accomplish the mission. Airspace control helps provide the necessary control while integrating air and ground assets.

Synchronization is a tenet of unified land operations, and is the arrangement of military actions in time, space, and purpose to produce maximum relative combat power at a decisive place and time (U.S. Department of the Army 2011, 9). Synchronizing Army aviation assets to meet the Brigade Commander’s intent is primarily the duty of the Brigade Aviation Officer (BAO). The BAO is the principal adviser to the Brigade Commander on Army Aviation, and is the liaison between the Brigade Combat Team and the Aviation Brigade (U.S. Department of the Army 2006, 1-2). The Air Liaison Officer (ALO), part of the Air Force Tactical Air Control Party, is the principal adviser to the Brigade Commander on joint air support and helps synchronize air operations to meet the commander’s intent (U.S. Department of the Army 2010, 7-3). The BAO and ALO work together to ensure that the task and purpose for aviation assets within the ground commander’s scheme of maneuver are disseminated to the appropriate air assets.

Airspace Control is the process used to increase operational effectiveness by promoting the safe, efficient, and flexible use of airspace (U.S. Joint Chiefs of Staff 2010b, I-2). For the Army, airspace control primarily aims to integrate airspace users during planning and in near-real-time execution. This integration enables the commander to maximize airspace user's capabilities as part of unified land operations while minimizing adverse impacts (U.S. Department of the Army 2012b, 1-1). Airspace users include fixed wing aircraft, rotary wing aircraft, unmanned aerial systems (UAS), and joint fires. It is imperative that commanders and staffs manage airspace to provide the greatest amount of flexibility while minimizing risk to airspace users. Airspace control is a part of the operations process requiring detailed planning, quality rehearsals, responsive integration and deconfliction during execution, and constant assessment to adjust to changing conditions.

Air Ground Integration is the process of arranging air and ground forces, and their actions, to create a force that operates by engaging as a whole in order to achieve a common objective. It is accomplished through the Mission Command Warfighting Function which integrates the other warfighting functions (intelligence, movement and maneuver, fires, protection, and sustainment) through the operations process. Air and ground forces are synchronized through clear task and purpose supporting the commander's intent, quality rehearsals, and decentralized execution. Commanders and staffs conduct airspace control to provide necessary control in order to maximize airspace user's capabilities, while minimizing adverse impacts. By providing this definition and establishing its supporting elements an evaluation of the doctrine, organization, and

materiel can help determine if the Brigade Combat Team can conduct efficient air ground integration.

## How do U.S. Joint and Army Doctrine Guide the Integration of Air and Ground Operations?

The Brigade Combat Team conducts operations within a designated area of operations (AO), and the BCT commander is usually the supported commander while conducting ground operations within the assigned AO. Ground operations are usually conducted by solely Army units and these operations are guided by Army doctrine. Air operations within the BCT's AO, however, are not always conducted by Army air assets. Army aviation, UAS platforms, and joint aircraft conduct operations in support of the BCT. Airspace is inherently joint in nature and requires a thorough understanding of U.S. Joint doctrine in order to properly manage airspace over the BCT AO. Conducting air ground integration within the BCT AO requires synchronizing Army and Joint air assets and managing airspace to maximize effects in support of the BCT commander's intent. A review of Joint and Army doctrine will provide the foundations of how to synchronize air and ground assets, and how to manage airspace within the BCT's AO.

The Joint Force Commander (JFC) will usually designate a Joint Air Component Commander (JFACC) to control air operations within the Joint Operations Area (JOA). The JFACC is responsible for planning, coordinating, tasking, monitoring, executing, and assessing air operations in support of the JFC's directives and intent (U.S. Joint Chiefs of Staff 2010a, II-2). Centralized control of air operations allows the JFC to ensure unity of effort for all air operations within the JOA. Command and Control of air operations is conducted through the Theater Air Ground System (TAGS), which is the system that

includes each element of the different U.S. services systems of air operations command and control (U.S. Joint Chiefs of Staff 2010a, II-9). The JFACC will use the command and control system of his service, so when the JFACC is an Air Force officer, then he will use the Theater Air Control System (TACS) as the primary command and control system. The Army's command and control system for air operations is the Army Air Ground System (AAGS). The AAGS provides Army commanders the ability to coordinate and integrate Army airspace users throughout the area of operations, and is designed to operate in conjunction with the TACS (U.S. Department of the Army 2013, 1-3). The interaction between the TACS and AAGS allows for the coordination and integration of airspace users across services and is the framework for conducting air ground integration within a joint environment (see figure 4).

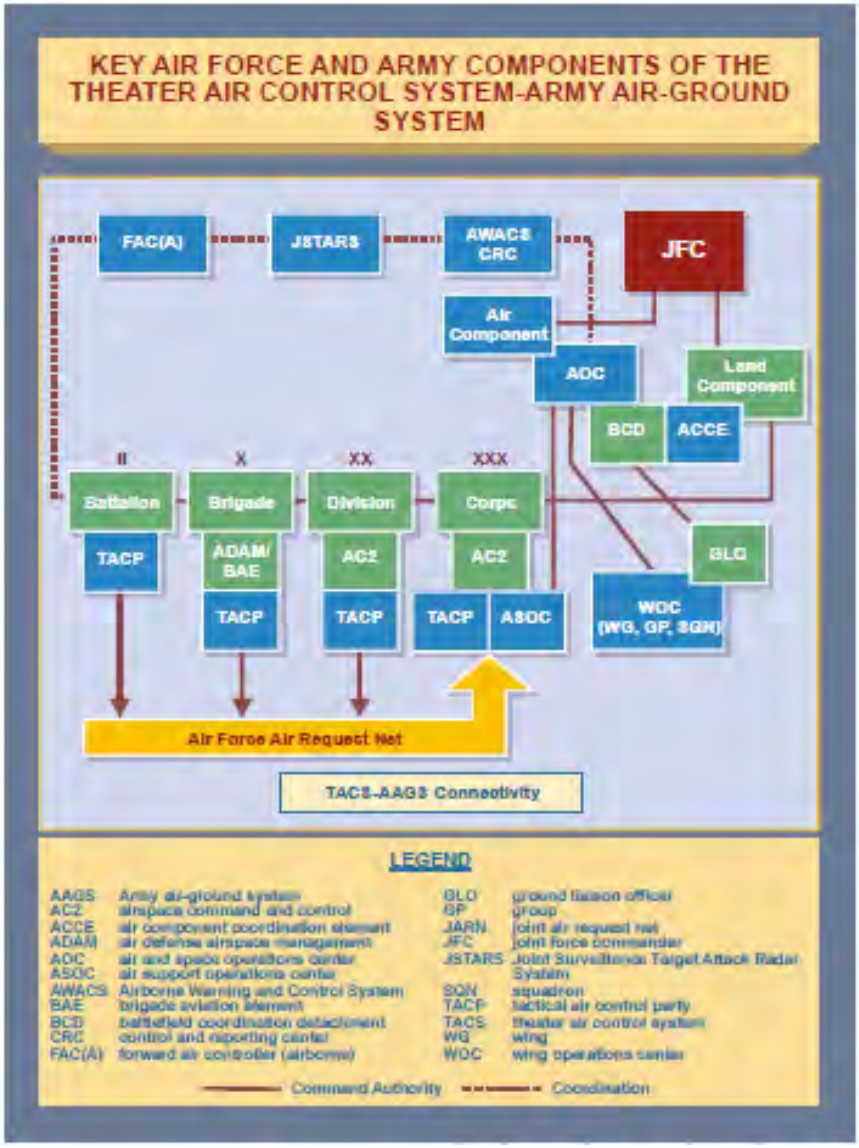


Figure 4. Key Components of the TACS-AAGS

*Source*: U.S. Joint Chiefs of Staff, Joint Publication 3-30, *Command and Control of Joint Air Operations* (Washington, DC: U.S. Joint Chiefs of Staff, 2010), II-14.

The structure of the TACS-AAGS provides the ability of the BCT staff to synchronize joint airspace users. The Tactical Air Control Party (TACP) and the Air Support Operations Center (ASOC) provide advice on how to best integrate and control

joint air assets (U.S. Joint Chiefs of Staff 2010a, II-10). The ground commander's scheme of maneuver, and task and purpose for joint air assets are forwarded to the Battlefield Coordination Detachment (BCD), which is the principal liaison element between the Army and the JFACC. The BCD processes Army requests for air support, monitors and interprets the land battle situation for the air operations center (U.S. Joint Chiefs of Staff 2010a, II-13). This enables crew members of joint air assets, primarily Close Air Support (CAS) aircraft, to gain a greater understanding of what the ground commander wants CAS to accomplish and provides situational awareness of other potential airspace users operating in close proximity. Through a shared understanding of the operation and effective airspace control, air assets are able to operate with greater flexibility and helps reduce the risk to air and ground forces. Thorough planning develops a shared understanding and synchronizes various elements.

During the planning process staffs synchronize the various warfighting functions to achieve a common objective. Integrating air and ground operations requires input from all warfighting functions. Targeting is an integrating process focused on the selection and prioritization of targets and matching the appropriate response to them, considering operational requirements and capabilities (U.S. Department of the Army 2012d, 1-12). During the targeting process intelligence assets, ground forces, and fires are synchronized to engage targets at the right place and the right time, with the most appropriate response (U.S. Department of the Army 2012d, 1-12). The TACS/AAGS connectivity facilitates targeting by processing target nominations, air support requests, and providing liaison elements between the Army and Air Force. The Fires Cell at each echelon is responsible for target coordination and for synchronizing fires to support the scheme of maneuver

(U.S. Department of the Army, Marine Corps, Navy, and Air Force 2007, IV-6). Planning helps synchronize operations and determines the requirements for airspace control.

Airspace control is necessary to integrate air and ground operations, and to provide for the safety of airspace users. Basic principles of airspace control emphasize the centralized planning of airspace that is coordinated amongst all echelons in order to achieve unity of effort. The coordination and integration of airspace control facilitates decentralized execution through timely and effective information flow, and the appropriate mixture of positive and procedural control. Procedural control relies on common procedures, designated airspace, and promulgated instructions by an authorized control agency to deconflict and activate air traffic control areas, airspace coordination measures (ACMs), fire support coordination measures (FSCMs), and air defense control measures. Positive control relies on surveillance, accurate identification, and effective communications between a designated airspace control agency and all airspace users. Positive control provides for the greatest degree of safety for airspace users, but requires a large amount of resources to maintain identification and communication with all airspace users. Procedural control provides the minimum amount of control in order to provide for the safety of airspace users and requires fewer resources. The appropriate mix of procedural and positive control must be used to provide the greatest amount of safety, with the resources available. An effective airspace control system provides the necessary unity of effort and is the responsibility of the Airspace Control Authority (U.S. Joint Chiefs of Staff 2010b, I-4 – I-6).

The Airspace Control Authority (ACA) is the commander designated by the JFC to have overall responsibility for the airspace control system and provide guidance for the

control of airspace throughout the airspace control area (U.S. Joint Chiefs of Staff 2010a, II-5). Since the responsibilities of the JFACC and the ACA are so closely related, the JFC usually designates the JFACC as the ACA, which provides for more centralized control and unity of effort. The ACA develops the Airspace Control Plan (ACP) and exercises authority through the Airspace Control Order (ACO), which provides specific control procedures for an established time (U.S. Joint Chiefs of Staff 2010a, II-5). The ACO includes the procedures for controlling airspace as well as the approved airspace coordinating measures for the airspace control area. The ACP, ACO, and Special Instructions (SPINS) of the Air Tasking Order (ATO) are the documents that provide the necessary guidance for conducting airspace control from the JFC down to the BCT. The ACO must be understood by all airspace users and airspace control elements. The centralized control of airspace provides for the safety of airspace users and ensures efficient use of airspace. Effective planning at all levels ensures that the appropriate airspace coordinating measures are added to the ACO and deconflicted to allow the greatest amount of flexibility when executing operations.

The Army primarily relies on procedural control when the ACA delegates the authority to control airspace, i.e., below the coordinating altitude (U.S. Department of the Army 2013, 1-3). The use of ACMs enables airspace control agencies to designate blocks of airspace for use by aircraft or fires, and reduce the risk of fratricide. Effective use of ACMs and FSCMs deconflict airspace users by separating them by altitude, lateral separation, or timing. Procedural control achieves the goal of preventing fratricide, and is effective when there are a small number of aircraft operating within the controlled airspace. As the number of aircraft and fires increase, the less effective procedural control

becomes. A large amount of airspace is blocked off by control measures in order to deconflict airspace use and limits the ability to achieve massed effects by multiple air assets. Positive Control allows for the integration of airspace users in close proximity and still provides the necessary safeguards to prevent fratricide. The Army is capable of performing limited positive control of a small amount of airspace, i.e., high density airspace control zone, but requires augmentation of additional assets, such as, air traffic control personnel and radars, in order to control large amounts of airspace over longer periods of time (U.S. Department of the Army 2013, 1-3). The reliance on procedural control requires a thorough understanding of airspace coordinating measures.

Airspace coordinating measures are measures employed to facilitate the efficient use of airspace to accomplish missions and simultaneously provide safeguards for friendly forces (U.S. Joint Chiefs of Staff 2010b, GL-6). ACMs are categorized into eight different types, with multiple uses for each type. ACMs are used to facilitate air defense, air traffic control, route aircraft, and separate aircraft to prevent fratricide. Joint Publication (JP) 3-52, *Joint Airspace Command and Control*, Appendix B, provides an overview of each ACM and its use in controlling airspace. During planning the staff identifies the need for appropriate ACMs based on the commander's scheme of maneuver for both air and ground forces, and the amount risk the commander is willing to accept. Requests for ACMs, during planning and execution, are forwarded through airspace control elements that are part of the AAGS. ACMs are approved by the ACA and are input into the ACO. This ensures that the ACMs are known by all airspace users within the airspace control area. Effective use of ACMs in conjunction with communications,

aircraft identification, and FSCMs facilitate procedural control of airspace by the designated controlling authority.

U.S. Joint and Army doctrine outline the framework and procedures for conducting air ground integration. In order to determine if the BCT can perform efficient air ground integration doctrine must be consistent, simple, and facilitate synchronization of operations. Joint and Army doctrine is consistent if its principles, systems, and organizations are in agreement or compatible. Doctrine is simple if concepts, terms, functions, and organizations are straightforward and clearly understood. Doctrine facilitates synchronization if efforts or systems are able to operate simultaneously and in concert with one another. The following evaluation will analyze doctrine to determine if U.S. Joint and Army doctrine meet the criterion above and contribute to efficient air ground integration.

Joint and Army doctrine must be consistent since efficient air and ground operations integration requires integration of joint air assets and airspace. Fundamental to conducting air ground integration is an understanding of the AAGS and how it works with TAGS to synchronize air and ground operations and control airspace. JP 3-30, JP 3-52, FM 3-52, FM 3-52.1, and FM 3-52.2 all provide information on the AAGS and how it facilitates air ground integration. The design of the AAGS and the role of each element are consistent amongst all five publications. FM 3-52.2, *Theater Air Ground System*, provides the greatest detail on each element within the AAGS and how it interacts with the TAGS to conduct coordination, synchronization, and deconfliction amongst Army and Joint air assets. FM 3-52, *Airspace Control*, identifies the AAGS as the primary system for coordinating and integrating all airspace use (U.S. Department of the Army

2013, 1-3). The study of these publications provides a clear understanding of how joint air assets are requested, coordinated, and synchronized with Army operations. Each publication outlines how airspace control, risk management, and targeting contribute to developing effective plans that integrate air and ground operations. Emphasis in each publication is on effective planning and coordination prior to execution. The requirement for near-real-time deconfliction of air assets during execution is identified. Each publication talks about the need for interoperable command, control, computers, and communication systems to provide a common operating picture amongst all airspace users and control elements. The fourth section of this chapter will provide evaluation of the materiel systems to provide a common operating picture and communicate with all airspace users.

The release of new Army doctrine in 2012 and 2013 greatly increased the consistency of how the Army synchronizes air and ground operations and conducts airspace control. ADP and ADRP 6-0, *Mission Command*, identify the Mission Command Warfighting Function as the center of integrating the other warfighting functions and conducting the continuous activity of airspace control (U.S. Department the Army 2012b, 1-4 - 1-5). ADRP 3-09, *Fires*, identifies targeting as a fundamental task to the Fires Warfighting Function, and its role in integrating and synchronizing fires into Unified Land Operations (U.S. Department of the Army 2012d, 1-3). Targeting focuses on identifying targets at the right place and right time to achieve the desired appropriate effect on target. This requires Fires personnel to coordinate airspace to ensure conflicts between ground fires and air operations are minimized using ACMs and FSCMs (U.S. Department of the Army 2012d, 1-8). FM 3-52, published in 2013, identifies the

operations process as the framework for conducting airspace control (U.S. Department of the Army 2013, 1-5). FM 3-52 is organized to mirror the operations process and clearly identifies the roles of the commander and staff in each phase of the process. The new doctrine clarifies how the operations process supports air ground integration, increasing the ability of the commander and staff to synchronize operations and conduct airspace control.

The principles of airspace control are consistent amongst Joint and Army doctrine. JP 3-52 and FM 3-52 are the two main publications guiding the conduct of airspace control. While JP 3-52 focuses on how joint airspace is controlled, and FM 3-52 focuses on how the Army controls airspace; both publications emphasize the need for simple and flexible airspace control plans to meet the supported commander's objectives while minimizing risk to airspace users. The types of airspace control, procedural and positive, are clearly defined and each publication stresses the need for the appropriate mix of procedural and positive control for effective airspace control. The limited number of systems required to conduct positive control within the Army requires an emphasis on procedural control. FM 3-52 emphasizes procedural control and the use of ACMs to control airspace (U.S. Department of the Army 2013, 3-4).

The types and usages of airspace coordinating measures are consistent throughout doctrine. JP 3-52, and FM 3-52 use the approved joint definition of ACMs, and provide a definition of the type and usage of each of the approved ACMs in Appendix B of both publications. The current eight types of ACMs and the multiple usages of each type is consistent amongst doctrine, but is complex and requires knowledge of air operations and air defense operations in order to fully understand how to use each ACM. In 2010 a

working group at the Combat Airspace Conference agreed on reducing the number of ACM types to five and the number of usages from 168 to 97 (Roberts, Shafer, and Pope 2012, 4). The complexity associated with the number of ACMs is overcome by extensive training by airspace management personnel and experience obtained through the repeated use of the most commonly used ACMs. In addition to ACMs, common reference systems facilitate procedural control.

Common area reference systems provide a two-dimensional display that facilitates the three-dimensional control of airspace, and are established at the operational level (U.S. Department of the Army 2013, B-24). The two most common area reference systems are the Global Area Reference System (GARS), and the Common Geographic Reference System (CGRS). GARS is the standard area reference system across the Department of Defense, while CGRS is an older system. Both systems establish cells that are 30 x 30 nautical miles (based on WGS-84 latitude and longitude) and divided into quadrants and keypads. GARS has quadrants divided by 15 x 15 nautical miles, which are further divided into nine keypads of 5 x 5 nautical miles. CGRS, however, has the 30 x 30 nautical mile cells divided into nine keypads of 10 x 10 nautical miles, then further divided into quadrants of 5 x 5 nautical miles. This leads to confusion since both reference systems use the terms keypads and quadrants, but have different methods of dividing the cells. The Airspace Control Plan (ACP) and the Airspace Control Order (ACO) must clearly designate which reference system is used in order to avoid confusion when using the reference system to route aircraft across the theater (U.S. Department of the Army 2013, B-25).

An analysis of doctrine shows that Joint and Army doctrine is consistent, and facilitates the synchronization of air and ground operations through the operations process. The AAGS is the primary system for conducting air ground integration by providing elements at every echelon from JFACC down the BCT to plan, coordinate, and synchronize air and ground operations. It also provides the framework for the Army to conduct airspace control. New Army doctrine clearly outlines the roles of the commander and staff in integrating operations across the warfighting functions. The doctrine is easy to understand when looked at as a whole, but the types and usages of ACMs cause confusion amongst airspace users and airspace control elements. This confusion can hinder the ability of conducting procedural control due the heavy reliance on ACMs to define how airspace is used and coordinated. Overall U.S. Joint and Army doctrine facilitates efficient air and ground integration, but continued refinement and standardization of ACMs is required.

## What is the Organizational Structure within the BCT that is Responsible for Air Ground Integration?

The organizational structure within the BCT influences the effectiveness of integrating air and ground operations into the commander's scheme of maneuver. The Armored Brigade Combat Team has several functional cells that work together to integrate air operations and fires to support the BCT's overall operations. The ADAM/BAE Cell, Fires Cell, and Tactical Air Control Party (TACP) work together to conduct air ground integration. This section will outline the roles of each cell and how each cell contributes to air ground integration. Analysis of the organization of the BCT will identify if it is consistent with other organizations within the TACS-AAGS, simple

to understand with clear roles and responsibilities for each cell, and if the organizations within the BCT can synchronize air and ground operations.

The Air Defense and Airspace Management (ADAM)/Brigade Aviation Element (BAE) Cell is responsible for providing the BCT with the aerial component of the common operating picture and ensuring aviation, air and missile defense, and airspace management considerations are included in the operations process (U.S. Department of the Army 2007, 1-2 - 1-3). The ADAM/BAE Cell has enhanced digital capabilities that display the aerial common operating picture (COP) in order to increase situational awareness of theater air operations. By combining the ADAM Cell and BAE Cell into one functional cell, the capabilities of each cell to conduct airspace control and provide situational awareness of air operations is integrated to achieve a single COP of the airspace within the BCT's AO.

The ADAM Cell is the only organic air defense capability within the BCT, and coordinates air and missile (AMD) operations with higher AMD Cells found within the AAGS. The cell consists of seven personnel to conduct planning and 24/7 operations to support AMD and airspace management. The lead of the ADAM Cell is the AMD Coordinator (Major/O-4) who is the senior AMD coordinator, planner and briefer. The ADAM Cell operates computer and communication systems and conducts operations to provide early air defense warning, engagement operations, and airspace management. The ADAM Cell provides the necessary expertise to conduct AMD planning and the C4 capabilities to provide the BAE with the COP (U.S. Department of the Army 2006, 2-12 - 2-14).

The Brigade Aviation Element (BAE) incorporates aviation assets into the BCT Commander's scheme of maneuver. The organization of the BAE facilitates 24/7 operations and is capable of operating in two places simultaneously. The Brigade Aviation Officer (BAO) (Major/O-4) is the lead of the BAE and is overall responsible for integrating air assets and conducting airspace management (U.S. Department of the Army 2007, 1-3). The BAE provides employment advice and planning for Army aviation assets, coordinates with the supporting Combat Aviation Brigade, and conducts airspace management (U.S. Department of the Army 2007, 1-1). In conjunction with the ADAM Cell, the BAE coordinates with the Fires Cell and Air Liaison Officer to facilitate aviation planning and participates in the targeting process.

The Fires Cell is responsible for the planning, coordination, and synchronization of fires to support operations. The Fires Cell is the centerpiece of the BCT's targeting process (U.S. Department of the Army 2010d, 7-2). The Fire Support Officer is in charge of the Fires Cell and is responsible for all fires planning and execution (U.S. Department of the Army 2013, 2-10). The Fires Cell is critical to air ground integration by coordinating and synchronizing fires with other airspace users in order to support the scheme of maneuver. Interaction with ADAM/BAE Cell and Tactical Air Control Party synchronizes fires and aviation assets, and identifies the required ACMs and FSCMS to facilitate airspace control.

The Tactical Air Control Party (TACP) is the Air Force representative located within the BCT, and is responsible for coordinating and synchronizing joint air support. The Air Liaison Officer (ALO) is in charge of the TACP, and is the principle advisor on joint air assets. The TACP also facilitates planning and conducts terminal attack control

of Close Air Support (CAS) in support of the BCT (U.S. Joint Chiefs of Staff 2009, II-9). The TACP maintains situational awareness on all planned and current air operations based on the Air Tasking Order and provides liaison with the Air Force. The TACP is an integral part of the targeting process and conducting airspace control. The ADAM/BAE Cell, Fires Cell, and TACP provide the necessary expertise and staff functions to integrate air and ground operations throughout the operations process.

The BCT operates within the AAGS to conduct air ground integration. Within the Division headquarters the Joint Air Ground Integration Cell (JAGIC) includes elements of the Fires Cell, AMD Cell, Airspace Control Cell, Aviation Cell and Air Support Operations Center (ASOC) (Wertz 2012, 63). The combination of the ADAM/BAE Cell, Fires Cell, TACP forms a Brigade Air Ground Integration Cell (BAGIC) that mirrors the function of the JAGIC (James 2010, 27). The BAGIC is not a formal organization identified in doctrine, but facilitates air ground integration by collocating all elements responsible for aviation, fires, and airspace control into one integrating cell. This facilitates communications and situational awareness, and makes the staff more responsive to changing conditions. Having organizations throughout the AAGS that mirror each other in structure and function enhance consistency and improves the ability to conduct air ground integration.

The AAGS has organizations from the theater level down to the BCT that mirror each other in structure and function. The Army Air and Missile Defense Command, found within the Joint Air Operations Center (JAOC), and other AMD Cells down to the ADAM Cell within the BCT coordinate theater air defense and facilitate airspace control. Fires Cells are located from the corps level down to the battalion level, with the

Battlefield Coordination Detachment providing liaison with the JAOC. These elements synchronize Army and Joint Fires, and facilitate both tactical and operational targeting. Airspace control elements conduct direct coordination from the theater level, Control and Reporting Center (CRC), down to the ADAM/BAE. This coordination facilitates rapid changes and distribution of the ACO to conduct near-real-time procedural control of airspace. The ASOC and TACP work for the JAOC and provide direct links to facilitate joint air support to the Army. The related organizations within the AAGS have similar responsibilities and are manned with similar personnel. This facilitates synchronization since they speak the same language and progress through similar training. The consistency of the AAGS organization, and the functions performed at each level enhance synchronization of air and ground operations.

The roles and responsibilities of each cell within the BCT are clearly outlined by doctrine. Field Manual Interim (FMI) 3-01.50, *Air Defense and Airspace Management Cell*, outlines the mission of the ADAM Cell and the roles and responsibilities of each member. Training Circular (TC) 1-400, *Brigade Aviation Element Handbook*, also outlines the roles and responsibilities of the BAE, and provides procedures for planning and executing the various missions of Army aviation. Army Doctrine Publication (ADP) and Army Doctrine Reference Publication (ADRP) 3-09, *Fires*, outline the roles of the Fires Cell in relation to targeting and supporting the commander. Field Manual (FM) 3-90.6, *Brigade Combat Team*, further outlines the responsibilities of the Fires Cell and how it supports the BCT. A clear delineation of the roles and responsibilities of individual members of the Fires Cell is not available in these manuals. The TACP's responsibilities and functions are found in multiple Joint and Army publications. Joint

Publication (JP) 3-09.3, *Close Air Support*, outlines the TACP's role in planning and executing CAS, and provides the most detail amongst the various publications covering the TACP and AAGS. The clear definition of the roles and responsibilities of cells and personnel contributes to simplicity since the functions and organizations are clearly understood. The redundancy of responsibilities amongst the cells furthers the argument of establishing the BAGIC in order to synchronize efforts.

The release of ADP and ADRP 6-0, *Mission Command*, and FM 3-52, *Airspace Control*, provide further clarification on who is ultimately responsible for conducting air ground integration. ADP and ADRP 6-0 identify the commander as the one overall responsible for operations, with the staff supporting the commander by conducting the operations process. FM 3-52 also identifies the commander as responsible for airspace control, but relies on the staff for planning and execution. The Brigade Aviation Officer is identified as the airspace control officer for the operations section (U.S. Department of the Army 2013, 2-9). This clarification helps simplify the process of air ground integration since the ADAM Cell, BAE, and Fires Cell at the brigade level are all led by Majors. The clear identification of responsibilities, and who is in charge enhances simplicity.

The organization within the BCT that is responsible for air ground integration includes the ADAM/BAE Cell, Fires Cell, and TACP. These cells work together to plan, coordinate and synchronize Army and joint airspace users to integrate into the commander's scheme of maneuver. Each cell has corresponding organizations at each level of the AAGS providing consistency, facilitating synchronization, and simplifying the structure to conduct efficient air ground integration.

## What Materiel Systems Enable Air Ground Integration and How Are They Used?

The ability of the BCT to conduct air ground integration is dependent on the materiel systems found in the ADAM/BAE Cell and Fires Cell. The Tactical Airspace Integration System (TAIS), Air Defense System Integrator (ADSI), Air and Missile Defense Workstation (AMDWS), Forward Area Air Defense (FAAD), and the Advanced Field Artillery Tactical Direction System (AFATDS) provide critical planning tools and the ability to conduct near-real-time airspace control during execution. This section will provide an overview of each system and how they interact to assist the BCT in conducting air ground integration. Analysis of these systems will determine if they simplify operations by creating a common operating picture, consistent with the systems used throughout the TAGS through interoperability, and facilitate synchronization through near-real-time procedural control of airspace.

The TAIS airspace workstation (AWS) is central to aviation mission planning and coordinating ACMs during planning and execution. This system interacts with the Theater Battle Management Core System (TBMCS) used by the JAOC to build and disseminate the Air Tasking Order (ATO) and Airspace Control Order (ACO). This allows TAIS to display the ACO and submit requests of ACMs during planning and execution (U.S. Department of the Army 2013, C-5). TAIS interacts with other Army mission command systems to provide a single picture for both air and ground operations. TAIS interacts with the Aviation Mission Planning System (AMPS) in the Combat Aviation Brigade to receive mission planning graphics to help synchronize aviation operations with the BCT's scheme of maneuver. Through the internal BCT server, TAIS passes the ACO to other systems, and receives updates from the Command Post of the

Future (CPOF) to update information on ground units (Kelton 2009, slide 6). TAIS receives aircraft location updates through Blue Force Tracker-Aviation (BFT-A) and Link-16 messages, and in conjunction with CPOF creates an integrated picture of ground and air operations (U.S. Department of the Army 2013, C-5).

BFT-A provides positional information on Army aviation assets, while Link-16 provides positional information for most fixed-wing aircraft. BFT-A systems on Army aviation aircraft send positional data via satellites to ground based servers. The servers disseminate the positional data to TAIS, which displays the data as an icon on the display screen. Link-16 is a Tactical Digital Information Link-J (TADIL-J) secure message format that passes positional information from fixed-wing aircraft to other aircraft and airspace control elements. These two systems provide updated situational awareness of individual aircraft to the TAIS system (U.S. Department of the Army 2013, C-3). Positional data increases situational awareness and along with the Dynamic Airspace Collaboration Tool (DACT) facilitates near-real-time procedural control.

The DACT provides the ability to collaborate with various agencies within the TAGS in order to coordinate changes to the ACO and pass operational information to conduct near-real-time procedural control of airspace. Through the DACT joint airspace control nodes within the TAGS can collaborate in real-time to deconflict ACMs and gather data required to dynamically retask aircraft during operations (Kelton 2009, slide 18). The addition of this tool greatly enhances the ability to conduct near-real-time procedural control, and reduces the reliance on tactical chat services to conduct coordination. TAIS is the primary system for working with outside agencies, but relies on the Air Defense Systems Integrator (ADSI) to receive additional information.

The ADSI is a robust communications hub that receives joint radar track data via Link-16, and Situation Awareness Data Link (SADL) messages for non-Link-16 equipped aircraft. The ADSI is capable of processing over 2,000 individual aircraft positional tracks and passes information to the AMDWS for display (U.S. Department of the Army 2013, C-4). The Enhanced Position Location Reporting System (EPLRS) radio provides the ADAM/BAE Cell the ability to pass ground unit positions to SADL equipped aircraft (A-10s and F-16B30s). These aircraft are capable of passing target information via the ADSI to TAIS and AMDWS and greatly enhance the ability to conduct digital CAS (Cox 2010, 16). The ADSI is the hub of the ADAM/BAE Cell communications since it combines information from joint radars and low-altitude Sentinel radars to create a single air picture (Brown 2013, slide 15). This information is transferred to TAIS and the AMDWS in order to pass to other mission command systems.

The AMDWS is the primary system used for planning air defense operations within the BCT. The AMDWS provides threat analysis of enemy air systems and displays track data received from the ADSI and FAAD to provide early warning of air and missile attack (Brown 2013, slide 16). FAAD receives information from low-level radar systems (Sentinel, lightweight counter-mortar radar, and firefinder) and the Airborne Warning and Control System (AWACS) to provide information on enemy and friendly airspace users (U.S. Department of the Army 2013, C-4). AMDWS can display the ACO, airspace control overlay, ACMs, unit airspace plan, along with enemy and friendly aircraft data to create a single airspace picture (U.S. Department of the Army 2013, C-5 - C-6).

Targeting data from the FAAD and ADSI are forwarded to AFATDS to facilitate CAS and counter-fire missions and can help identify conflicts between airspace users.

AFATDS is found in the Fires Cell and is used to conduct fire mission planning and execution. AFATDS can build and display ACMs and FSCMs as well as surface-to-surface munitions trajectories in order to deconflict fires and other airspace users. AFATDS can only display ACMs built as corridors and will only display the last effective time of the ACM from the ACO. This means that if an ACM as several start and stop times in the ACO, AFATDS will only display the last effective time (U.S. Department of the Army and Air Force 2009, 45). Limitations in displaying ACMs can prevent AFATDS from identifying conflicts with fires and current ACMs. Trajectory data can pass from AFATDS to TAIS and conflicts identified by TAIS operators. The interaction between all materiel systems within the ADAM/BAE and Fires Cell facilitate air ground integration throughout the operations process (see figure 5).

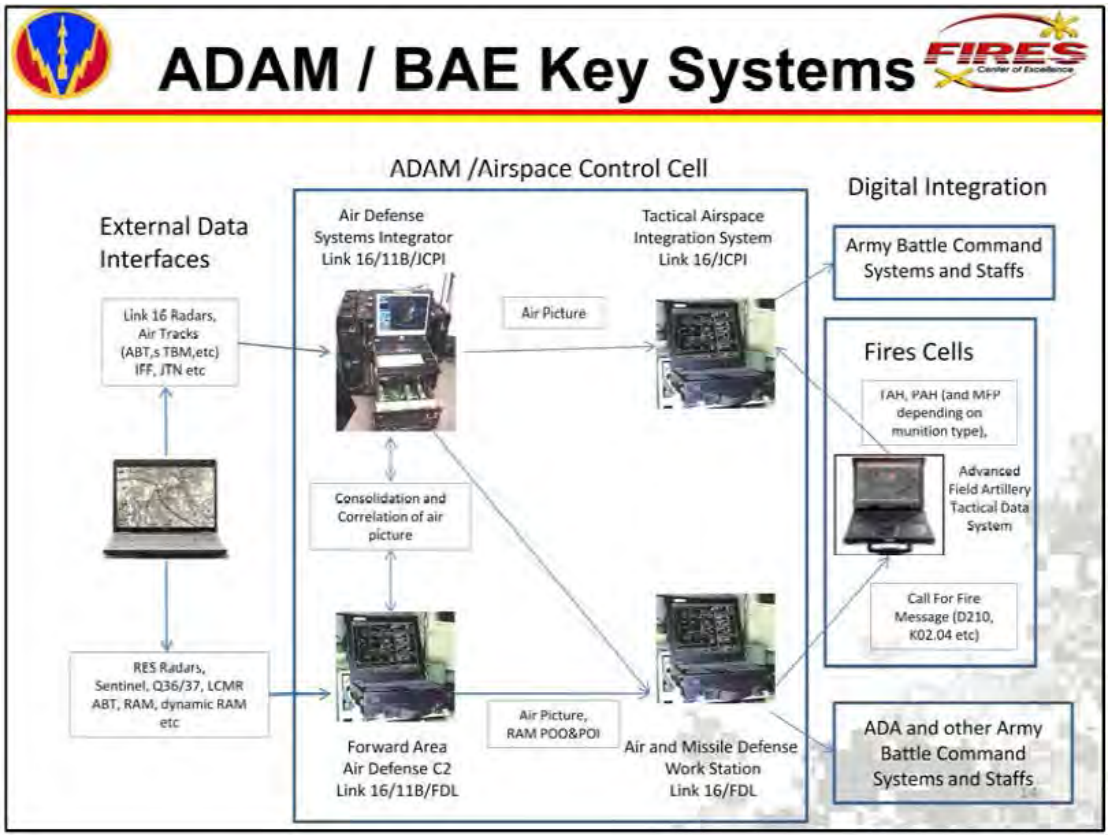


Figure 5. ADAM/BAE materiel systems interaction

*Source*: CW3 Anthony J. Brown, ADAM/BAE (Briefing, Fort Sill, OK, U.S. Army Air Defense Artillery School, 16 January 2013), slide 14.

Efficient air ground integration requires systems that provide a common operating picture of air and ground operations. This creates situational understanding and helps eliminate unnecessary complexity. TAIS provides the capability to incorporate information from various sources to create a common operating picture of air and ground operations. The ability to receive positional information from all airspace users via BFT-A, Link-16, and data from battlefield servers provides situational awareness of air operations to compliment the ground unit positions received from CPOF. TAIS can

display ACMs, aircraft locations, and surface-to surface fires trajectories to identify airspace conflicts, and facilitate near-real-time procedural control. A common operating picture is necessary to assess operations, and helps the commander make decisions based upon a common understanding of what is actually taking place. Commanders, facilitated by the staff, disseminate guidance based upon situational understanding in order to exploit opportunities and mitigate risks as they arise during execution.

The systems found within the ADAM/BAE and Fires Cells are interoperable throughout the AAGS, making them consistent with Joint and Army requirements. TAIS is the system used by the Army for airspace management and air traffic services (Kelton 2009, slide 4). The TAIS AWS (laptop) is found at the brigade level through the Corps level, with full TAIS Shelters used for air traffic services at the Aviation Brigade through theater level. The fielding of TAIS amongst the various airspace control nodes within the AAGS, in conjunction with the interoperability with the TBMCS and Army mission command systems facilitates information flow during mission planning and execution.

The ADSI, FAAD, and AMDWS are also found throughout the AAGS as part of the Theater Integrated Air and Missile Defense System. These systems facilitate dissemination of the ACO and tracking of friendly and enemy air tracks from theater radars. The ability to receive multiple tactical data link information via tactical servers and radios helps maintain situational awareness of aircraft when low altitude radars are limited by terrain. Operations in mountainous terrain limit the line of sight of low altitude radars and decrease the situational awareness at lower altitudes (Strokin 2009, 59). Self reporting systems on aircraft provide information via Link-16, SADL, and BFT-A to help offset this decrease in situational awareness, but do not allow for positive control of

airspace without real-time track data from radars. The interoperability of the ADSI and FAAD with theater air and missile defense and airspace control nodes facilitates information dissemination and helps create a common operating picture.

The AFATDS is the primary fire control system for all U.S. ground forces. The system is found from the battery level through theater level, and helps plan and execute surface-to-surface fires. The AFATDS facilitates clearance of fires by identifying coordination requirements based on established ACMs, FSCMs, or unit boundaries. Communication parameters within the AFATDS allow multiple units to maintain situational awareness of fire missions and facilitate clearance of fires by appropriate authorities without extra communications. The ability to build numerous units into the AFATDS allows for information to pass vertically and horizontally throughout Fires Cells within the AAGS. The interoperability with TAIS and AMDWS extends situational awareness to other cells responsible for airspace control and helps synchronize air and ground operations.

Synchronizing operations in near-real-time is essential to efficient air ground integration. As identified above, TAIS, with inputs from other systems, provides a common operating picture of both air and ground operations. The addition of the DACT enhances near-real-time coordination and deconfliction, allowing BCT to adapt to changing conditions. TAIS with inputs from ADSI and AFATDS help the ADAM/BAE Cell conduct near-real-time procedural control of airspace. The common operating picture provided by TAIS does have some limitations that hinder the ability of the staff to conduct efficient air ground integration.

The air picture provided by TAIS and FAAD require timely and accurate information for aircraft tracks. The BFT-A relies on positional data that can be tens of seconds to several minutes old before it is displayed in TAIS (U.S. Department of the Army 2013, C-3). The refresh rates for BFT-A requires the TAIS operator to predict where the aircraft will be based on historical tracks. Operating in mountainous terrain reduces the coverage of low-altitude radars like the Sentinel. Gaps in radar coverage degrade situational awareness at lower altitudes where the most congestion occurs (Strokin 2010, 59). Analysis by the U.S. Army Aviation Center of Excellence in 2009 identified an issue with "ghosting" that is caused by the same aircraft being reported by multiple sources (i.e., radar, Link-16, BFT-A) and requires operators to conduct trend analysis to determine which icon is the appropriate location for the aircraft (Crocitto 2009, 8). The issues with accurate locations of airspace users creates confusion in certain situations and causes the staff to create more restrictive ACMs to ensure the safety of all airspace users. This situation causes the staff to deconflict operations instead of synchronizing operations to achieve to true integration of air and ground operations.

The evaluation of the materiel systems used by the BCT to conduct air ground integration shows that they help simplify operations by creating a common operating picture, are consistent with Joint and Army systems through interoperability amongst systems within the AAGS, and help synchronize operations by working in concert with other systems to achieve near-real-time procedural control of airspace. The reduced accuracy of aircraft positions due to prolonged refresh rates of the BFT-A and gaps in radar coverage due to terrain hinder efficient integration of airspace users. Evaluating the systems as a whole, however, shows that the BCT can conduct air ground integration.

## Findings

This chapter answered the secondary research questions and provided analysis of the doctrine, organization, and materiel used by an Armored Brigade Combat Team to conduct air ground integration. A definition of Air Ground Integration and the associated processes was provided in order to provide the framework to help answer the remaining secondary research questions. The analysis focused on determining if doctrine, organizations, and materiel are consistent, simple, and synchronized to facilitate efficient air ground integration. Chapter 3, figures 1 through 3, define each evaluation criteria and is the basis for determining if the BCT can perform efficient air ground integration with the current doctrine, organization, and materiel. The findings below are a summary of the analysis from early sections in this chapter.

### Definition of Air Ground Integration

The first section of this chapter analyzed current doctrine to establish a common definition of air ground integration. JP 1 provided the definition of integration and ADP and ADRP 6-0 provided the framework for the actions associated with synchronizing air and ground operations, as well as, conduct airspace control. Air Ground Integration is defined as the process of arranging air and ground forces, and their actions, to create a force that operates by engaging as a whole in order to achieve a common objective. This definition requires that air and ground operations be synchronized in order create a force that operates as a whole. Airspace control is necessary to maximize the effects of air and ground systems while providing the necessary safeguards to prevent fratricide. Airspace control and synchronizing operations are key elements of conducting air ground integration.

## Doctrine

U.S. Joint and Army doctrine is consistent in how to conduct air ground integration. The Army Air Ground System (AAGS) is the primary system to conduct air ground integration and is clearly defined in both Joint and Army doctrine. Principles of airspace control are consistent between JP 3-52 and FM 3-52 with emphasis on conducting airspace control throughout the operations process. ADP and ADRP 6-0 outline how the Mission Command Warfighting Function is responsible for airspace control and synchronizing air and ground operations. U.S. Joint and Army doctrine agree and are compatible, and enable efficient air ground integration.

Current doctrine is simple and clearly understood with the exception of the types and usages of airspace coordinating measures. The number of ACM types and usages makes procedural control of airspace more complex, and requires a reevaluation of the need for the eight different types and 167 usages of ACMs in current doctrine. Training and experience in airspace control is needed to understand the proper use of ACMs to conduct procedural control. Overall doctrine is simple and does not hinder air ground integration.

Finally, doctrine is synchronized because it allows systems to operate simultaneously and in concert with one another. Commanders and staffs synchronize air and ground operations through the operations process. Doctrine outlines the need for effective liaison with air and ground units, and the AAGS provides systems to synchronize air and ground forces to accomplish the supported commander’s intent. The targeting process, airspace control, and effective coordination facilitate air and ground operations to work as one toward a common objective.

## Organization

Analysis of the organizations within the BCT that are responsible for air ground integration is consistent with other organizations within the AAGS. At each echelon of the AAGS there are organizations that mirror the ADAM/BAE Cell, Fires Cell, and TACP in design and function. This organization allows the BCT to interact with similar organizations within the AAGS and facilitates air ground integration through shared training and experience amongst the various echelons. Air Defense, Aviation, Fires, and Air Force organizations are found throughout the AAGS and enable efficient air ground integration.

The organization within the BCT is simple since it is easy to understand and facilitates efficient air ground integration. The roles and responsibilities of the ADAM/BAE, Fires Cell, and TACP are clearly defined in doctrine. FM 3-01.50, TC 1-400, ADRP 3-09, and JP 3-09.3 outline the organization and roles of each cell respectively. The publication of ADP and ADRP 6-0, and the update of FM 3-52 clarify the role of the commander, staff, and the Brigade Aviation Officer in particular as the officer in charge of airspace control. The commander is identified as the one overall responsible for air ground integration, and doctrine outlines how the staff supports the commander through the operations process.

The ADAM/BAE Cell, Fires Cell, and TACP work as one when they are organized into a Brigade Air Ground Integration Cell (BAGIC) and this organization helps facilitate synchronization. This is an informal organization that mirrors the establishment of the Joint Air Ground Integration Cell (JAGIC) in the U.S. Army Division. The collocation of Air Defense, Aviation, Fires, and Air Force personnel

facilitate synchronization of air and ground forces and airspace control. By working as one cell, the BAGIC enables the BCT to conduct efficient air ground integration.

## Materiel

The last element analyzed is the materiel systems used to conduct air ground integration. The systems found in the ADAM/BAE and Fires Cells are consistent and interoperable with the systems found throughout the AAGS, and are able to share information to create a common operating picture of air and ground operations. Similar materiel systems are found at every echelon within the AAGS and allow information to pass amongst Joint systems. The interoperability and redundancy of systems throughout the AAGS and TACS is consistent with Army and Joint principles of airspace control.

The ability to have a common operating picture throughout the AAGS helps simplify an already complex system. Shared understanding amongst all elements of the AAGS reduces the time to coordinate operations and increases the ability to react to dynamic situations. The materiel systems within the BCT are interoperable with other Joint and Army systems and help reduce complexity.

The materiel systems within the BCT work as one and help conduct near-real-time procedural control of airspace. This helps synchronize operations by increasing situational awareness while executing operations. The integrated displays of TAIS and the AMDWS help create a common operating picture that allows operators to identify airspace conflicts. The Dynamic Airspace Collaboration Tool (DACT) within TAIS allows multiple users to deconflict airspace and gather information to retask aircraft simultaneously. Positional information for aircraft at lower levels can be degraded and requires additional precautions when conducting procedural control of airspace. The

additional precautions do not hinder air ground integration, but do not contribute to efficient integration of air and ground forces toward a common objective.

## Summary of Findings

The figure below depicts the evaluation of doctrine, organization, and materiel that facilitate air ground integration within the Brigade Combat Team. A “plus” indicates that the category contributes to efficient air ground integration, an “oval” indicates that the category does not hinder air ground integration, and a “minus” indicates that the category has a negative impact on air ground integration.

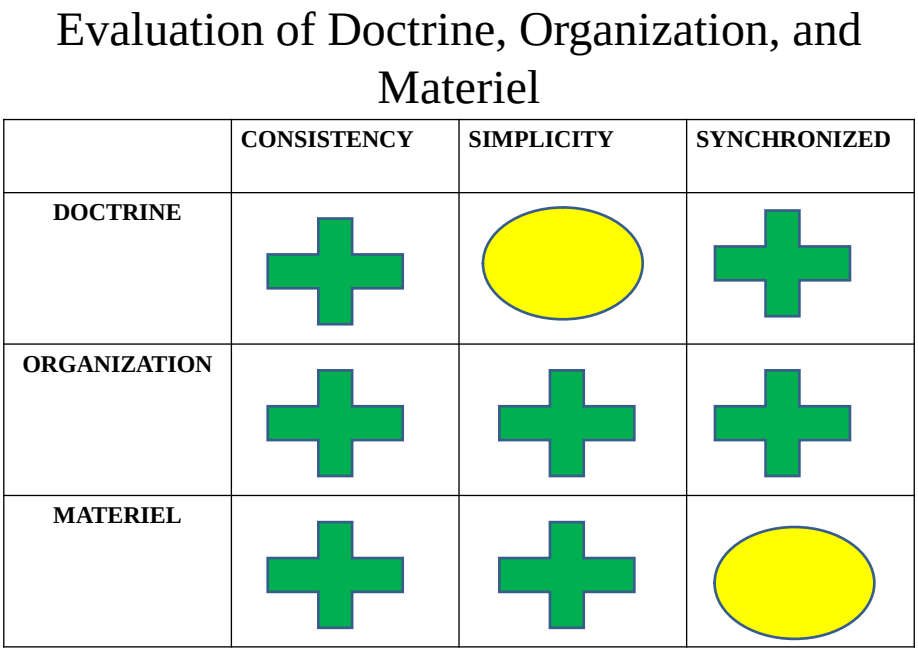


Figure 6. Evaluation of Doctrine, Organization and Materiel

*Source:* Created by author

Analysis of the current doctrine, organization, and materiel shows that overall the doctrine, organization, and materiel is consistent, simple, and synchronized. Answering the primary research question: yes, the Brigade Combat Team can conduct efficient Air Ground Integration with the current doctrine, organization and materiel.

## Summary

This chapter answered the secondary research questions and evaluated the doctrine, organization, and materiel that help the BCT conduct air ground integration. A definition of air ground integration was provided in order to outline the framework for analysis. An outline of U.S. Joint and Army doctrine, the organizations within the BCT that are responsible for air ground integration, and the materiel systems used to conduct air ground integration were provided. Analysis of each component based upon the evaluation criterion of consistency, simplicity, and synchronized determined how efficient the BCT can conduct air ground integration. The analysis of doctrine, organization, and materiel provided an answer to the primary research question: Yes, the U.S. Army Brigade Combat Team can conduct efficient air ground integration with the current doctrine, organization and materiel, although issues still remain with a common definition, simplifying the uses of ACMs, and increasing the real-time situational awareness of air operations to increase synchronization. The next chapter will provide conclusions, recommendations, and topics for future research relating to air ground integration.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

## Conclusions

This thesis set out to answer the primary research question, Can the U.S. Army Brigade Combat Team conduct efficient air ground integration with the current doctrine, organization, and materiel? In order to answer this question several secondary questions were answered: what is air ground integration, how does U.S. Joint and Army doctrine guide the integration of air and ground operations, what is the organizational structure within the BCT that is responsible for air ground integration, and what materiel systems enable air ground integration and how are they used? The doctrine, organization, and materiel were evaluated to see if they were consistent, simple, and synchronized to determine if the BCT can conduct efficient air ground integration.

### What is Air Ground Integration?

A definition of air ground integration does not exist in current doctrine, and this causes confusion when discussing the topic. Depending on the context of the discussion, air ground integration can focus solely on Army aviation assets, or just airspace control. For the purposes of this study air ground integration is defined as the process of arranging air and ground forces, and their actions, to create a force that operates by engaging as a whole in order to achieve a common objective. Key to achieving full integration air and ground operations must be synchronized to operate simultaneously, and airspace control must provide the necessary safeguards to prevent fratricide, while still maximizing the effectiveness of aircraft and fires. In order to conduct efficient air ground integration, the

U.S. Army BCT must be able to synchronize operations and conduct airspace control throughout the operations process, which includes: planning, preparing, executing, and assessing operations.

## Doctrine

Analysis of doctrine identified that U.S. Joint and Army doctrine are consistent and synchronized. Definitions and processes for synchronizing air and ground operations, and conducting airspace control are consistent throughout the Army Air Ground System (AAGS). Joint and Army doctrine stress the importance of the proper mix of procedural and positive control of airspace, and the interaction of the AAGS and Theater Air Control System (TACS) provides the necessary mechanisms to conduct both types of control. The AAGS and TACs interaction provides effective liaison between the Army and Air Force to coordinate and synchronize air operations and fires. This interaction facilitates synchronizing air and ground forces throughout the operations process. U.S. Joint and Army doctrine is consistent and synchronized which enables the Army BCT to conduct efficient air ground integration.

Doctrine is clear and the interaction between the AAGS and TACS is easy to understand, but the number of airspace coordinating measures (ACMs) used to conduct procedural control is cumbersome and requires review. The complexity of the current set of ACMs is overcome by extensive training and experience, and the BCT can still perform procedural control of airspace. Current doctrine is simple in outlining the structure of the AAGS and how the various elements interact, and the complexity of ACMs does not have a negative impact on conducting air ground integration. Overall U.S. Joint and Army doctrine enables efficient air ground integration.

## Organization

The organizational structure responsible for air ground integration within the BCT is consistent, simple, and enables synchronization. The ADAM/BAE Cell, Fires Cell, and TACP are the primary staff cells responsible conducting airspace control, and synchronizing air and ground operations to achieve the commander's intent. Every echelon of the AAGS has similar organization, and includes Air Defense, Fires, and Aviation personnel responsible for airspace control and coordinating air assets to support ground operations. Current doctrine clearly outlines the roles and responsibilities of each cell and how they interact within AAGS structure. By combining the ADAM/BAE Cell, Fires Cell, and TACP into a Brigade Air Ground Integration Cell (BAGIC) the BCT can more effectively synchronize fires, and air and ground forces to achieve the BCT commander's intent. The organization of the BCT enables efficient air ground integration.

## Materiel

The materiel systems within the BCT are consistent and simple, but require additional development to fully synchronize operations during execution. The primary systems within the BCT include the Tactical Airspace Integration System (TAIS), Air Defense Systems Integrator (ADSI), Air and Missile Defense Workstation (AMDWS), Advanced Field Artillery Tactical Direction System (AFATDS), and Forward Area Air Defense (FAAD) system. These systems are interoperable with the other Army mission command systems, and the Air Force's Theater Battle Management Core System (TBMCS) which enables the BCT to display a common operating picture (COP) of both air and ground operations. The COP provides near-real-time situational awareness to the

BCT commander and staff. The ability of the BCT to fully synchronize air and ground operations is limited by the delay in positional reporting of the BFT-A, as well as a lack of low-altitude radars providing tracks of low flying aviation assets. This lack of fidelity of the air picture at lower altitudes requires more conservative procedural control, and forces the BCT to deconflict airspace instead of achieving full integration. Overall the materiel systems within the BCT enable efficient air ground integration.

## Recommendations

This study identified several issues with the doctrine, organization, and materiel that require further action or study. Recommendations for action include: developing a formal definition for air ground integration, reducing the number of ACM types and usages, and increase the positional data accuracy of aircraft. Recommended topics for further study include: how to better train air ground integration within the BCT, personnel policies that make assignments to the ADAM/BAE Cell an important part of career progression for Air Defense and Aviation officers, and what facilities are needed to train airspace control during homestation training.

### Formal Definition of Air Ground Integration

This study provided a definition of air ground integration in order to clarify the meaning of the term, and outline the processes associated with the topic. A formal definition in U.S. Joint and Army doctrine is necessary to provide a clear understanding of what air ground integration is, and aid in solving many of the issues identified over the last ten years of persistent conflict. A Joint definition is required since air ground integration requires coordination and synchronization across U.S. military services.

Finally, a formal definition will aid future research and working groups by narrowing the focus of study, and provide a framework to help solve current and future issues with air ground integration.

### Simplify the Number of Airspace Coordinating Measures

There are too many types and uses of ACMs in current doctrine, and this complicates how organizations conduct procedural control of airspace. This issue is under review by the Air Land Sea Application Center, and continued work on streamlining the number of ACMs will continue over the next several years (Roberts, Schafer, and Pope 2012, 5). Distilling the number of ACMs down to the essential types will help airspace control agencies and airspace users understand the graphic display of the Airspace Control Order (ACO) on their digital systems, and reduce confusion. Since the Army relies primarily on procedural control of airspace, reducing the number of ACMs will decrease complexity and help increase the ability of the BCT to conduct efficient air ground integration.

### Increase Positional Data Accuracy of Aircraft

The inaccuracy of the positional tracks of aircraft displayed in TAIS and the AMDWS requires operators to interpolate track data to predict where aircraft are actually located. This process requires operators to request large ACMs to protect airspace users, and focuses on deconfliction rather than integration. By increasing the accuracy and timeliness of aircraft self-reporting positional data, airspace control agencies and other airspace users will have more real-time situational awareness. Equipping Army Aviation assets with Link-16 capabilities will increase positional data accuracy, and allow all

subscribers to identify aircraft locations. If Link-16 capabilities are not feasible, then increasing the rate of positional reporting through BFT-A is required. Finally, increased numbers of Sentinel radars, or similar systems, is required to track aircraft at lower altitudes. This tracking ability is particularly important in complex terrain when line-of-sight becomes an issue, and limits the range of radars. The ability of the BCT to have real-time positional data of aircraft will allow the BCT to fully integrate air and ground operations.

### How to Better Train Air Ground Integration

A topic for future research is how to better train air ground integration. Many issues identified while researching this thesis identified a lack of training of personnel assigned to the ADAM/BAE Cell. Many Soldiers did not receive any training on airspace control prior to being assigned to the ADAM/BAE Cell, and did not understand the principles of airspace control, how the materiel systems worked, and how to plan, coordinate, or manage airspace. Combat Training Centers identify that the ADAM/BAE Cell does not train together prior to arriving at the training centers, and lack standard operating procedures on how to plan and execute air ground integration. A comprehensive study on how to train air ground integration is needed.

### Personnel Policies for ADAM/BAE

Another topic for future research is what personnel policies will make the ADAM/BAE Cell an important assignment for Air Defense and Aviation personnel. Research conducted by the U.S. Army Aviation Center of Excellence identified issues with how personnel view the assignment to the ADAM/BAE Cell. Personnel do not see

the assignment as important to career progression, and have a generally negative view on being assigned to the ADAM/BAE. Additional research is required to identify appropriate personnel policies to make the positions within the ADAM/BAE Cell a career enhancer, and to reward good performance.

### Facilities for Homestation Training

Training air ground integration is a complex issue, and requires a large amount of resources. Quality training requires interaction with airspace users, and Army and Joint airspace control elements. Research is needed to identify what facilities are needed to incorporate all organizations that are involved in air ground integration, while maximizing the resources available to units during homestation training. Advances in communications and simulations equipment offer potential solutions to problems with conducting live air ground integration training.

## Summary

This thesis identified that the current doctrine, organization, and materiel within the Armored Brigade Combat team is consistent, simple, and synchronized. A definition of air ground integration was provided, and recommendations were made to simplify the doctrine associated with airspace coordination measures, and increase the accuracy of positional data reporting of aircraft. This study concluded that the U.S. Army Brigade Combat Team can conduct efficient air ground integration with the current doctrine, organization, and materiel.

# GLOSSARY

Air Ground Integration. The process of arranging air and ground forces, and their actions, to create a force that operates by engaging as a whole in order to achieve a common objective. (Author's Definition)

Airspace Control. A process used to increase operational effectiveness by promoting the safe, efficient, and flexible use of airspace. (JP 3-52)

Airspace Coordinating Measure. Measures employed to facilitate the efficient use of airspace to accomplish missions and simultaneously provide safeguards for friendly forces. (JP 3-52)

Mission Command. The exercise of authority and direction by the commander using mission orders to enable disciplined initiative within the commander's intent to empower agile and adaptive leaders in the conduct of unified land operations. (ADP 6-0)

Positive Control. A method of airspace control that relies on positive identification, tracking, and direction of aircraft within an airspace, conducted with electronic means by an agency having the authority and responsibility therein. (JP 3-52)

Procedural Control. A method of airspace control which relies on a combination of previously agreed and promulgated orders and procedures. (JP 3-52)

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