

# **Organizational Concepts for the Sensor-to-Shooter World**

## **The Impact of Real-Time Information on Airpower Targeting**

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## Abstract

The term real-time information into the cockpit (RTIC) involves systems capabilities required to provide aircrews timely and essential off-board information to allow mission adjustments in response to rapidly changing combat conditions. The term military technical revolution (MTR) requires converging technological products which have a demonstrated military utility, and military recognition that the application of these converging technologies will cause a radical change in the character of warfare over a very short period of time.

RTIC does not foreshadow a coming MTR although it does employ converging technological products which have a demonstrated military utility. RTIC is not likely to cause radical change to the character of warfare. Nonetheless, it improves a commander's ability to employ operational art—to employ military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles.

This thesis assesses the capabilities of RTIC from two perspectives: its impact on the air tasking process, and the command and control flexibility it affords the joint force air component commander (JFACC). It concludes that the impact on the air tasking process is evolutionary, not revolutionary—current RTIC capabilities remain largely dependent on human-intensive operations which limit reductions in decision cycle times. It further suggests that RTIC's true impact on targeting is directly attributable to the increased flexibility provided to the JFACC for prosecuting the execution-day air tasking order.



## About the Author

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## Acknowledgments

The advice, admonition, assistance, cajoling, instruction, and guidance of several groups and individuals were indispensable as I attempted to turn questions regarding sensor-to-shooter capabilities into answers regarding sensor-to-shooter employment. I thank Majors Zigfried J. “Ziggy” Dahl, Guido Hawks, and the members of the Talon Shooter Team at the Space Warfare Center for enlightening my understanding of both the capabilities and possibilities of real-time information into the cockpit. Further thanks go to Lt Col Bob Schloss with the CENTAF Air Operations Center (AOC) staff who augmented my book knowledge on the activities of combat plans and combat operations with actual experience in a functioning AOC. I also express my gratitude to Lt Col John Cowen at the US Space Command’s Combined Intelligence Center. His patient instruction on the transformation of US reconnaissance data into cockpit-useable information was excellent.

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## Chapter 1

# Introduction

Due to battlefield dynamics, the JFACC/JFC (Joint Force Air Component Commander/ Joint Force Commander) may be required to make changes to the planned joint air operations during execution.

—Joint Pub 3-56.1, Command  
and Control for Joint Air  
Operations

**Today's Situation.** U-2 signals intelligence equipment picks up an active enemy air defense radar. These signals cue the U-2's advanced synthetic aperture radar system to image the area. Data is sent to ground processing systems and three hours later,<sup>1</sup> the finished product arrives in the hands of the joint force air component commander (JFACC) at the air operations center (AOC). Evaluation of the images indicates fixed and mobile surface-to-surface Scud missile launchers in the area. The decision to attack the Scuds is passed from the JFACC to flights of F-15Es through the airborne command, control, and communications (ABCCC) aircraft. The fixed Scud launchers are destroyed, however, the mobile launchers had moved long before the F-15s arrived in the area.

**Tomorrow's Situation.** A defense support program (DSP) satellite identifies a ballistic missile launch. Coordinates of a launch ellipse are immediately data linked to an on-orbit RC-135 Rivet Joint. Rivet Joint sensors refine the launch coordinates in seconds. Precise coordinates are simultaneously transmitted to real-time information into the cockpit (RTIC) cell within the combat operations division (COD) of the AOC and to an orbiting joint surveillance target attack radar system (JSTARS) aircraft. JSTARS tracks the Scud launchers<sup>2</sup> as they move from their launch locations. Meanwhile, the RTIC cell identifies an adequately configured strike package en route to another target and redirects it to attack the launchers. The redirection uses both secure-voice transmissions to alert the affected crews and a direct data link to pass vital mission information. This mission information includes an updated flight route, current target-area weather, revised threat information along the new flight path, photographs of recently targeted Scud transporters-erectors-launchers (TEL) and continuously updated sets of latitude, longitude, and elevation for the moving TELs. Within minutes, the F-15s acquire radar contact with objects in the reported TEL location, use their low-altitude navigation and targeting infrared for night (LANTIRN) systems to visually identify the objects as Scud launchers,

and moments later, employ their weapons on the doomed targets—the strike is successful and once again the United States has transformed information into combat power.

Real-time information into the cockpit is a new buzzword in the Air Force vernacular. Along with its parent phrase, sensor-to-shooter, RTIC deals with the “systems capabilities required to provide aircrews timely and essential off-board information to allow mission adjustments in response to rapidly changing combat conditions.”<sup>3</sup> The essence of RTIC is flexibility, and flexibility is a tenet of airpower equal with centralized control.<sup>4</sup> At issue is the synergy that arises from the application of RTIC technology in an environment of centralized command. More specifically, the RTIC flexibility made possible by current technologies combined with the unity of command embodied in today’s JFACC has matured sufficiently to warrant changes to the existing command and control (C<sup>2</sup>) architecture laid out in Air Force and joint doctrine.

This thesis explores organizational concepts for an RTIC environment that is available today. Its focus is on increasing JFACC flexibility by applying real-time information to airpower targeting. A look at the air tasking process as established in current joint doctrine<sup>5</sup> and employed during the Gulf War provides the foundation for this analysis of near-term RTIC possibilities. It also helps set the boundaries of what this thesis is as well as what it is not. It is an examination of C<sup>2</sup> organizational architectures that could be employed near term (i.e., well within a decade). As such, it explores RTIC as a capability that supplements the air tasking process but does not replace it. It is oriented toward, though not confined to, air-to-ground actions performed by limited sets of weapon platforms<sup>6</sup> operating beyond the close battle. Additionally, it is a reaffirmation of the value of unity of airpower command<sup>7</sup> employed by today’s JFACC. It is not a proposal to rewrite essay M, “Tenets of Aerospace Power”<sup>8</sup> in volume 2 of Air Force Manual (AFM) 1-1, Basic Aerospace Doctrine of the United States Air Force as De-Centralized Control/Decentralized Execution; rather, it is an investigation aimed at enhancing the airpower flexibility available in an appropriately C<sup>2</sup> architecture.

The centralized control and decentralized execution of the Gulf War air campaign—its planning, tasking, and execution of an average 2,847 sorties per day<sup>9</sup>—worked well. Though not error free, the C<sup>2</sup> team from the JFACC, Lt Gen Charles A. Horner, through the tactical air control system (TACS)<sup>10</sup> “spectacularly outperform[ed] the best team of leaders Iraq could put in the field.”<sup>11</sup> Why do we have a JFACC today, and why did the JFACC C<sup>2</sup> concept work so well in the Gulf War? The JFACC concept is largely a response to the numerous tactical victories and strategic defeat experienced in Vietnam. Lack of unified command in air operations in Southeast Asia was arguably a key consideration leading to the JFACC concept as outlined in the Goldwater-Nichols Act,<sup>12</sup> JCS Pub 26, Joint Doctrine for Theater Counterair Operations,<sup>13</sup> and the current Joint Pub 3-56.1, Command and Control for Joint Air Operations.<sup>14</sup> Refinement of the JFACC concept came to fruition in Desert Storm. General Horner’s command and control was effective for a

number of reasons. The capability of General Horner's tactical air control system to convert joint force commander (JFC) guidance into explicit aircraft missions was a principal reason. More precisely, the tactical air control center's<sup>15</sup> ability to control the sorties in today's war while coordinating the specific missions for tomorrow's war was crucial to the success of the JFACC command and control.

Although it can be argued that the current C<sup>2</sup> approach to airpower has not been stressed, it seems to be a logical extension of the theoretically and historically sound tenet of centralized control. Today's notional JFACC fights the air portion of the theater campaign primarily through his AOC<sup>16</sup> which disseminates targeting and other guidance via the air tasking order (ATO).<sup>17</sup> The combat operations division of the AOC, through a number of channels, can add, delete, or modify missions on the current-day ATO. Combat operations may add or delete sorties through direct unit contact. They may alter airborne missions through ABCCC or airborne warning and control system (AWACS) aircraft.

RTIC offers a much-improved ability to modify missions and a correspondingly enhanced C<sup>2</sup> flexibility for the modern JFACC. US reconnaissance and sensor capabilities are tremendous. Likewise, US information processing and information flow capabilities are extraordinary and available, though many are not yet operational. These sensor and information transfer capabilities tied with current fighter and weapons technologies offer capabilities to today's JFACC that were only imagined by the warriors of Desert Storm. They can provide an advantage in "observation-orientation-decision-action" (OODA)<sup>18</sup> cycle times over any available to potential adversaries. An appropriate C<sup>2</sup> architecture, however, is needed to fully exploit the capabilities presented by RTIC.

This thesis provides a three-pronged analysis to identify an organizational structure that can properly engage RTIC possibilities and take full advantage of the impact that real-time and near-real-time (NRT) information into the cockpit can have on airpower targeting. The first two portions of this analysis explore the current air tasking process and describe the capabilities of today's sensors, information processing, data links, and shooters. The third segment examines a fusion of the two.

Chapter 2 examines the current air tasking process. An understanding of joint air operations development, plans and the planning process, targeting, the air tasking cycle, and the command, control, communications, computers, and intelligence (C<sup>4</sup>I) requirements necessary to link these together provides the foundation for further RTIC analysis. Understanding today's air tasking process in the context of AOC operations provides a basis for exploring JFACC flexibility needs, and presents one-half of the background needed to understand the potential offered by RTIC.

Chapter 3 explores the second half of this background—current capabilities. It provides descriptions of current US reconnaissance systems and information transfer abilities. This section describes several recent demonstrations of sensor-to-shooter capabilities that bear directly on RTIC

organizational structures. It presents the nodes of the theater air control system—specifically, the reconnaissance sensors and weapon systems—and the C<sup>2</sup> structure that links these together to point out the potential of RTIC and the need for a revised C<sup>2</sup> architecture. The chapter closes by affirming the continuing need for centralized C<sup>2</sup> with decentralized execution.

Chapter 4 articulates the advantages gained by superimposing the sensor-to-shooter features described in the third chapter over portions of the current air tasking process detailed in the second chapter. It also defines organizational changes that will enable the supposed “real-time central control, coordination, and integration of ongoing air operations” (emphasis added)<sup>19</sup> ascribed to the Gulf War to actually take place in real time.

Finally, chapter 5 moves slightly beyond the thesis’s self-imposed confines laid out in the beginning of this chapter and briefly looks at RTIC architecture possibilities beyond the near-term future.

#### Notes

1. Capt Daniel E. Johnson, operations officer, Combined Imagery Exploitation Facility (CIEF), US Space Command; Warrant Officer Michael E. Waliohn, Canadian Forces CIEF NCOIC; and TSgt David A. Grubbs, CIEF Team B Exploitation NCOIC; interviewed by author, Combined Intelligence Center, Peterson AFB, Colo., 4–5 April 1996. The significance of this time is that it is measured in hours, not seconds or minutes. Three hours represents a realistic period for processing and transmitting U-2 material. Actual processing times, however, are classified.

2. Craig Covault, “Joint-STARS Patrols Bosnia,” *Aviation Week & Space Technology*, 19 February 1996, 48–49; and Maj Christopher H. Frasier, 11th Space Warning Squadron, Falcon AFB, Colo., interviewed by author, 4 January 1996. JSTARS combines synthetic aperture radar imaging with moving target indicator data to provide high resolution radar images. This allows JSTARS crews to differentiate between stopped vehicles and moving traffic. Furthermore, crews can determine whether vehicles are wheeled or tracked by measuring Doppler signatures from the advancing and receding treads of individual vehicles. Current Bosnian missions use such high resolution radar images to typically scan areas as small as 2 x 4 kilometers (1.2 x 2.5 nautical miles) in size. DSP and Rivet Joint-supplied coordinates of a Scud launch ellipse allow JSTARS crews to focus their efforts in such a small area and track specific vehicles found within this area.

3. *Combat Air Forces Mission Need Statement 315-92*, Mission Need Statement for Real-Time Information in the Cockpit (RTIC), 26 April 1994.

4. *Air Force Manual (AFM) 1-1*, Basic Aerospace Doctrine of the United States Air Force, vol. 1, March 1992, 8.

5. *Primarily Joint Pub 3-56.1*, Command and Control for Joint Air Operations, 14 November 1994.

6. Cost considerations immediately negate any notion of all fighter, bomber, and attack aircraft being fully equipped to perform RTIC missions—those requiring off-board voice and data information for retargeting. Much of the RTIC capability available in the near term is oriented toward multiseat aircraft employing precision guided munitions (PGM), or single-seat PGM-capable aircraft that remain survivable at medium to high altitude in all threat environments. RTIC capabilities allowing workloads that do not compromise pilot safety during low-altitude, high-threat missions that may entail PGM retargeting will likely be unavailable in the near term. F-15E, F-117, and PGM-capable B-1 and B-2 aircraft would be well suited for RTIC missions.

7. This is a slight adaptation of the unity of command principle of war, defined as “Ensuring unity of effort for every objective under one responsible commander,” found in AFM 1-1, vol. 1, 1.

8. AFM 1-1, vol. 1, 8.

9. Gulf War Air Power Survey, vol. 1, Planning and Command and Control (Washington, D.C.: Government Printing Office, 1993), pt. 2:7. Hereafter cited as GWAPS.

10. TACS now referred to as the theater air control system.

11. GWAPS, 329.

12. Formally titled, “The Department of Defense Reorganization Act of 1986.”

13. JCS Pub 26, Joint Doctrine for Theater Counterair Operations, resulted from a joint doctrine pilot program established in 1982 by the Joint Chiefs. In 1985, the commander in chief of the European Command (CINCEUR) formally submitted to the chiefs a joint doctrine for theater counterair operations. One element of this proposed doctrine was the concept of the JFACC, an officer appointed by the theater or JFC to plan and coordinate a jointly fought air campaign. On 21 February 1986, the chiefs approved CINCEUR’s proposal as JCS Publication 26.

14. Joint Pub 3-56.1 provides fundamental principles and doctrine for the command and control of joint air operations throughout the range of military operations. It lays out JFACC responsibilities and a notional JFACC organization.

15. The TACC of the Gulf War is today’s air operations center (AOC).

16. AOC, joint AOC, or combined AOC.

17. The acronym ATO is used throughout this thesis to represent the air tasking order as used during Operation Desert Storm as well as tasking directives such as the integrated tasking order used by US forces, Korea, and the air tasking message used during Operation Deliberate Force in Bosnia.

18. Col John R. Boyd, “A Discourse on Winning and Losing,” a collection of unpublished briefings and essays (Maxwell AFB, Ala.: Air University Library, August 1987), Document No. M-U 30352-16, no. 7791, 2; and Maj David S. Fadok, John Boyd and John Warden: Air Power’s Quest for Strategic Paralysis (Maxwell AFB, Ala.: Air University Press, February 1995), 16. Colonel Boyd contends that all rational human behavior, individual or organizational, can be depicted as a continual cycling through four distinct tasks—observation, orientation, decision, and action. Boyd refers to this decision-making cycle as the OODA loop. Using this construct, the crux of winning vice losing becomes the relational movement of opponents through their respective OODA loops. The winner will be whomever repeatedly observes, orients, decides, and acts more rapidly (and accurately) than the enemy.

19. GWAPS, 139.

## **Chapter 2**

# **The Air Tasking Process Today**

The campaign objective, together with its relationships to strategic and tactical objectives, is the paramount consideration in every campaign. . . . Orchestration of aerospace missions into an effective campaign in the face of peculiar and often rapidly changing situations comprises the airman's operational art.

—Air Force Manual 1-1,  
Basic Aerospace Doctrine of the  
United States Air Force, Volume 1

The air tasking process begins with planning at the strategic level. Strategic objectives connect to tactical force employment through planning at the operational level which focuses on operational art—the employment of military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles.<sup>1</sup> This process concludes at the tactical level with the employment of units in combat.

Knowledge of five areas within this overarching air tasking process is critical to an understanding of the full process (fig. 1). First, the overall concept of joint air operations development involves the translation of the joint force mission into a joint air operations plan. Second, this plan and the planning process encompass research into the operational environment, the determination of objectives, the identification of a clearly defined strategy, and an assessment of center(s) of gravity (COG). Third, a joint targeting process matches the objectives and guidance promulgated in the JFACC's plan with inputs from intelligence and operations personnel to select specific targets and target sets and to identify the forces needed to achieve desired objectives against those targets. Fourth, a joint air tasking cycle provides for the effective and efficient employment of available air assets. Fifth, appropriate command, control, communications, computers, and intelligence (C<sup>4</sup>I) resources provide the connectivity to ensure the air tasking process is not simply a linear process, beginning with the JFC's theater campaign plan and ending with bombs on target, but a cyclical one involving constant feedback and continuously updated taskings. Further discussion of these five areas will clarify the air tasking process in total.

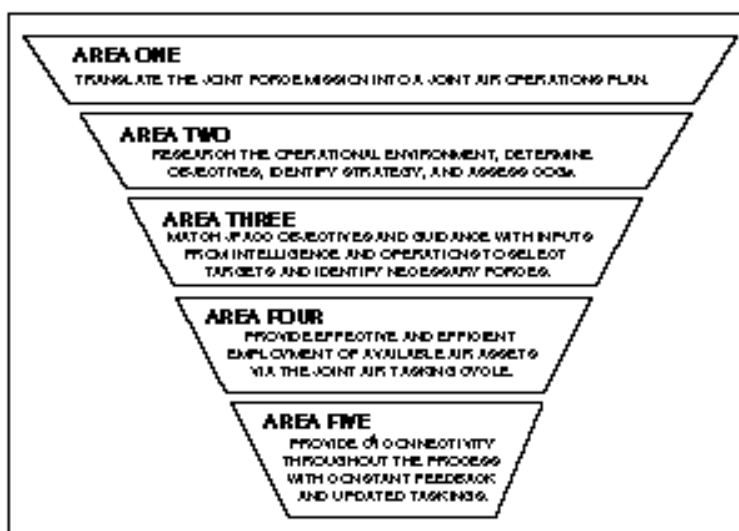


Figure 1. The Air Tasking Process

## Concept of Joint Air Operations Development

Planning for joint air operations begins with understanding the joint force mission.<sup>2</sup> The JFC's mission statement expresses what the joint force must accomplish and why. It is the driving force for all detailed planning that follows and is based on the commander's strategic appreciation of the various factors—political, economic, military, and social—affecting his area of responsibility (AOR).<sup>3</sup> It is also the articulation of the strategic and operational objectives needed to accomplish the mission and forms the basis for determining components' objectives.

The JFACC uses the JFC mission, strategic appreciation, and objectives to devise an estimate of the situation and an appropriate concept of air operations. This concept of air operations bridges the gap between JFC-delineated objectives and the formulation of a course of action (COA). When the JFACC's COA is approved by the JFC, it becomes the basic concept for subsequent air operations and states what will be done. The how is laid out in the joint air operations plan and supporting plans such as the master air attack plan (MAAP), the air defense plan, and the airspace control plan. The JFACC provides daily guidance to the AOC to ensure air operations effectively support the joint force objectives while retaining sufficient flexibility to adjust to the dynamics inherent in military operations. AOC personnel use this guidance to continually refine the MAAP and supporting orders, specifically, the air operations order, the airspace control order, and the air tasking order. The ATO provides the primary vehicle for disseminating the who, when, and where of joint air operations while the AOC maintains responsibility for updates and revisions to the current-day, or



execution-day, ATO. This ATO, however, is not the plan, but one product in the air operations planning process.

## **Joint Air Operations Plans and the Planning Process**

The JFC normally assigns a JFACC responsibility for joint air operations planning.<sup>4</sup> The JFACC, in turn, develops a joint air operations plan to employ that portion of the air effort made available to him for accomplishing the JFC's objectives. This plan documents the JFACC's scheme for integrating and coordinating joint air operations.

Five phases—operational environment research, objective determination, strategy identification, COGs identification, and the joint air operations plan development—make up the normal joint air operations planning process. Though the phases are not required to be completed in order, each phase produces an end product, and at some point, the phases must be integrated and the products of each phase must be verified for coherence. The final product is the joint air operations plan which details how joint air operations integrate with and support the JFC's theater campaign plan.

Operational environment research applies Sun Tzu's dictum: "Know the enemy and know yourself; in a hundred battles you will never be in peril."<sup>5</sup> Today's phrase for Sun Tzu's maxim, and the product of this phase, is intelligence preparation of the battle space (IPB). Operational environment research, like IPB, focuses on gaining information about both friendly and enemy capabilities, intentions, and doctrine, and the environment in which the operations will take place in order to reduce uncertainties. Its intent is to maximize understanding of the opponent, the theater of operations, and the friendly forces available to accomplish the JFC's objective.

Objective determination is arguably the most crucial of the five phases. Clearly defined and quantifiable objectives that contribute to the accomplishment of the JFC's operation result from this phase. These joint air objectives flow from the JFC's objectives and should complement other components' objectives. More than land and maritime power, airpower in conjunction with the exploitation of space-based systems can directly impact the strategic level of war and can do so in an integrated or independent manner, simultaneously or sequentially. The air objectives at each level must support the objectives of the higher level and ultimately support the JFC's objectives to ensure unity of effort.

Strategy identification produces a clearly defined joint air strategy statement. The strategy states how the JFACC plans to exploit joint air capabilities and forces to support the theater objectives of the JFC. The joint air operations plan is how the JFACC communicates, promulgates, and articulates this strategy.

Center(s) of gravity identification is noted in two definitions. Carl von Clausewitz defines COGs as "the hub of all power and movement, on which

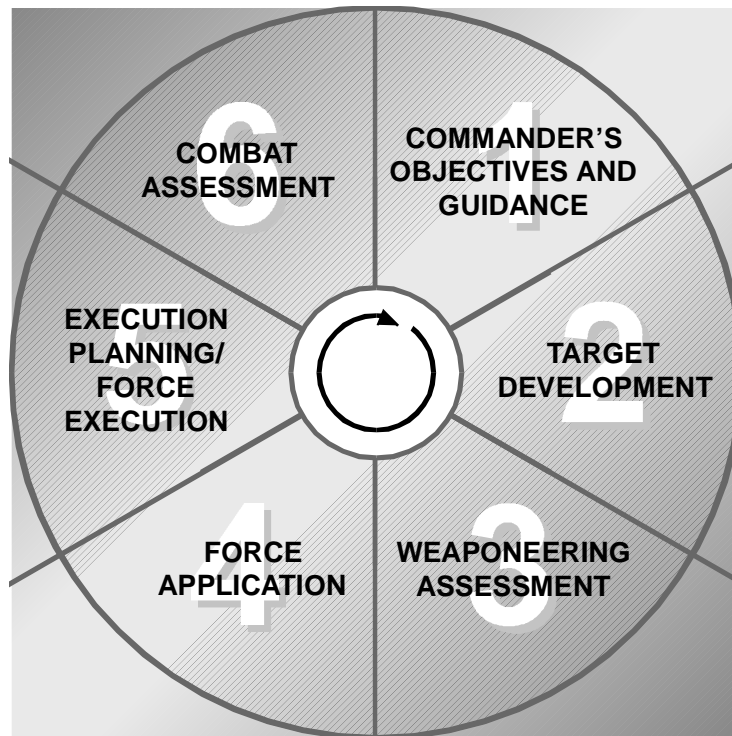
everything depends. . . . the point against which all our energies should be directed.”<sup>6</sup> Joint Pub 1-02 updates the definition slightly stating that centers of gravity are “those characteristics, capabilities, or localities from which a military force derives its freedom of action, physical strength, or will to fight.”<sup>7</sup> Both definitions point to the desired product of this phase—the identification of those enemy COGs that could be defeated to satisfy the JFC’s strategic, operational, and tactical objectives and those friendly COGs to be defended. The COGs of interest to the JFC and JFACC are those that, if defeated, may have the most decisive results. Airpower has a unique ability to attack many of the COGs from the third dimension throughout the AOR, to engage target sets associated with each COG, and to engage these targets simultaneously as well as sequentially.

Joint air operations plan development delivers the actual air operations plan detailing how joint air operations support the JFC’s campaign plan. This plan is based on JFC guidance. It integrates the air effort in achieving JFC objectives. It accounts for current and potential enemy offensive and defensive threats. The plan indicates necessary phasing of air operations in relation to the JFC’s operational phasing and in relation to specific air phases. The plan identifies objectives and targets by priority order, describing the order in which they should be attacked, the desired results, and the weight of effort required to achieve expected results. It details the capabilities and forces needed to achieve the previously determined objectives and also accounts for systems analysis to identify specific targets that should be reattacked to meet the objectives.

## **Targeting: The Process and Responsibilities**

Joint Pub 3-0, Doctrine for Joint Operations, describes targeting as “the process of selecting targets and matching the appropriate response to them taking account of operational requirements and capabilities.”<sup>8</sup> This straightforward definition is simple, but hardly complete. Targeting is certainly not the linear process these few words seem to indicate. Rather, it is a cyclical process that operates in the context of friendly requirements and capabilities as well as the threats imposed by the adversary. The cycle begins with JFC-provided guidance and priorities, and continues with the identification of component requirements, the prioritization of these requirements, and the acquisition of targets or target sets. It continues with actual target attack, and comes full circle with component and JFC assessments of the attacks which provide feedback within the cycle, adding guidance for future targeting plans. In essence, the continuous targeting cycle moves from objectives and guidance and proceeds through execution and combat assessment (fig. 2).<sup>9</sup>

Targeting matches inputs from intelligence and operations personnel to JFC guidance and objectives. Together, this input-guidance mix leads to the



Source: Joint Pub 3-56.1, 14 November 1994, IV-1

Figure 2. Targeting Cycle Phases

selection of specific targets and the identification of those forces necessary to achieve the desired objectives against those targets.

The JFC may establish and task an organization within staff personnel to accomplish broad targeting oversight functions or may delegate the responsibility to a subordinate commander (e.g., the JFACC). Typically, the JFC organizes a joint targeting coordination board (JTCB),<sup>10</sup> which operates at the discretion of the JFC who defines its role. It may be an integrating center for the targeting effort or it may serve as a JFC-level review mechanism. Typically, the JTCB reviews target information, develops targeting guidance and priorities, and may prepare and refine joint target lists. The JTCB maintains a macrolevel view of the AOR and ensures targeting nominations are consistent with the JFC's campaign plan. Likewise, it maintains a complete list of restricted targets, areas where special operations forces are operating, and similar areas in need of deconfliction to avoid endangering current and future operations.

The JFC normally delegates the authority for execution planning, coordination, and deconfliction associated with joint air targeting to the JFACC. It, in turn, must possess a sufficient C<sup>2</sup> infrastructure in both personnel and equipment. Furthermore, targeting mechanisms dealing with detailed planning, weaponing, and execution are required at the component level to facilitate this targeting process.

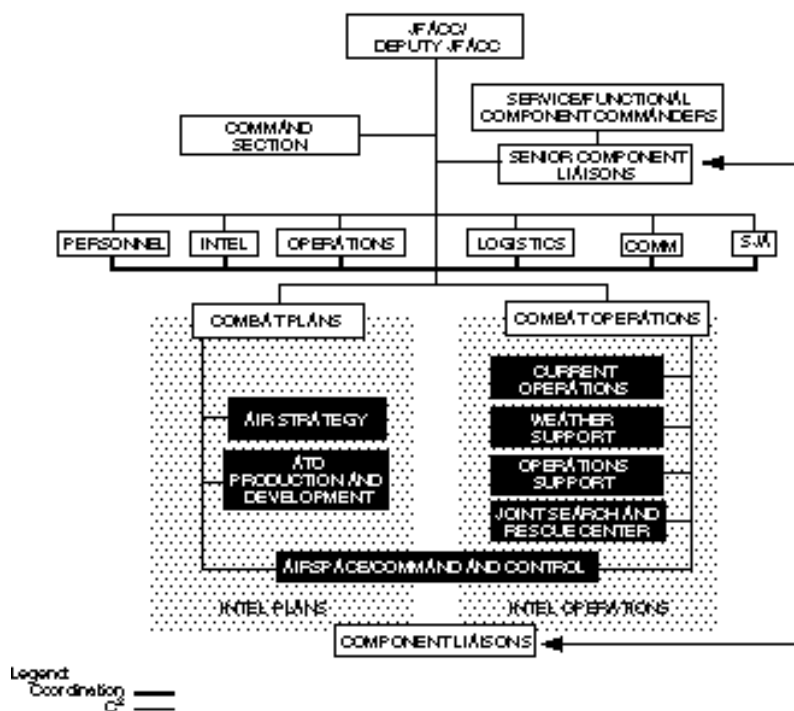
Synchronization, integration, deconfliction, allocation of forces, and weaponeering—matching weapons against target vulnerabilities—are essential targeting functions for the JFACC and his staff. All components are normally involved in targeting and should establish procedures and mechanisms to manage the targeting function.”<sup>11</sup> Targets scheduled for deliberate attack by component direct support air capabilities/forces should be included in the joint ATO, when appropriate, for deconfliction and coordination. . . . Therefore, components should provide the JFACC a description of their direct support plan through the liaison elements within the JAOC.”<sup>12</sup> This allows for both coordination and deconfliction between each component and within the JFC staff and the JFACC C<sup>2</sup> infrastructure.

Two other specific targeting responsibilities outside the planning, coordinating, allocating, synchronizing, and deconfliction previously discussed are listed in joint doctrine as JFACC/JFC staff targeting responsibilities.<sup>13</sup> The first is to monitor execution and redirect joint air operations as required. The second instructs the JFACC or JFC staff to direct alert joint air capabilities/forces for prosecution of real-time targets in support of joint forces. Each has a direct bearing on sensor-to-shooter operations. Both occur in the execution planning/force execution targeting cycle phase and are the ultimate responsibility of the AOC’s combat operations division.

## **The Joint Air Tasking Cycle**

To effectively employ the available joint air assets, the JFACC uses a joint air tasking cycle. This repetitive process involves six phases to plan, coordinate, allocate, and task joint air missions. Phase one, JFC and component coordination, produces JFC guidance. Phase two, target development, results in the creation of a joint integrated prioritized target list (JIPTL). Phase three, weaponeering and allocation, furnishes the MAAP. Phase four, ATO development, generates the ATO and its associated special instructions (SPINS). Phase five, force execution, leads to combat results. In turn, phase six, combat assessment, provides recommendations back to the coordination step in phase one.

This notional air tasking cycle accommodates changing tactical situations, revised JFC guidance, and support requests from other component commanders. Its phases are very much related to the targeting phases depicted in figure 2. In both cases the approach is the same, a systematic process matches available forces with targets to achieve operational objectives. The JFACC’s air operations center provides the central C<sup>2</sup> structure for accomplishing the planning, developing, and coordinating of the air tasking cycle. Figure 3 shows a notional AOC. Two divisions form its core: combat plans and combat operations. Combat plans is responsible for planning future air operations which includes the responsibility of drafting the joint air operations plan to support the JFC’s theater campaign and



Source: Joint Pub 3-56.1, 14 November 1994, II-6

Figure 3. Notional JFACC Organization (the air operations center)

building the daily ATO.<sup>14</sup> Execution of the daily ATO is carried out by combat operations,<sup>15</sup> which closely follows current air operations by shifting missions from their scheduled times or targets and making other adjustments as the situation requires.”<sup>16</sup>

Both combat operations and combat plans are integral to the development and execution of the ATO. There are usually three ATOs in the air tasking cycle at any time: the current or execution-day ATO (today’s plan), the ATO in production (tomorrow’s plan), and the ATO in planning (the following day’s plan). This standard planning arrangement accordingly follows a three-day or 72-hour cycle. Combat plans is responsible for planning future air operations. It normally develops the air operations strategy and air apportionment recommendation and produces the ATO in coordination with the combat intelligence division. It supports the ATO development process with information on the adversary’s current and future force structure, capabilities, and intentions. Combat operations is responsible for monitoring and executing current air operations. It normally assumes responsibility for the ATO when it is released.

The air tasking phase specifically critical to the combat operations division is phase five, force execution. Real-time flexibility is at a premium during this phase. The JFACC, through the combat operations division of the AOC, directs the execution and deconflicts all forces made available by the JFC for

the execution-day ATO. Combat operations must be responsive to required changes during ATO execution. In-flight reports, initial battle damage assessment (BDA), significant weather changes, changing priorities, mission aborts, and the identification of time-sensitive targets<sup>17</sup> may prompt the redirection or retasking of forces before launch or once airborne. During ATO execution, combat operations serves as the central agency for revising the tasking of individual missions and force packages. It has the attendant charge to coordinate and deconflict those changes with the appropriate control agencies or components. Current joint doctrine states that “ground or airborne command and control platform mission commanders may be delegated the authority from the JFACC to redirect sorties/missions made available to higher priority targets as necessary.”<sup>18</sup>

### **Command, Control, Communications, Computers, and Intelligence (C<sup>4</sup>I)**

The speed and pace of battle and the agility of forces is continually increasing. The commander with the greater ability to evaluate the battlefield and expose and exploit an adversary’s vulnerabilities will have the greater chance to prevail.”<sup>19</sup> These truths were not penned by Sun Tzu or Clausewitz, but by the chairman, Joint Chiefs of Staff (CJCS), in his 1993 policy memorandum on C<sup>2</sup> warfare. Their veracity will likely persist for quite some time. TACS currently serves as the JFACC’s vehicle for rapid, agile exposition and exploitation of enemy vulnerabilities.

The TACS is the organization, personnel, procedures, and equipment necessary to plan, direct, and control theater air operations and to coordinate air operations with other services and allied forces.<sup>20</sup> It is the JFACC’s primary means of executing assigned duties. It provides the capability for centralized control while execution of operations is decentralized to the level that permits maximum responsiveness. The AOC, as the senior element of the TACS, has the capacity to display the current air and surface situation using data from all available sources. It maintains connectivity to various air and surface elements of the TACS. The AOC uses the contingency theater automated planning system (CTAPS) to produce and disseminate the ATO and manage its execution. Through the use of local and remote CTAPS terminals, the ground elements of the TACS have an instant computer interface capable of transferring time-sensitive operational and intelligence information. Similar information is passed from the AOC to air elements such as AWACS, ABCCC, and JSTARS via HF, VHF, UHF, SATCOM, tactical digital information links (TADIL), and other voice and data links.

This chapter illustrates the air tasking process as it stands today. Though the process works well, it could work better with the integration of RTIC technology and the incorporation of an appropriate C<sup>2</sup> organizational

architecture. The following chapter shifts the focus from current airpower command and control to current and near-term sensor-to-shooter capability.

### Notes

1. Joint Pub 5-0, Doctrine for Planning Joint Operations, 13 April 1995, I-2.
2. Joint Pub 3-56.1, Command and Control for Joint Air Operations, 14 November 1994, III-1.
3. AOR is defined in Joint Pub 1-02, Department of Defense Dictionary of Military and Associated Terms, 23 March 1994, as a defined area of land in which responsibility is specifically assigned to the commander of the area for the development and maintenance of installations, control of movement, and the conduct of tactical operations involving troops under the commander's control, along with parallel authority to exercise these functions." AOR is sometimes used synonymously with joint operations area and is defined as "that portion of an area of conflict in which a joint force commander conducts military operations pursuant to an assigned mission and the administration incident to such military operations."
4. Joint Pub 3-56.1, III-2.
5. Samuel B. Griffith, ed., Sun Tzu: The Art of War (London: Oxford University Press, 1971), 84.
6. Carl von Clausewitz, On War, ed. and trans. by Michael Howard and Peter Paret (Princeton, N.J.: Princeton University Press, 1989), 595–96.
7. Joint Pub 1-02, 63.
8. Joint Pub 3-0, Doctrine for Joint Operations, 1 February 1995, III-25.
9. Joint Pub 3-56.1, IV-1.
10. Joint Pub 3-0, III-26.
11. Ibid.
12. Joint Pub 3-56.1, IV-2-3.
13. Ibid., IV-3.
14. Ibid., II-7.
15. Ibid.
16. Ibid.
17. Time-sensitive targets are defined in Joint Pub 1-02 as "those targets requiring immediate response because they pose (or will soon pose) a clear and present danger to friendly forces or are highly lucrative, fleeting targets of opportunity."
18. Joint Pub 3-56.1, IV-11.
19. Chairman of the Joint Chiefs of Staff Memorandum of Policy No. 30, Command and Control Warfare, 8 March 1993, 4.
20. Air Combat Command Instruction 13-AOC, Operational Procedures—Air Operations Center, vol. 3, 1 June 1995, 16.

## Chapter 3

# Sensor-to-Shooter Capability

First, we must design our forces to collect all the information possible about potential adversaries. Second, we must shorten the time it takes the collected intelligence to reach the weapons system. Third, we must get the intelligence to the warfighter in a user-friendly format that allows the warfighter to employ weapons in a timely manner.

—Lt Col C. R. Davis, USAF  
Airborne Reconnaissance: The Leveraging  
Tool For Our Future Strategy

Effective employment of air-to-surface airpower has always required an ability to identify and locate targets. This is nothing new. From spies in enemy territory, to pilots' eyes, to airborne electromagnetic sensors, to space-based satellite reconnaissance systems, putting bombs on target to achieve tactical, operational, or strategic effects has relied on the process of converting sensed data into useful information—information that is necessary for planning and conducting combat operations from the air. Reconnaissance is naturally a primary element of this process. The remainder of this process involves both the data-to-information conversion and the movement of appropriately formatted information from the reconnaissance platform to the attacking weapon system.

Also not new is the quest for more rapid transmission of the sensed targeting information from the sensor to the shooter. Col John R. Boyd's<sup>1</sup> discussion of an observation-orientation-decision-action cycle or OODA loop in many ways reflects similar thoughts expressed by Carl von Clausewitz in his classic *On War*. These same thoughts were expressed by Lt Gen Howell M. Estes III, director for operations, JCS J-3. Seeing the enemy, taking action before the enemy can react is what it's all about . . . that's called getting inside the enemy's decision loop. . . . Improving [our abilities on the battlefield] is going to be dependent on refining ways to get inside of this loop. An important way to do this is to gather the right imagery and to quickly get it to somebody that can do something with it. This is the challenge that we all face.<sup>2</sup>

To fully comprehend the advantages to be gained by direct sensor-to-shooter RTIC operations, one must understand the capabilities provided by current reconnaissance systems and the processing that transforms sensed data into useable information. With these fundamentals established, this chapter proceeds into current RTIC capabilities and concludes with a discussion of the continuing need for command and control.



## Reconnaissance Systems

Throughout the history of warfare, commanders have sought to achieve a better understanding of the battlefield situation than that of their enemies. Friendly agents in enemy territory provided one means toward that end. Advantages gained through observations from some high elevation or overlooking promontory offered another. The better views offered by higher terrain were augmented by those from tethered observation balloons as early as 1792 when the French employed them against Austrian-Prussian forces at Valmy.<sup>3</sup> The airplane raised observation to new heights—literally and figuratively—during the Italian invasion of Libya in 1911 and soon after over the battlefields of World War I.<sup>4</sup>

Many of the “reconnaissance systems” used during the First World War and before remain viable today; spies and eyes serve as prime examples. Today’s intelligence agents, though certainly more technologically sophisticated than their past counterparts, serve many of the same functions. It is the eyes of special operations forces (SOF) that are in many ways the same primary sensors used by the cavalry troops of the Napoleonic era. Numerous means of gathering enemy information, however, have advanced considerably since earlier days. Once inconceivable, systems such as national satellites, DSP satellites, defense meteorological satellite program (DMSP) satellites, U-2s, unmanned aerial vehicles (UAV), RC-135 Rivet Joints, RC-135 Cobra Balls, E-8 JSTARS, and E-3A AWACS, which can provide instantaneous or NRT information, exist today.

There are a variety of ways reconnaissance systems may be categorized to aid a discussion of their capabilities. Systems once clearly delineated as national, theater, or tactical,<sup>5</sup> now have missions and produce information that no longer fit into a distinct category. The terms national, theater, and tactical no longer provide an adequate tool for clearly categorizing reconnaissance systems, just as the terms strategic and tactical rapidly blur when applied to modern aircraft capabilities. Grouping systems by type of information provided—electro-optical (EO), infrared (IR), synthetic aperture radar (SAR), moving target indication (MTI), COMINT, ELINT, HUMINT, IMINT, and SIGINT<sup>6</sup>—is straightforward. This arrangement, however, becomes cumbersome for illustrating the relationship between reconnaissance collection, data processing, information dissemination, and end user application. A more useful classification scheme separates reconnaissance into space systems, aerial systems, and surface systems.

**Space Systems.** Space systems have become an integral part of the national military forces providing support across the operational continuum and at all levels of war. Space systems provide information that allows commanders to assess the situation, develop concepts of operations, and disseminate changes to their forces quickly.<sup>7</sup> National reconnaissance, surveillance, and targeting acquisition (RSTA) systems provide support to the National Command Authorities (NCA) and are also of great utility to combatant commanders.

Information from national systems is provided to the JFC via service component tactical exploitation of national capabilities program (TENCAP) systems.<sup>8</sup> Discussion of the direct role national space assets may have in the collection of reconnaissance or surveillance information is beyond the scope of this study. Several nonnational space systems, however, have a direct bearing on possible RTIC employment and are discussed below.

Defense support program (DSP) satellites provide one source of IR data to USSPACECOM's tactical event system. This system is composed of three independent elements: attack and launch early reporting to theater (ALERT), joint tactical ground station (JTAGS), and tactical detection and reporting (TACDAR). Together, these elements ensure theater forces receive assured and timely warning of theater ballistic missile (TBM) launches.<sup>9</sup> The signature of the Iraqi Scud missiles proved to be the principal means of launch detection during Operation Desert Storm.<sup>10</sup> DSP satellites successfully detected all 88 Scud launches during that conflict. They also provided Space Command with observations that were then used to calculate the approximate location of the missile's launch site.<sup>11</sup>

The defense meteorological support program (DMSP) provides all important real-time and NRT weather information. Not only do these satellites allow the determination of areas and heights of cloud coverage, they also provide the raw data needed to resolve often crucial IR detection ranges for forward looking infrared (FLIR), LANTIRN, and other IR systems.

**Aerial Systems.** Aerial systems are the primary source of RSTA for the JFC. All the services possess and operate these systems, which have varying, but complementary, capabilities, limitations, and operating characteristics.<sup>12</sup>

The RC-135 Rivet Joint, and to a lesser degree the Navy's EP-3, carry a vast array of passive ELINT and SIGINT collectors to provide real-time threat warning, target cueing, and other classified functions via the tactical information broadcast service (TIBS) or via tactical receive equipment and related applications (TRAP). Rivet Joint broadcasts this information to JSTARS and AWACS and, via satellite relay, to numerous users including the highest levels of the national command authority. A modified version of Rivet Joint, Cobra Ball, includes additional reconnaissance capabilities to include systems operating in the IR arena.

The E-8C JSTARS employs a steerable 25-foot antenna that incorporates side-looking airborne radar, SAR, and wide area surveillance/MTI radar modes to provide locations, numbers, vehicle differentiation, and direction of movement of forces and weapon systems.<sup>13</sup> It also has the ability to image surface-to-air missile sites, airfields, roadways, and bridges on a real-time basis.<sup>14</sup> JSTARS can process the data it obtains either on board and data link the processed information to the requester, or data link the data directly to its deployable ground system where the processing is completed. In either case, the information—including SAR imagery—can be sent directly to the user in near real time.<sup>15</sup> JSTARS employs Joint Tactical Information Distribution System, a surveillance and control data link (SCDL), or its onboard SATCOM system for information updates, intelligence dissemination, and cross-cueing with AWACS,

Rivet Joint, EP-3, ES-3, and other airborne and ground sites within and beyond line-of-sight.

E-3A AWACS combines a powerful airborne radar and numerous radio and data-link relays to merge air defense radar imagery into a coherent picture of the air battle. An important surveillance capability relevant to RTIC command and control is AWACS's ability to provide a real-time update of selected airborne weapon systems directly to, among other places, the AOC.

UAVs bring an additional reconnaissance capability to the theater. The CIA-operated Gnat 750-45 Lofty View and the Defense Airborne Reconnaissance Office (DARO) Tier II Predator reportedly carry a 450–500-pound payload consisting of a synthetic aperture radar with one foot resolution, three EO or IR sensors in a chin turret, and a wideband satellite data-link antenna. The Gnat can fly extended distances and still stay on station 24 hours. The SAR, with its 150 degrees of azimuth and 40 degrees of elevation, can cover an 8,000-foot swath at 25,000-foot altitude.<sup>16</sup> The combination of long loiter times, a multiple sensor array, and a data-link capability allow it to transmit "real-time data in the form of moving video instead of the still pictures sent through UHF communications."<sup>17</sup> Other UAVs such as the Pioneer and Hunter are in the field. Still others, such as the Tier II+ Global Hawk and Tier III- DarkStar, may very soon add stealth, 24+-hour loiter, MTI, SIGINT, wide band data and communications relay, and other capabilities to those of the now operational Lofty View and Predator.<sup>18</sup>

The U-2 uses an ASARS-2 (advanced synthetic aperture radar system) to digitally format radar images for monitoring target activity to more than 100 nautical miles from the aircraft's track. It also has the capability to collect IR imagery or employ the senior year electro-optical reconnaissance system (SYERS) for photographic imagery. Additionally, the U-2 contains extensive COMINT and ELINT collection suites. Though not all of the U-2's diverse products can be transmitted real time, many can. Contingency Automated Reconnaissance System sites receive data-linked collections which can be processed and forwarded to various users in near real time.

**Surface Systems.** One of the principal missions of special operations forces is special reconnaissance (SR). SR complements national and theater intelligence collection assets by obtaining specific, well-defined, and time-sensitive information. It may complement other collection methods where there are constraints of weather, terrain masking, hostile countermeasures, or other systems availability. SR is a human intelligence function that places the United States or US-controlled "eyes on target" in hostile, denied, or politically sensitive territory.<sup>19</sup>

## **The Significance of Intelligence Processing**

Raw reconnaissance data, even when comprehensive and unquestionably accurate, are of little use to the war fighter. The data, in its most basic form,

may be little more than a multitude of ones and zeros in the case of digitally transmitted satellite information. It may be a wonderfully clear photographic image of some location, but without additional, vital information such as the location of the photo, its orientation relative to north, and its time and date of origin, the image might be useless.

To be helpful this data must be processed into useable information. Imagery taken from an aerial or space-based sensor generally requires modifications in order to be useful. Several “hits” of IR data must be processed to differentiate between some ground explosion and a ballistic missile launch. Still more data is needed to determine critical information such as missile launch point and expected impact area. ELINT data must be meshed with known pulse repetition frequency (PRF) information, and perhaps even geolocation information, to determine that a radio frequency emitter is a hostile surface-to-air missile target tracking radar, not a less threatening early warning radar or some communications relay site. Similar processing is needed to transform COMINT, HUMINT, and SIGINT data into useable information.

What drives the significance of intelligence processing in an RTIC environment are combat circumstances necessitating the redirection of planned sorties. An obvious first concern is the priority of a newly identified “pop-up” target. Only those assets planned, or fragged, against lower priority targets will be redirected against pop-up targets of higher priority.<sup>20</sup>

Many situations call for sortie retaskings. Some demand an immediate response by a large and diverse package of weapon systems. Others are less urgent or call for a much more limited diversion of aerial assets. Each of the four scenarios offered here are not meant to be inclusive nor detailed; rather they should illustrate merely a handful of plausible situations where effective retasking of airpower assets would be advantageous.

**Scenario One.** Aircraft targeted against a high priority target abort their mission due to poor weather, lost tanker support, launch runway closure, et cetera. Other aircraft, originally planned against a lower priority target, are redirected against the first aircraft’s higher priority target.

**Scenario Two.** A package en route to a highly defended target loses its suppression of enemy air defenses (SEAD) support so it is retasked to a less well-defended target. Similarly, an ELINT collector’s discovery of a previously unidentified threat in an area targeted by a non-SEAD supported, nonstealthy package forces a redirection of that package toward a less threatening environment.

**Scenario Three.** A pop-up TBM threat<sup>21</sup> is identified. As in the first scenario, this threat may be attacked by a shooter originally tasked to destroy a lower priority target.

**Scenario Four.** The commander in chief or JFC designates particular “fleeting targets” as high priority targets. An Internal Look ’96 exercise input gave the following scenario: HUMINT sources in theater identified a truck convoy being loaded with naval mines at a previously suspected, but as yet untargeted, weapons storage area. The convoy departed the area for a nearby

port facility to transfer the mines to awaiting vessels. The situation led to the retargeting of missions against both the convoy and the naval vessels.

Sortie retaskings in such scenarios or similar situations demand specialized intelligence processing. Threat briefings based on a planned ingress routing may become instantly worthless as a package is redirected. Target photos that were once vital, likewise lose their value as a mission is retargeted. An airborne crew cannot afford to return to base for new target materials. Rather, in an environment of dynamic “on the fly” retargeting, sufficient mission materials must find their way to the cockpit, both to ensure target destruction and to ensure crew survival. Near-real-time imagery that is hours old may be sufficient in some retargeting scenarios but does not suffice when minutes count as in scenarios three and four. Target geolocation information that is 15 to 20 minutes old may allow a Scud TEL to evade attack when real-time information can help assure a kill.

RTIC would allow aircrews far more effective battle space awareness and weapons employment in a retargeting situation. Not only would aircrew effectiveness be enhanced, but RTIC could provide the JFACC with an observe-orient-decide-act cycle far more condensed than any before. To many, the capabilities espoused by RTIC—real-time imagery transfer to the cockpit, updated flight routing information, current threat intelligence, direct feed of targeting coordinates and weapons delivery parameters, and the like—seem plausible enough, but only in a not-too-near future. This future, however, is here, today, right now.

## **Information Transfer: The “Talon” Possibilities**

Modern theater air warfare operations require the capability to process, correlate, and display national as well as organic near-real-time and real-time information into the cockpit or directly to advanced weapons systems, and real-time information out of the cockpit to enhance combat execution and aircrew survival.<sup>22</sup>

The key to RTIC is getting the right information, to the right shooter, at the right time. This is the goal of the Air Force Tactical Exploitation of National Capabilities Talon Shooter program. More specifically, Talon Shooter focuses on delivering enhanced real-time and NRT intelligence to and from aircraft cockpits, and to the weapons carried on aircraft. In effect, Talon Shooter “seeks to develop automated information update capabilities to bridge the gap from the aircrew pre-flight briefing to the full mission flight profile (ingress, over target, and egress).”<sup>23</sup>

The potential mission execution benefits of RTIC enhancements are significant, including such things as (1) threat avoidance updates; (2) imagery of targets; (3) navigational updates; (4) target location accuracy updates; (5) en route and target area weather updates; (6) precision munitions and

weapons computer updates; (7) retargeting updates; and (8) passing immediate BDA from the shooter to rear C<sup>2</sup> elements to influence the current and next ATO cycle, and similar execution information which can increase the likelihood of mission success and aircrew survival.<sup>24</sup>

Talon Shooter has demonstrated the validity of the RTIC concept through Project Strike I, an Air Combat Command-Space Warfare Center cooperative effort conducted in July 1995. Strike I demonstrated significant opportunities in five areas: (1) the ability to tailor intelligence to support strike missions in progress; (2) the communications-dissemination architecture and connectivity to pass data to in-flight aircraft; (3) the interfaces and the actual onboard processing capability to display and apply the passed data; (4) the ability to conduct a successful target strike based on the use of the data provided; and (5) an AOC capability for the JFACC to tailor intelligence, including imagery and threat data, for direct dissemination to tactical platforms.<sup>25</sup>

The completion of Strike I objectives, exemplified by successes in each of the five areas above, moved the project from demonstration status into research, development, and acquisition (RD&A). Further research will be carried out through a Project Strike II. Acquisition is already under way for quick reaction capability (QRC) sets to allow for the modification of six B-1B Lancers to a configuration similar to that used for the B-1B portion of Strike I. RTIC is not an eccentric concept from some distant ethereal realm, but a demonstrated capability available today.

Though Strike I demonstrated the validity of employing real-time information into the cockpit, it did not directly address an overall concept of employing RTIC operations. The overriding concern for these operations is to provide the necessary mission information to aircrews that will allow weapons delivery on target inside the normal mission planning cycle. The affected time frame ranges from a mission added to the execution-day ATO where target priority and time on target (TOT) considerations preclude routine mission planning to a retasked airborne mission already en route to a target or flying combat alert. Necessary mission materials may vary with the specific weapon systems, however, routinely they would encompass ingress and egress routing, en route and target area weather, en route and target area threats, routing information (coordinates, charts, fuel considerations), weaponeering information (attack parameters), and targeting information (IR, radar, or photo imagery). "RTIC operations" should not bring instantaneous visions of theater-wide aerial auftragstaktik or mission-type orders. Though RTIC should improve battle space awareness, it does not represent the fruition of any transparent battlefield concept. Perhaps in the not so near future, mission-type orders may be viable for air operations during a major regional contingency. Given today's technology, however, and the C<sup>2</sup> limitations of this technology, airpower remains best served by centralized control with decentralized execution rather than decentralized control with decentralized execution.

## **The Continuing Need for Command and Control**

Air Force Manual (AFM) 1-1, Basic Aerospace Doctrine of the United States Air Force, in its discussion of the tenets of aerospace power, describes centralized control as the “master tenet.” It elaborates by stating that “without centralized control, commanders cannot exploit the speed and flexibility of aerospace platforms to concentrate forces—whether in attack or defense—from diverse locations on decisive points, establish and enforce theater-wide priorities, execute synergistic campaigns, establish appropriate balances, or assure persistent attacks.”<sup>26</sup> It further states that too much or too little centralization has proved to be counterproductive. Too much centralization delays responsiveness; too little leads to dissipation of effort.<sup>27</sup> Clearly, RTIC furnishes an opportunity to shift the degree of centralization along this continuum. It allows a move toward greater decentralized control by providing the prospect of vastly increasing each aircrew’s “information domain” to a degree where individual aircrews can make autonomous retasking decisions. More likely in the near term, RTIC shifts the degree of centralization in the opposite direction. It gives the JFACC, through the AOC staff, the tools to more effectively prosecute the JFC’s objectives.

Longer term shifts toward decentralization, perhaps even radical changes to several long-held tenets of aerospace power, are likely, but only after potential problems are addressed and overcome. Three tenets of aerospace power—priority, synergy, and concentration—seem most at odds with moves toward decentralization. AFM 1-1 rightly points out that an air commander’s operational priorities should flow from an informed dialogue with the combined or joint force commander. Furthermore, such an exchange will make it more likely that the JFC will set priorities based on a thorough understanding of the enemy’s capabilities, vulnerabilities, and intent, an understanding that is essential lest scarce assets be inadvertently risked without having a significant impact on the outcome of the conflict.<sup>28</sup> RTIC-inspired decentralization, though offering improved tactical flexibility, may reduce the operational- and strategic-level synergistic effects of more centralized control. This decentralization, even though individual aircrew battle space awareness is at a peak, still may push airpower employment back toward the penny packet bane of previous conflicts.

Other more practical problems associated with moves toward decentralized control remain despite resolutions of priority, synergy, and concentration problems. Target deconfliction procedures could prove difficult to establish. Ensuring appropriate refueling availability and deconfliction would be no small task. Also, one cannot assume that the level of aircrew proficiency is uniformly high throughout an entire force. The lieutenant who may be exceptionally adroit at tactically employing his aircraft may be wholly unprepared to take on the decision-making role essential in a decentralized control environment.

The control of airpower, in the future as well as in the past, whether more centralized or less, despite the level of technology used or the size of the forces involved, should provide the focus for airpower employment. Appropriate control remains essential to maximize airpower's flexibility and versatility, ensure its effective concentration, and properly apply airpower's tenets of priority, synergy, balance, and persistence.

### Notes

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10. Defense Science Board Final Report on "Lessons Learned During Operations Desert Shield and Desert Storm," 8 January 1992, 65. (Secret) Information extracted is unclassified.
11. Gulf War Air Power Survey, vol. 1, Planning and Command and Control (Washington, D.C.: Government Printing Office, 1993), pt. 2:247-48.
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16. "Tier 2 UAV Revealed," *Aviation Week & Space Technology*, 7 February 1994, 23.
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18. Several sources discuss the capabilities of the Tier II+ and Tier III-, both of which are currently undergoing testing. David A. Fulghum, "Air Force Prepares New UAV Acquisitions, Operations," *Aviation Week & Space Technology*, 27 November 1995, 52; and "Predator, DarkStar and other Cult Classics," *The Economist*, 17 June 1995, 81, proved most valuable.
19. Joint Pub 3-05, Doctrine for Joint Special Operations, 28 October 1992, II-7.
20. Lt Col James R. Brungess, USAF, chief of combat operations, CENTCOM Exercise Internal Look '96, interviewed by author, Camp Blanding, Fla., 21 March 1996. The chief of combat operations has the authority to retask aircraft based on mission priorities assigned by the JFACC based on CINC guidance.
21. Gulf War Air Power Survey, vol. 2, Operations and Effects and Effectiveness (Washington, D.C.: Government Printing Office, 1993), pt. 2, chap. 6 details coalition efforts to eliminate the Scud threat posed by Iraq against Saudi Arabia and Israel.



22. Capt Marta Bertoglio, ed., "AFTENCAP Program Plan FY96," Space Warfare Center, Falcon AFB, Colo., Information Cutoff: 20 August 1995, 4-19. (FOUO) Information extracted is unclassified.
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24. Ibid., 4-18. Information extracted is unclassified.
25. Ibid.
26. AFM 1-1, Basic Aerospace Doctrine of the United States Air Force, vol. 2, March 1992, 113.
27. Ibid.
28. Ibid., 116.

## Chapter 4

# Enhancing JFACC Targeting Flexibility

[The long lead time in the Air Tasking Order development process] has sometimes been overstated. After the ATO was distributed follow-on coordination and revision were required, even with accurate and timely BDA. The issue is not whether the ATO was useful but rather how it can be improved. This experience points to the need for an interactive planning and information dissemination system that can meet the time lines imposed by modern warfare.

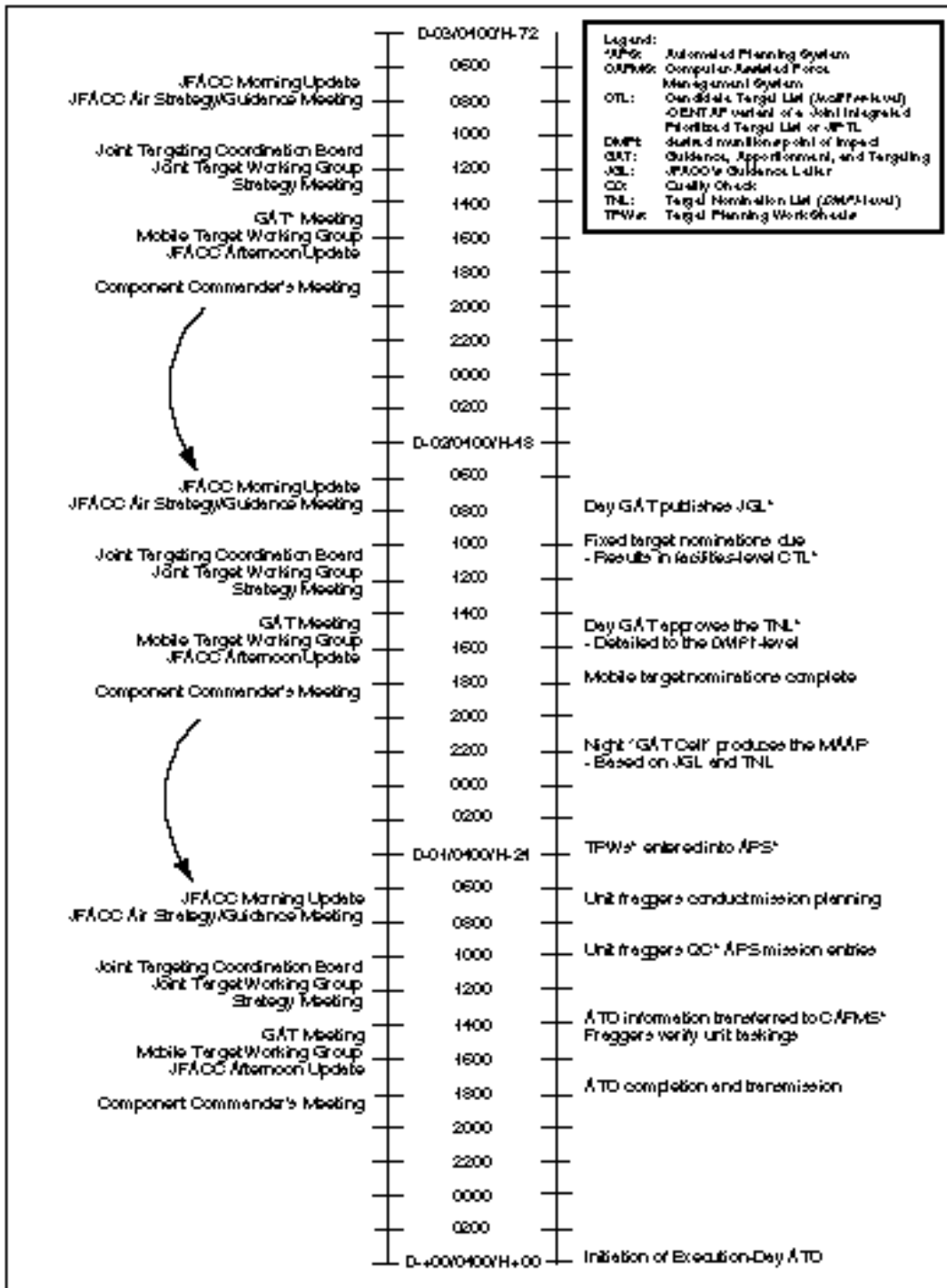
—James A. Winnefeld and  
Dana J. Johnson  
Joint Air Operations

The air tasking process in Operation Desert Storm met the time lines imposed on it by the Gulf War, but it may not have the flexibility necessary for today's wars or for those of the future. In its concluding chapter on command and control (C<sup>2</sup>), the Gulf War Air Power Survey (GWAPS) seems to concur with James A. Winnefeld and Dana J. Johnson in this statement: "Because war is full of surprises, military leaders must try to create and maintain command and control systems (composed of personnel, procedures, and equipment) that can adapt to the unexpected by sensing, analyzing, and then solving the problems which the surprises endemic to war create."<sup>1</sup> GWAPS notes that "the combat operations division provided real-time central control, coordination, and integration of ongoing air operations for the air commander."<sup>2</sup> Real time as used here, however, is a far cry from the type of "sensing, analyzing, and solving" or OODA cycle times that may be possible with today's sensors, processors, and information flow capabilities. In the search for lessons from the Gulf War, authors such as Winnefeld and Johnson criticize the air tasking process, particularly the ATO cycle, for its "lack of flexibility."<sup>3</sup> A discussion of C<sup>2</sup> architecture involves more than a simple investigation regarding the sufficiency of the air tasking process in the Gulf War. The misconception that air planners require 48 hours to proceed from target identification to target neutralization does not invalidate the reality that the JFACC has less than optimum flexibility. In the Gulf War, JFACC servicing of targets was rapid; today, it can be quicker. JFACC control was flexible; today it should be "fluid."

## Thinking outside the ATO Paradigm

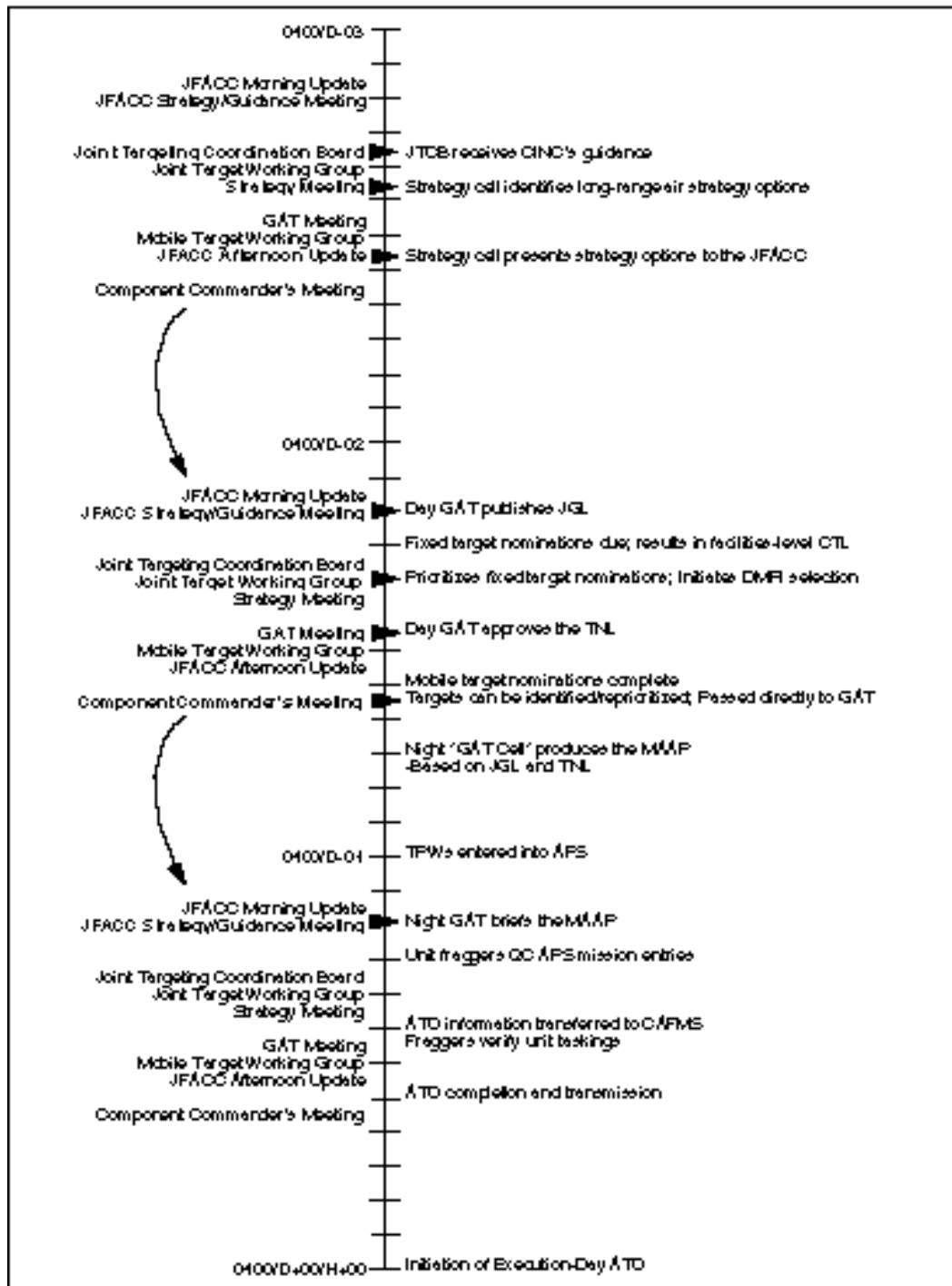
According to Capt Lyle G. Bien, US Navy, “the JFACC air tasking order . . . proved effective in managing the 3,000 daily sorties flown by Coalition air forces during Desert Storm, but the 48-hour ATO cycle did not permit rapid response to mobile targets. In a more dynamic war, only a reduced ATO cycle—which appears to be almost physically impossible—or a greater reliance on aircraft standing strip or airborne alert will be required.”<sup>4</sup> Captain Bien expresses two opinions that seem prevalent regarding the ATO cycle: first, the timeline for ATO production is rigid, and second, mobile targeting— or time critical targeting (TCT)—is only accomplished through the use of ground or airborne alert assets. The so-called 48-hour air tasking process previously laid out in chapter 2 has worked well. It proved effective during Desert Shield and Desert Storm; it worked well for operations in Bosnia; and its usefulness has been born out in numerous exercises from the Central Command’s Internal Look to Ulchi Focus Lens in Korea. General Horner’s command and control system during Desert Storm, a C<sup>2</sup> system based on this ATO process, not only worked well but also showed it could adapt quickly to changes in the operational situation.<sup>5</sup> Execution-day ATO interdiction and strategic attack missions were retargeted based on weather intelligence,<sup>6</sup> BDA,<sup>7</sup> and pop-up Scud notifications.<sup>8</sup> Similar retaskings took place for air refueling,<sup>9</sup> battlefield air interdiction (BAI),<sup>10</sup> and close air support (CAS)<sup>11</sup> missions. The fact that a nominal ATO process is roughly based on a 48-hour target nomination and planning cycle with a 24-hour execution period does not mean it must operate in some fixed, unalterable time frame. In Exercise Tandem Thrust ’92 for example, the ATO cycle started just 11 hours prior to execution day and worked well for the numbers of participating forces involved. A far more serious misperception, however, involves the retasking of available assets within the execution-day ATO. Captain Bien asserts the response to mobile targets appearing inside a given ATO planning cycle—or more broadly, time critical targets—will force a greater reliance on ground or airborne alert. He is mistaken. RTIC provides a distinct and far better alternative.

An examination of an ATO cycle’s time line should facilitate an understanding of the potential for RTIC applications. Figure 4 presents a notional 48-hour ATO cycle. The center of the figure provides a time reference for both the recurring meetings listed on the left and targeting events on the right. Figure 5 provides an expanded look into the process, delineating which group or meeting generates what product. Both figures indicate that fixed target nominations are due a full 40 hours prior to the start of the 24-hour execution-day ATO. (Note that “mobile targets” in these two figures refer to mobile enemy ground units.) Clearly, an attempt to set aside aircraft by scheduling ground or air alert missions to deal with high priority targets identified within this 40-hour window is less than ideal. Other options must be available.



Source: CENTCOM Exercise Internal Look '96

Figure 4. Notional ATO Cycle



Source: CENTCOM Exercise Internal Look '96

Figure 5. Time Line to Produce an Execution-Day ATO

The ATO paradigm refers to the concept that the only effective air tasking is air tasking done in advance. Notional air taskings as presented in figures 4 and 5 ideally identify all targets to be attacked in a 24-hour execution period some 40+ hours in advance of that ATO's first launch. Current procedures exist to add targets identified inside this 40-hour window to this same ATO. Missions added to the ATO during the execution period that can still follow routine ground planning procedures still fit this paradigm.

Thinking beyond this ATO paradigm is the responsibility of the combat operations division in the AOC. The COD "supervises the execution of the ATO, adjusting and refining as necessary to accommodate battlefield dynamics."<sup>12</sup> The chief of combat operations (CCO) not only ensures that the air tasking done in advance by combat plans is carried out effectively but also retasks missions on the published ATO as needed to thoroughly integrate the full scope of the air effort toward the attainment of theater objectives.<sup>13</sup> Fleet Marine Force Manual (FMFM) 3, Command and Control, appropriately summarizes the notion: "The measure of command and control effectiveness is simple: either our command and control works faster than the enemy's decision and execution cycle or the enemy will own our command and control."<sup>14</sup>

## **An Air Operations Center Rapid Response Cell**

Current US airpower doctrine delegates the COD of the AOC the responsibility for monitoring and executing "current joint air operations." Decisions and actions that apply to the current ATO period are executed through the COD which normally assumes responsibility for the joint ATO as soon as it is released.<sup>15</sup>

Situations requiring retasking are identified to the CCO (senior operations duty officer, or SODO, outside USCENTAF and LANTAF). The CCO has prime responsibility for monitoring and directing the current air situation.<sup>16</sup> The CCO performs these functions with the assistance from the offensive operations branch. Offensive operations consists of a cadre experienced in battle management and well versed in doctrine and force application.<sup>17</sup> These personnel are augmented by offensive duty officers, specialists for each deployed weapon system and supporting function. Enlisted duty technicians assist the processing of immediate air requests and perform routine flight following.

The CCO, through the offensive operations staff, first decides on the necessity for retasking a mission on the published ATO based on the situation (such as those characterized by the four scenarios discussed in chapter 3), target priority and rapidity of response needed. With that judgment made, the suitable shooter availability is determined. Is there a shooter in an appropriate phase of flight for retasking? Approaching the IP (initial point for beginning an attack) is too late. Does the shooter have an appropriate

weapons load for the given target? Does the shooter have the necessary fuel to get to the target and return to base (RTB) or poststrike refuel? If refueling is required, are appropriate tanker assets available? Given the aircraft and its weapons load, will the en route and target area weather permit mission accomplishment?

With this information, the CCO chooses one of four actions: **Action one.** Retask no one. The target priority is insufficient to warrant retasking on the current ATO or appropriate shooters are unavailable for a sufficiently prompt response; **Action two.** Retask a nonairborne, nonalert mission. The target priority is sufficient to warrant retasking a mission on the current ATO, however, the situation is acceptably stable to allow some mission planning by crews prior to takeoff; **Action three.** Task an airborne or ground alert mission; and, **Action four.** Retask an airborne mission of lower priority or retask an available higher priority mission while retasking a lower priority mission(s) to cover the retasked higher priority mission.<sup>18</sup>

Each of these four actions can occur, have occurred, and will continue to occur without the advantages of RTIC. Mission success, however, specifically relating to actions three and four can be in doubt even when conditions are heavily in the crews' favor. Concerning The Great Scud Chase during Desert Storm, GWAPS recorded, "It was soon clear that only aircraft flying on station over the launch sites could attack the mobile launch platforms before they escaped. . . . But even then they could have a difficult time. On 9 February the current operations log reported, 'Scud launch-Israel. Two F-15Es were on station and saw the launch but were unable to find the launcher. Two F-15Es on target immediately—two additional F-15Es closed within five minutes. No luck.'"<sup>19</sup> Along with information, RTIC brings an increased probability for mission success.

Once again, the overriding concern for RTIC, and consequently for an RTIC cell, is to provide the necessary mission information—routing information, en route and target area weather, en route and target area threats, weaponering information, and targeting information—to aircrews allowing weapons delivery on target inside the normal mission planning cycle. Action one, no retasking, obviates the need for RTIC. Action two, though it requires no real-time information into the cockpit, can be supported by the unity of action provided by an integral RTIC cell. Tasking an alert mission or retasking an en route mission, as called for in actions three and four, truly put the concept of an RTIC cell to the test.

A prime consideration for an RTIC cell is its composition. The driver behind its organization is the information it must provide to the aircrews of a retasked mission. This calls for five elements in the cell: a mission coordinator (MC), aircraft specific mission planners (MP), a photo interpreter (PI), an intelligence threats representative (IN), and a weather expert (WX).

Currently, the responsibility for retasking missions falls to the CCO. This should continue as mission retaskings split into two branches: retasked missions requiring RTIC and retasked missions that do not. The CCO's "second hat" as RTIC MC follows the airpower tenet of centralized control.

The creation of an RTIC cell does not obligate the division of execution-day ATO mission control currently embodied in the CCO. The MC's role in an RTIC cell would be very much akin to the CCO's present duties of monitoring and directing the current air situation. Specifically, the CCO would determine the missions to be retargeted and ensure the appropriate information is channeled to the crew. MPs, experts in their particular weapon system, take on the responsibility of preparing rerouting and weapon-specific attack profile information. The PI's role, in coordination with the MPs, is to select the proper imagery from the appropriate source(s) for transmission to the shooter. The MP-PI team ensures that routing information, if needed, is passed on the correct scale charts, that radar imagery is omitted if not needed, and that photo imagery is presented from the best possible perspectives and scales. Essentially the MP-PI team makes certain only a proper amount of best-possible, weapon-specific information is delivered to the crew. IN supports the MPs by integrating real-time and NRT threat information into the retargeting process to assure maximum safety for the crews. WX provides input to the MC regarding the viability of retargeting a mission based on en route and target area weather. WX also feeds this information to the MP-PI team to ensure viable routing and to ensure laser, IR contrast, and other weather-based considerations are factored into attack options.

A second essential consideration is the location of the RTIC cell. The current configuration of the combat operations division of the AOC furnishes a made-to-order environment for the operations of an RTIC cell. The CCO position can take on the parallel responsibilities of the RTIC MC. MP, PI, IN, and WX expertise is already resident in the COD though additional personnel may be required to augment the RTIC cell depending on the level or effort it is expected to assume. Naturally the same concerns over in-theater placement of the AOC would apply to an RTIC cell adjunct of the COD. The pros and cons of AOC locale and possible alternatives to in-theater placement are outside the scope of this thesis. Nonetheless, discussions on either side of this debate apply equally as well to the placement of an RTIC cell as they do to the location of the AOC.

With an appropriately staffed air operations center RTIC cell in a theater hosting RTIC-capable aircraft, how is airpower targeting affected? Is there or should there be an impact on targeting at all? Targeting takes on two definitions in Joint Pub 1-02. First, it is simply a process for selecting targets and matching the appropriate response to them, taking into account operational requirements and capabilities.<sup>20</sup> Second, it is more meticulously defined as the analysis of enemy situations—relative to the commander's mission, objectives, and capabilities at the commander's disposal—to identify and nominate specific vulnerabilities that, if exploited, will accomplish the commander's purpose by delaying, disrupting, disabling, or destroying enemy forces or other resources critical to the enemy.<sup>21</sup> A third definition deals with targeting's impact on "the mission cycle." Targeting is discussed as "a decision making process used by commanders to employ forces . . . there are six



general mission steps: detection, location, identification, decision, execution, and assessment.”<sup>22</sup>

RTIC introduces significant change to targeting as presented in each of these definitions. Matching an appropriate response to a selected target in an RTIC environment, as described in the first targeting definition, embraces a level of airpower flexibility and versatility considerably beyond that described in AFM 1-1.<sup>23</sup> In light of the rapid pace of the modern battlefield, and especially in light of mobile surface-to-air and TBM threats, RTIC allows the JFACC, through his staff and TACS, to retask execution-day ATO missions far more effectively than previously possible. In an RTIC environment, a retasked crew does not depart blindly from a well-planned mission toward a set of coordinates associated with some inadequately described target. Instead, they maneuver their aircraft from one well-planned mission to another, and they do so with impressive battle space awareness.

RTIC has a lesser impact on targeting from the second definition’s perspective. Analysis of the enemy situations is mostly unaffected, however, identifying specific vulnerabilities can change. In situations where the United States or its coalition partners do not have a surplus of air assets as arguably was the case during Desert Storm, RTIC may allow for the creation of a dual-focused target priority system and reduce, even obviate, the need for targeting via ground or airborne alert assets. One target priority focus would replicate today’s JIPTL. The other focus would rank the priorities of additional time critical targets. This second focus would expand the overall list of targets based on increased vulnerabilities associated with RTIC capabilities. Together, the integration of these two focuses would provide the CCO invaluable guidance on retasking missions.

A look at the impact of RTIC on targeting’s mission cycle—detection, location, identification, decision, execution, and assessment—reinforces the overriding near-term value of the concept. Of the six steps in this cycle, RTIC most directly addresses two: decision and execution. RTIC provides vastly superior flexibility for the JFACC decision-making process during the actual course of battle. Also, it equips the JFACC with a truly remarkable method of executing those decisions. Joint Pub 1-02 defines operational art as “the employment of military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles. Operational art translates the joint force commander’s strategy into operational design, and, ultimately, tactical action, by integrating the key activities at all levels of war.”<sup>24</sup> To highlight RTIC’s impact on operational art, the definition should be written as, the employment of military forces to attain strategic and/or operational objectives through the design, organization, integration, and conduct of strategies, campaigns, major operations, and battles. Operational art translates the joint force commander’s strategy into operational design, and, ultimately, tactical action, by integrating the key activities at all levels of war.

## **Sensor to Processor to Shooter**

The principal question involved in examining the conversion and transfer of sensed data to shooter information is, "What information is required by the shooter?" The first piece of information an aircrew needs is the fact that their mission is being redirected. Secondly, the crew needs a variety of mission information: routing information, en route and target area weather, en route and target area threats, targeting information, and weaponeering information. Each of these information needs involves some link between a sensing or reconnaissance system on one end and the tasked weapons system on the other.

The RTIC cell mission commander does not arbitrarily redirect an execution-day ATO mission. Mission retasking decisions are based on a variety of factors: mission aborts, previous mission BDA reports, the detection of a time critical target, and appropriate shooter availability.<sup>25</sup> Each of these factors involves sensors of one kind or another. Mission aborts may be "sensed" by wing weather personnel who report takeoff field conditions as WOXOF (weather of 0 foot ceilings, obscured, 0 foot visibility, and fog) or they may be relayed by AWACS as an entire package of bombers, escorts, and SEAD assets aborts due to the loss of tanker support. Near-real-time BDA reported by an aircrew just experiencing PGM "no-guides" against a high priority target was sensed by the aircraft's onboard delivery system. DSP-derived information on the location of a Scud launch may impact retargeting decisions. It also may not if appropriately located, appropriately armed shooters are unavailable.

The sensor-to-processor-to-shooter path may be quite clear in situations involving weather reports and shooter BDA; it may be less discernible for other cases. What is important is the path's impact on possible RTIC operations.

Sensor-to-processor-to-shooter paths may differ for time critical versus nontime critical targeting. Each retasked mission will likely require different and often unique information; the applicable sensors may not be the same; and required processing may differ. Nonetheless, the path's impact on possible RTIC operations remains critical.

Diverse yet notably important sensor-to-processor-to-shooter paths are exemplified by the following sensor-processor-shooter-RTIC scenario involving high priority TBM detection and targeting. Geosynchronous DSP satellites identify and down link a host of IR data. Within moments, the data is received and separate IR "hits" are correlated by the equipment and personnel in the 11th Space Warning Squadron at Falcon AFB, Colorado. Several bits of data indicate the possibility of a TBM launch. An aural warning goes out to operations centers in the affected theater simultaneously with the threat warning sent out via TIBS and TRAP.<sup>26</sup> AWACS-provided TIBS information displays RTIC-capable shooters en route to targets in an area near the TIBS-provided coordinates of the Scud launch site. The CCO

identifies shooters who are sufficiently far from their targets to negate the possibility they have begun their preplanned attack. The CCO verifies that their weapons load is compatible for the time critical targeting of a Scud or its TEL, and engages the RTIC cell to ensure the threat situation between these shooters and the Scud launch site is acceptable, and provides an initial vector to the now retasked shooters. As previously arranged, Cobra Ball and JSTARS aircraft, upon receipt of the same TIBS Scud launch information, reorient their sensors to the launch area. Cobra Ball's IR and SIGINT sensors refine the elliptical area bounding the possible TEL location. This information is used by Joint-STARS to locate then track the TEL while simultaneously data linking updated TEL coordinates directly to the approaching shooters' weapon systems. Steering cues from the JSTARS link tie in to the shooters' IR targeting systems allowing the aircrews to locate, identify, and destroy the TEL and other Scuds readying to launch.

Certain sensor-to-processor-to-shooter paths require human intensive processing; others do not. A brief examination of the mission information needs of a redirected aircrew—routing, weather, threats, targeting, and weaponing information—highlights areas where human interaction and planning is still critical and underscores areas ripe for automation.

In an RTIC environment, route determination for a retasked mission is not heavily dependent on persons other than the retasked crew. Certainly the aircrew must know the location of the target and, in some cases, the location of the IP from which the attack will begin, but meticulous preplanning of a route to the target or IP could be unnecessary when real-time and NRT weather and threat information is available in the cockpit.

Several reconnaissance systems collect threat information that may impact a retasked mission's route of flight. Regardless of the collection system, ELINT and SIGINT processing occur in NRT.<sup>27</sup> Processed, threat-specific information can be loaded automatically into TIBS/TRAP for immediate dissemination throughout the theater. This off-board, broadcast information can be transmitted directly to en route aircraft via TADILs. Onboard avionics such as the Talon Shooter project's real-time symmetric multiprocessor (RTSMP)—a downsized super computer designed for in-flight use—offer further processing of off-board and onboard information to provide crew-selectable displays of threat information. Aircrews may elect to disregard acquisition systems and display only threats that are within lethal range of the aircraft or route of flight. They may color "tag" threats to indicate when the information was last updated. The RTSMP can factor aircraft altitude, course, and speed into the determination of threats' lethal radii, and display the threats with their associated "lethality rings" to allow the aircrew to select appropriate routing.<sup>28</sup> Regardless of the information's display, the sensor-to-processor-to-shooter path for threat information is both direct and short.

A similar direct, short path applies to theater weather. This information is available in real time and NRT depending on the sensor used and its location relative to the theater and could be provided to en route aircrew as part of

TIBS/TRAP broadcast information. Like threat information, knowledge of en route weather may be vital to the determination of a redirected mission's route of flight. Unlike threat information that shooter aircrews can receive via TIBS/TRAP then display in a cockpit-selectable fashion, specific weather-based weaponeering information such as target detection range or laser attenuation specifics requires extensive, less rapid processing.

In general, weaponeering and targeting involve a degree of expert human interaction that, at present, exceeds the capabilities of automated systems. Determining the appropriate types and numbers of munitions or the necessary aim point that must be hit to achieve a desired effect on a specific target remains as much an art as a science. Likewise, the integration of targeting with intelligence and operations information on force posture, capabilities, weapons effects, objectives, rules of engagement, and doctrine requires more than automated systems can provide.

Though apparently straightforward, the seemingly mundane task of obtaining and transmitting appropriate target imagery to a redirected shooter illustrates the need for human interaction. Many, if not most imagery products not already part of some archive or data base, require significant processing to convert raw data into aircrew-useable images and may be available only on an NRT basis. Even imagery products immediately at hand in an AOC require processing before they are readily useable in the cockpit. Systems such as 5D (demand driven direct digital dissemination); power scene; imagery data exploitation; and digital imagery exploitation production system, either link the AOC to various data bases and archives to bring needed imagery in, or allow the manipulation of available imagery to provide a set of images specifically oriented to both the attack heading and run-in altitude of the diverted attacker.<sup>29</sup> These systems allow a mission planner-photo interpreter team to provide suitable imagery—optical, SAR, or IR—tailored to the weapon system's crew. This may include a wide-area image to provide initial target area recognition cues, a narrower field of view image to refine the area perspective to a specific target view, and an image of the specific desired munitions point of impact or DMPI. This imagery also may be processed to include views of the target appropriately oriented to a given attack profile. This processing is not only available, but in many instances is extremely important. In other instances, time is the more critical element, and less-processed, more rapid information is highly preferable over well-processed, slower information.

Greater automation of information processing holds the promise for more rapid decision cycles. Automated information processing, however, does not assure automated decision making. Even in an environment of completely direct sensor-to-shooter pathways, an RTIC cell will be necessary for effective sensor-to-shooter operations until expert systems can provide more fully developed mission information and can be more fundamentally integrated into the decision-making process.

## **Direct Sensor to Shooter**

Currently, little if any data goes directly from sensor to shooter. With several reconnaissance systems, however, sufficient onboard processing is available to allow the transfer of information, not data, directly to expectant shooters. Sufficient communications bandwidth, a severe limitation in the past, remains a concern, but is ameliorated in a world of HF, VHF, UHF, SHF, SATCOM links,  $K_u$  band data links, joint tactical information distribution systems, tactical digital information links, tactical data information exchange systems, tactical receive equipment, and multimission advanced tactical terminals (MATT).

The information sent directly from the sensor to a shooter can be nearly as diverse as the communication paths over which it is sent. HUMINT definitely refers to a collection system with onboard processing and is perhaps the simplest application of the direct sensor-to-shooter concept. Real-time communications from Special Forces personnel can provide excellent, and sometimes otherwise unobtainable, information. ELINT and SIGINT collections from national sensors can provide NRT threat information that in essence travels direct from the sensor to appropriately equipped shooters.<sup>30</sup> Additionally, IMINT in the form of optical, SAR, or IR imagery annotated with latitude and longitude of the target can be linked directly from either U-2 or Predator aircraft. This imagery may be supplemented with other information such as a mobile target's coordinates, heading, and speed. This flow of diverse information into the cockpit, whether from sensor to shooter or sensor to processor to shooter, is achievable today with radios such as the MATT offering data flow rates approaching 20 kilobytes per second on each of its four channels, and onboard processors like the real-time symmetric multiprocessor performing 20 million instructions per second throughout the dynamic flight environment of the F-15E. High volume information flow, however, is only an enabler for RTIC; it is a necessary, but not sufficient condition for the overall RTIC concept.

## **Integrated Flexibility**

Real-time information into the cockpit complements onboard sensors to increase battle space awareness; it does not replace those sensors.<sup>31</sup> Similarly, RTIC supports the ATO process; it does not replace it. It does not provide a panacea to cover for imperfect intelligence, an incomplete command and control systems, or insufficient forces. It does, however, bolster a key tenet of aerospace power. It provides tremendous flexibility to the JFACC on the actual employment of forces. RTIC may even be called, with accuracy, a force multiplier.

Having an RTIC cell does not eliminate the need for the airborne command element (ACE) aboard AWACS which can, "when necessary, assume the

command authority of a tactical air control center over aircraft flying combat air patrol with an AWACS or over airborne strike formations preparing for an attack mission.”<sup>32</sup> It does not replace the battlefield coordination element (BCE) aboard ABCCC. Rather, the abilities of an RTIC cell fill a C<sup>2</sup> niche in the air tasking process in a manner currently unavailable to the ACE, BCE, or CCO. An RTIC cell provides an additional dimension of command and control that allows for more effective decision making and improved execution during the execution-day targeting cycle.

As with the ATO that at some point must prohibit further changes, the flexibility offered by RTIC has limitations as well. Retasking a mission on its IP to target run is just as foolish with RTIC as without. Yet along a continuum during the execution-day ATO, from a point where target priority and TOT considerations preclude routine mission planning to a package nearing its IP to target run, real-time information into the cockpit offers an OODA cycle unprecedented in aerial warfare. It offers today’s JFACC a tool to more effectively employ American airpower and American airmen in combat.

#### Notes

1. Gulf War Air Power Survey, vol. 1, Planning and Command and Control (Washington, D.C.: Government Printing Office, 1993), pt. 2:137.
2. *Ibid.*, 145.
3. James A. Winnefeld and Dana J. Johnson, Joint Air Operations (Annapolis.: Naval Institute Press, 1993), 110.
4. Capt Lyle G. Bien, USN, “From the Strike Cell,” Proceedings, June 1991, 59.
5. Gulf War Air Power Survey, vol. 3, Logistics and Support (Washington, D.C.: Government Printing Office, 1993), pt. 2:95.
6. *Ibid.*, 94.
7. Gulf War Air Power Survey, vol. 5, A Statistical Compendium and Chronology (Washington, D.C.: Government Printing Office, 1993), pt. 2:234.
8. Gulf War Air Power Survey, vol. 1, pt. 2:252.
9. Gulf War Air Power Survey, vol 2, Operations and Effects and Effectiveness (Washington, D.C.: Government Printing Office, 1993), pt. 1:204.
10. Gulf War Air Power Survey, vol. 5, pt. 2:253.
11. *Ibid.*
12. Air Combat Command Instruction (ACCI) 13-AOC, Operational Procedures—Air Operations Center, vol. 3, 1 June 1995, 32.
13. *Ibid.*
14. Joint Pub 3-09.3, Joint Tactics, Techniques, and Procedures for Close Air Support, 1 December 1995, II-1.
15. Joint Pub 3-56.1, Command and Control for Joint Air Operations, 14 November 1994, C-2.
16. ACCI 13-AOC vol. 3 on p. 32 states that “the SODO [CCO for USCENTAF] has prime responsibility for monitoring the current air situation and advising the CCO [DCO for USCENTAF] of dynamic mission requirements and resource status. . . . When a requirement is of an immediate nature, the SODO summarizes the current air situation for the CCO, who approves/disapproves adjustments to the published ATO.” During USCENTCOM Exercise Internal Look '96, Lt Col James R. Brungess, USAF, as CCO, had prime responsibility for both monitoring and directing adjustments to the published ATO.
17. *Ibid.*

18. Certainly this brings out concerns regarding possible “ripple effects,” however such contingencies were exercised during Internal Look '96.
19. Gulf War Air Power Survey, vol. 2, pt. 1:188.
20. Joint Pub 1-02, Department of Defense Dictionary of Military and Associated Terms, 23 March 1994, 380.
21. Ibid.
22. Ibid., 245.
23. Air Force Manual 1-1, Basic Aerospace Doctrine of the United States Air Force, vol. 2, March 1992, 115–16.
24. Joint Pub 1-02, 274.
25. Lt Col James R. Brungess, chief of combat operations, CENTCOM Exercise Internal Look '96, Camp Blanding, Fla., interviewed by author, 21 March 1996.
26. Lt Col Darrell Herriges and Maj Christopher H. Frasier, 11th Space Warning Squadron, Falcon AFB, Colo., interviewed by author, 4 January 1996.
27. Mr. Ronald Cole, National Security Agency Liaison to US Space Command, Peterson AFB, Colo., interviewed by author, 3 April 1996.
28. Capt Geoffrey H. Hills, chief, Space/Weapon Systems Integration, Space Warfare Center, Falcon AFB, Colo., interviewed by author, 5 April 1996.
29. Capt Daniel E. Johnson, operations officer, Combined Imagery Exploitation Facility (CIEF), US Space Command; Warrant Officer Michael E. Waliohn, Canadian Forces CIEF NCOIC; and TSgt David A. Grubbs, CIEF Team B Exploitation NCOIC, Combined Intelligence Center, Peterson AFB, Colo., interviewed by author, 4–5 April 1996.
30. Larry Arkfeld, “Combat Integration Capability (CIC) Communications Plan: Revision A,” unpublished paper prepared for SWC/DOZC, 6 October 1995, 3.
31. Maj Zigfried J. Dahl, “The Talon Shooter RTIC Road Show,” slides, undated, 31.
32. Gulf War Air Power Survey, vol. 1, pt. 2:98.

## Chapter 5

### A Look to the Future

If a man does not give thought to problems which are still distant, he will be worried by them when they come nearer.

—Confucius  
The Sayings of Confucius

The joint campaign should fully exploit the information differential, that is, the superior access to and ability to effectively employ information on the strategic, operational and tactical situation which advanced US technologies provide our forces.

—Joint Pub 1, Joint Warfare of the  
Armed Forces of the United States

Referring to an Air Combat Command study on the air campaign in the Gulf War conducted by SDS International, Col Bruce Gillette, chief of the Air Force Theater Air Defense Requirements Division, said “the study looks at what can be done that will give the best payoff [in destroying mobile theater ballistic missile launchers]. Should we improve the sensors, the shooters, or the command-and-control systems?”<sup>1</sup> The answer should be yes. Yes, we should improve the sensors. Yes, we should improve the shooters. Yes, we should improve the C<sup>2</sup> systems. These improvements should not only address the threat posed by TBM or the potential offered for theater missile defense but also should address the integration of all three—sensors, shooters, and C<sup>2</sup> systems.

The RTIC cell construct laid out in this thesis offers increased targeting flexibility to the modern JFACC, but it is only an incremental step down the path toward minimized decision cycles and maximized targeting effectiveness. Integrated sensor, shooter, and C<sup>2</sup> improvements will allow the US military to further its journey down the path toward maximum airpower effectiveness.

**Sensors.** A handful of today’s sensors have the ability to directly link information to a shooter. Much of this information is threat related; some is data related; little is imagery related. An ability to broadcast real-time imagery of a stationary or moving target along with specific geolocation and, if needed, moving target information, from a wider variety of sensors to individual shooters is plausible. IR sensing capabilities added to the entire fleet of RC-135s may add a tremendous counter-TBM capability. This improvement, refined DSP data processing, and additional IR capabilities and



sensor range expansions for JSTARS offers added opportunities to precisely locate TBM units.

Various other sensors are on the horizon. RF/seismic sensors capable of deriving 3-D conformations of underground structures offer an ability to locate, identify, and target underground facilities.<sup>2</sup> “Relaxed-optical-tolerance imaging”<sup>3</sup> presents an opportunity for producing fine resolution, space-based imaging at greatly reduced costs by overcoming reduced hardware tolerances with postdetection processing (i.e., overcoming low-cost less-capable hardware with improved computer software). Microelectromechanical systems, bistatic SAR systems, ultraspectral optics, quantum well infrared photodetectors, and other obscure technologies appear to offer the promise of continuing improvement in sensor systems and their component technologies.<sup>4</sup> More importantly, the prospect for sensor correlation and fusion in the context of a “system of systems” architecture is increasingly bright.

**Shooters.** Two areas offer the greatest potential for future improvement to the combat air force(s) regarding RTIC: communications and direct weapon systems links. Improved communications capabilities for both voice and data information flows are a must. The idea that there is a single aircraft sent into combat without the threat information capabilities offered by TADIL-J or its equivalent seems reprehensible. As RTIC capabilities improve, RTIC-capable aircraft should include single-seat as well as multiplace shooters. This may prove viable once the integration of off-board information can occur automatically with an input feeding directly into the shooters’ navigation and targeting systems. A third area of expanding future capabilities does not concern RTIC, but real-time information out of the cockpit. Real-time information out of the cockpit adds another dimension to the targeting flexibility offered by RTIC through improved and more rapid BDA. Another clear area regarding the future of RTIC is the expansion of its use from force application via deep interdiction and strategic attack missions to force application in the CAS and counterair missions. RTIC should also have a place in force enhancement missions such as airlift and air refueling.

**C<sup>2</sup> Systems.** The future may hold the promise for airpower employment via the C<sup>2</sup> procedures of an auftragstaktik system where mission-type orders are employed in a decentralized control-decentralized execution environment. This will be truly effective only when the promise of near-complete battle space awareness becomes a reality. Until that time, real RTIC C<sup>2</sup> advances likely will come from ever-widening communications “pipes” allowing exponential increases in sensor-to-shooter information flows and sensor cross-cueing capabilities. Steady improvements should also occur as the RTIC concept goes through the day-to-day learning process of becoming RTIC operational reality.

Systems are required that can support decisions by bringing to bear all relevant information, including the fusion and presentation of current and historical data from all sources. Dynamic command and control is central to increasing the capabilities of airpower. Increases in capability will arise primarily from the ability to collect, analyze, and use information to make

critical decisions to engage the enemy quickly and decisively—in short, to maximize the effect on the enemy within the constraints imposed. Certain functions are crucial: timely information, timely decisions, proper assignment of tasks to computers and automation, and proper synchronization.<sup>5</sup> Without a determined effort to manage this generation, distribution, storage, fusion, and presentation of information to support timely decision making, airpower of the twenty-first century will be data rich, information ragged, and decision poor.

The future holds the promise of combining sensor arrays, targeting systems, weapons delivery capabilities, and C<sup>2</sup> methods in a number of ways to allow maximum flexibility for the JFACC. For this concept, for those above, and for RTIC in general, the devil is not so much in the details, but in the decision—the decision to prioritize these capabilities and make the investments required to bring ideas into reality.

#### **Notes**

1. Frank Oliveri, “Upgrades for Killing Launchers Studied,” *Air Force Times*, 22 January 1996, 26.
2. “New World Vistas: Air and Space Power for the 21st Century,” *Sensors Volume*, undated draft, iv.
3. *Ibid.*, v.
4. The New World Vistas’ sensor and attack volumes provide excellent discussions of potential advances in sensors, weapons and weapons platforms, command and control, and the functional integration of all three.
5. “New World Vistas,” *Attack Volume*, undated draft, 7.

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