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TARGETING FOR EFFECT: IS THERE AN ICEBERG AHEAD?

by

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14. ABSTRACT

Some airpower enthusiasts see the Desert Storm air campaign as the fruition of the ideas of Douhet and Mitchell and as the final fulfillment of their promises. The reason for their excitement is embodied in the belief that the concept of parallel war and an effectsbased strategy promises a new capability for the conduct of future wars. The capability to control an enemy quickly and without having to destroy him has been the goal of military forces from the time of Sun Tzu. This paper summarizes the current literature on controlling an enemy through an effects-based airpower strategy. It begins with the ideas of the early theorists such as Douhet and Mitchell to demonstrate that while they were the first to think about effects, they were unable to pursue any effects-based strategy due to the limitations of precision. As precision matured, it allowed the concept of parallel war to be pursued during Desert Storm. Unfortunately, the current application of precision and the concept of parallel warfare is not really the effects-based strategy claimed by its proponents. Both Desert Storm and Bosnia serve as examples to show how effects capabilities were limited by the tactics, resources and strategy along with the real world limitations of current systems. viii This paper suggests that while an effects-based strategy offers tremendous potential, there are several key areas lacking emphasis. For example, the current weapons systems and those planned for the next generation simply continue to look at destruction rather than effects. we must develop weapons for effects and not solely on the destruction based systems we are currently developing. Planning is essential to look at how we plan for and conduct operations based on effects-based strategy. Tactics development within the Air Operations Center is not preparing future planners for conducting campaigns based upon effects but simply a continuation of the current destruction based approach. Targeting is based on the desert Storm model and is only applicable to industrialized systems. A targeting strategy applicable to all levels of conflict is necessary. Collectively, what is needed is to develop an overall plan to pull together all the elements of effects-based thought. This paper attempts to address many of these ideas to help structure future efforts in this area.

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Preface

Since Desert Storm, many accounts describe the resurgence of a dominant and decisive role of airpower for the future. The reasons for this enthusiasm are often attributed to the remarkable success of the air campaign during Desert Storm. The excitement many enthusiasts felt came, not only from the actual results, but also from the possibilities that an effects-based strategy could provide more capabilities to future conflicts, especially in conflicts where airpowers role was yet to be defined. In my quest to find out more about how to implement an effects-based strategy, I sadly discovered there is actually very little written on the subject except as simple statements of the *utility of effects*. Instead, my critical review suggested reasons for caution and a lack of information about how to implement such a strategy. This paper is *not* intended to develop an effects-based strategy. Instead, it is a review of the available literature along with a discussion of some of the key elements I believe are needed as part of an effects-based strategy. With this information, you as the reader can determine if you see the same observations and help set a course to help leadership direct additional work in the correct areas.

I would like to thank Col. Joseph McCue of the Air War College faculty for his encouragement and support in the development of this paper. While his background and instruction in the acquisition process has been welcome to the students of his classes, I especially thank him for his ability to develop in me the motivation, encouragement and

perseverance to take on this challenging subject. I also want to thank Dr. Grant Hammond, also of the AWC faculty, who helped me better understand the nuances of doctrine, strategy and airpower as they applied to the actual thoughts of the early airpower theorists.

Most of all, I want to thank my loving wife Sandy, who patiently supported me through the many hours in the analysis and preparation of this paper. Without her support, I would not be at Air War College today!

Abstract

Some airpower enthusiasts see the Desert Storm air campaign as the fruition of the ideas of Douhet and Mitchell and as the final fulfillment of their promises. The reason for their excitement is embodied in the belief that the concept of parallel war and an effects-based strategy promises a new capability for the conduct of future wars. The capability to control an enemy quickly and without having to destroy him has been the goal of military forces from the time of Sun Tzu. This paper summarizes the current literature on controlling an enemy through an effects-based airpower strategy. It begins with the ideas of the early theorists such as Douhet and Mitchell to demonstrate that while they were the first to think about effects, they were unable to pursue any effects-based strategy due to the limitations of precision. As precision matured, it allowed the concept of parallel war to be pursued during Desert Storm. Unfortunately, the current application of precision and the concept of parallel warfare is not really the effects-based strategy claimed by its proponents. Both Desert Storm and Bosnia serve as examples to show how effects capabilities were limited by the tactics, resources and strategy along with the real world limitations of current systems.

This paper suggests that while an effects-based strategy offers tremendous potential, there are several key areas lacking emphasis. For example, the current weapons systems and those planned for the next generation simply continue to look at destruction rather than effects. we must develop weapons for effects and not solely on the destruction

based systems we are currently developing. Planning is essential to look at how we plan for and conduct operations based on effects-based strategy. Tactics development within the Air Operations Center is not preparing future planners for conducting campaigns based upon effects but simply a continuation of the current destruction based approach. Targeting is based on the desert Storm model and is only applicable to industrialized systems. A targeting strategy applicable to all levels of conflict is necessary. Collectively, what is needed is to develop an overall plan to pull together all the elements of effects-based thought. This paper attempts to address many of these ideas to help structure future efforts in this area.

Chapter 1

Introduction

> *The ingredients for a transformation of war may well have become visible in the Gulf War, but if a revolution is to occur someone will have to make it.*
>
> —Gulf War Airpower Survey

Throughout modern history, airmen have been dreamers. They contemplated grand visions of a decisive role for airpower as the force to compel the enemy to do our will.[1] Their beginnings into military aviation began when they first jumped into primitive vehicles, constructed of wood and canvas, held together by wires and glue, to conduct reconnaissance over enemy territory. Once aloft, they dreamed of the potential of the air. While airborne, these aviators may have pondered new ideas about the best way to employ this new capability called airpower. Their thoughts may have first congealed during WWI, as they flew over the static trenches of France and Italy, watching millions of men rush headlong to their deaths. These horrific sights, both from the air and on the ground, stimulated a desperate search to find ways to restore mobility to the modern battlefield. This new capability, the airplane, could now take the battle directly to the enemy using the air as a new dimension of attack. As these ideas for the use and capabilities of the air further developed, some airpower theorists looked to the previous writings of military strategists to develop specific air strategies. These airpower theorists

looked to Clausewitz, Jomini and Sun Tzu to help explain the failure of WWI commanders to achieve mobility of the battlefield. They saw the potential role of airpower as the ultimate "…force to compel our enemy to do our will."[2] Using these thoughts, these theorists developed the strategies to employ the new tools of airpower with grand visions for the future.

As these strategies developed and merged many years later with the improvements in precision, this evolution led many of today's strategists [3] to the conclusion that the Desert Storm air campaign is the fruition of the early theorists ideas as well as the catalyst for a resurgence of the dominant role of airpower.[4] The major advance that has made this belief possible is not only the evolution of strategy, but the improvements in precision. Precision weapons now make it possible to send a single plane and weapon against targets that once required massive formations of aircraft dropping thousands of bombs to destroy. In fact, not only can we destroy many potential targets with a single weapon, the surgical capability of precision may open new possibilities for airpower. As one key former Pentagon planner states,

> a unique combination of capabilities and opportunities have congealed to make it possible for airpower to fulfill the role that many airman have dreamed about for years, and perhaps, equally important, to open a path to new missions and expanding roles.[5]

These improved capabilities in aircraft and precision munitions may now offer a chance for airpower to better support our future joint strategy for dealing with an uncertain post-Cold War world. Combined with the results of Desert Storm, the debate on the dominance and decisiveness of the role of airpower has re-energized the dreamers who believe airpower's role has again changed the nature of war.[6]

Some strategists believe the air campaign in Desert Storm has advanced a new strategy for airpower that can control an enemy through his systems.[7] *Rather than targeting simply for destruction, it is now possible to target for effects.* "Increasingly, war is more about destroying or incapacitating *things* as opposed to *people*. It is now about pursuing an *effects-based* strategy rather than an *annihilation-based* strategy, a strategy that one can *control* an opponent without having to *destroy* him (emphasis in original)."[8] The potential in an effects-based strategy is in it's ideas about control rather than destruction to rapidly achieve the same desired end state. Although written more than 2000 years ago, Sun Tzu's basic strategy for controlling the enemy to create the opportunity for an easy victory supports effects-based thinking. He believed "…those skilled in war subdue the enemy's army without battle. They capture his cities without assaulting them and overthrow his state without protracted operations."[9] For over 2,000 years, militaries have sought ways of controlling an opponent. It would indeed be an important breakthrough if effects-based strategy is available today and could indeed control an enemy. This would be especially significant with conflicts around the world if airpower could use its inherent capabilities of flexibility and range to control an enemy anywhere in the world.

Control over an enemy requires new ways of thinking about effects and how to use force effectively. Simply defined, an effect seeks "to produce as a result."[10] In military terms, this desired result can be generalized to be control of an enemy to achieve the desired outcome. We sometimes need to destroy his capability to wage war while on other occasions, we may be able to achieve the same result in other ways. "Well beyond the activity of destroying an opposing force lies the ultimate purpose of war—to compel a

result. Use of force to control rather than destroy an opponent's ability to act lends a different perspective to the most effective use of force."[11] The effects-based strategy represents an approach where "…the idea that an enemy organization's ability to operate as desired is ultimately more important than destruction of the forces it relies on for defense."[12] An effects strategy attempts to control the things of an enemy that are important to him. Key to the idea of controlling an enemy is selecting the right things, or systems to control. By thinking in terms of systems, effective control will result if targeting can achieve specific effects against the key portions of a system that render the entire system ineffective. In simplest terms, selecting the correct systems might make it possible to use aspects other than simply destruction to achieve the desired results.

The concept of control brings a new language to airpower along with the complex challenge of how to plan for effects. Some examples of these new terms include "...render ineffective, negate, disable, prevent, neutralize, limit, reduce and stop."[13] While each of these terms will add a new dimension to effects that will be expanded later in the discussion, destruction remains a key tool in the arsenal of the effects strategy. However, under an effects strategy, *destruction is not the only method of control*. For example, jamming of an enemy radar is a well known effects strategy frequently used in Vietnam and Desert Storm. With jamming, you simply render the opponents systems useless during the period of interest. Another example of effects is simply to control the enemy by the threat of destruction. During Desert Storm, radar sites and power plants were purposefully shut down to avoid targeting.[14] One key advantage to this approach can be seen in the planning of campaigns. Consider if we can exercise control over an enemy without having to destroy as many of his systems. In today's rapidly decreasing

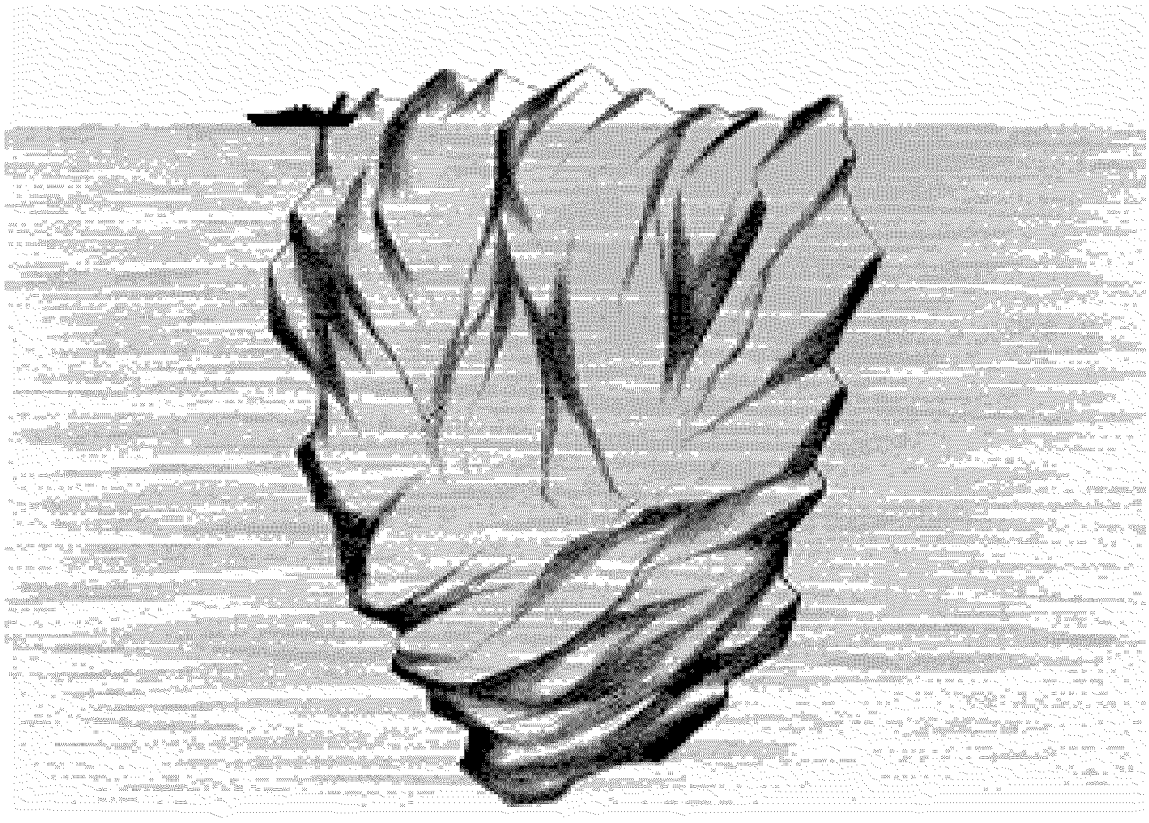
budget environment, effects thinking has the potential to offer significant leverage to our current and future forces by reducing the duration and force structure required to achieve the same objective. However, the process to do so, even in cases when it might be achievable, cannot be assumed to be without significant challenges and risks. "The process of planning for effects is complex,"[15] and some of the problems encountered during Desert Storm highlight the challenges in developing and implementing an effects-based strategy.

The thesis of this paper is that despite the claims of a new strategy of airpower discussed above, we are not comprehensively developing the elements for its implementation. My simple contention is that the results of Desert Storm have led to some unrealistic claims about the capabilities of precision guided munitions and the capability to execute an effects-based strategy. The methodology used here will be to describe the elements making up an effects-based strategy and describe how each element contributes to effects.[16] For an effects-based strategy using precision guided munitions to be effective, it is important to have the necessary resources, a clear strategy for targeting and a good understanding of the constraints to the approach.[17] Chapters 2 and 3 serve as primer to two background areas. Chapter 2 traces the evolution of thoughts of the early airpower theorists related to effects. It concludes that many of the plans of these theorists were indeed effects-based, but the limitations in precision limited the results possible. Chapter 3 describes the role of precision. Precision and precision munitions serve as a key enabling technology that made the implementation of an effects-based strategy possible. Readers with a background who can support the conclusion that the early theorists thought about effects and that precision enabled the current capability

can consider skipping directly to Chapter 4. In Chapter 4, the role of airpower in Desert Storm and Bosnia, the claims about precision munitions and the use of an effects-based strategy are assessed. While many types of munitions were used in Desert Storm, the focus will be limited to laser guided bombs since they represent the largest number employed, were primarily used against the most important strategic targets and are currently the first choice in any effects-based planning. Chapter 5 discusses the critical role of targeting, tactics and resources in an effects-based strategy. Chapter 6 provides a summary and conclusion.

Figure 1 serves as a analogy that will be further developed throughout the paper. The picture illustrates the fact that 8 to 9 times as much of an iceberg remains below the surface as the visible portion. When applied to the discussion of effects, the figure supports my belief that the current status of effects planning has not accounted for many critical factors to implementing such as strategy. The many of the factors of effects are not well understood and seem to be hidden below the small portion that's visible. Each chapter will identify areas and where they fit within this illustration.

From its humble beginnings in WWI, our airpower dreamers may have led us to some exciting new possibilities for airpower in the future. While some airpower enthusiasts look for strategies to defeat an enemy without supporting ground and naval forces, any claims that an effects-based strategy can accomplish this objective should be viewed skeptically. This paper is not an attempt to argue that airpower is the dominant capability for all future conflicts, and strategic bombardment its mantra. Instead, it is a discussion on how an effects-based strategy, as a part of a joint operation, could add



Source: Picture is copied from Patrica Lauber, Junior Science Book of Icebergs and Glaciers (Garrard Publishing Company, Champaign IL, 1961), 14.

Figure 1. Iceberg as an Analogy of Effects

significantly to our airpower and overall military capabilities. A revolution is indeed possible, but as the review committee from the Gulf War Airpower Survey found, it is only barely visible. We need much more analysis at the areas below the waterline. An appropriate beginning is with the workings of the airpower theorists, those early pioneers of the air.

Notes

[1] All the early proponents of airpower, Mitchell, Douhet and the Air Corps Tactical School all believed in the decisiveness of airpower. See Col. Richard Szafranski, "Parallel War, Promise and Problems", *Proceedings*, (August 1995):58. Brig. Gen. Billy Mitchell defined air power as "the ability to do something in the air". See Brig. Gen. William Mitchell, *Winged Defense: The Development Possibilities of Modern Air*

Notes

Power-Economic and Military, (Curtis Publishing Company, Copyright 1924 and 1925), 2.

[2] Carl von Clausewitz, *On War*, ed. And trans. Michael Howard and Peter Paret (Princeton N.J.: Princeton University Press,1976), 5.

[3] In this case, I use the word strategist to describe someone who develops a plan to utilize resources to achieve an objective. The air campaign plan from Desert Storm is often referred to as a strategy at the operational level of war.

[4] See for example Richard H. Schultz, The Future of Air Power in the Aftermath of the Gulf War, Air University Press, Maxwell AFB AL, July 1992 where Secretary of The Air Force Donald B Rice says: "Airpower,…has emerged as a dominant form of military might. Airpower did exactly what airpower visionaries said it could." 11. Some other proponents, chief among these are Col. Dave Deptula and Dr. Richard Hallion, support the belief this dominant role is the result of a new effects-based strategy. See Col. David A. Deptula, *Firing for Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, August 24, 1995) and Richard P. Hallion, "Precision Guided Munitions and the New Era of Warfare" *Air Power History,* (Fall 1996).

[5] Frederick L. Frostic, Former Deputy Assistant Secretary of Defense (Requirements and Plans), Washington D.C., "The New Calculus: The Future of Airpower in Light of Its Growing Qualitative Edge*"*, *Draft Version*, (December 1996):1. Used by permission of the author. Special thanks to Dr Richard Hallion, the Air Force Historian, for making a draft available to help in my study. All page references are to this draft.

[6] For example, see Christopher Bowie, *The New Calculus,* Rand Study, (1993), 83. "But the results of our analysis do indicate that the calculus has changed and airpower's ability to contribute to joint battle has increased."

[7] In addition, see an excellent explanation in Col. David A. Deptula, *Firing for Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, August 24, 1995).

[8] Richard P. Hallion, "Precision Guided Munitions and the New Era of Warfare", *Air Power History*, (Fall 1996):13.

[9] Samuel B. Griffith, *Sun Tzu: The Art of War*, (Oxford University Press, 1963), 79.

[10] American Heritage Concise Dictionary, (Houghton Mifflin Company, 1994), 270.

[11] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 4.

[12] Ibid., 8.

[13] Ibid., 5.

[14] Ibid., 9.

[15] Ibid.

[16] Per Col. John Warden, "*The Air Campaign* is, very simply, a philosophical and theoretical framework for conceptualizing, planning, and executing an air campaign." To the extent that it helps planners in arranging their thoughts-before they are in the thick of

battle-it will have achieved its ends." The Air Campaign: Planning for Combat, Pergamon-Brassey International Defense Publishers, 1989, xvii.

[17] A variety of studies look more closely at strategy as the relationship between ends and means. Since the ends is typically the fulfillment of some political objective, some mechanism is needed to evaluate how the military capability leads to the desired objective. One such study is by Thomas P. Ehrhard, Making the Connection: An Air Strategy Analysis Framework, School of Advanced Airpower Studies, Air University Press, Maxwell AFB AL, April 1996

Chapter 2

The Strategy of Airpower: Destruction or Effects

Strategy is a process, a constant adaptation to shifting conditions and circumstances in a world where chance, uncertainty, and ambiguity dominate.

—Williamson Murray and Mark Grimsley
The Making of Strategy: Rules, States and War

Consider the thoughts of the early aviators of WWI if today, they could sit and watch, on a television no less, as virtually live pictures of laser guided weapons surgically destroying a building. How would their strategy adapt and change as a result of not only new weapons, but more sophisticated air defenses and hardened bunkers. From their writings, it is reasonable to conclude that in some form, they believed the words of Clausewitz that, "…war is a way of carrying out political action by other means" and they developed strategies appropriately.[1] Would they see these improved capabilities as simply more destructive capability or as a method of exercising greater control to achieve the desired objective? This chapter examines the theories of airpower and the ideas of the early theorists about effects and control. Unfortunately, it is difficult to assess if many of their best ideas were simply ignored and became subservient to the limitations in weaponry. By tracing the evolution of airpower strategy, it is possible to find examples of how these theorists intended more than just destruction of the enemy forces and sought ways to control the enemy. The following examples support a conclusion that effects-

based thinking is not new, and evidence of it is found in the works of the airpower theorists.

Guilio Douhet may have been the first airpower theorist who considered aspects of effects in the development of his theories. In his book entitled *Command of the Air*, he viewed the airplane as more than just a vehicle for exploration and reconnaissance.[2] His ideas about airpower began in WWI, through experiences such as those by Austro-Hungarian airman who literally bombed the Italian city of Treviso into submission.[3] He believed that the strategy one can implement "...depends upon the technical means of war available."[4] His beliefs considered attacking a nations most vulnerable centers directly to defeat the enemy without engaging their army. These centers included cities, populace, transportation nets and commerce. Using the technical means available from WWI, he proposed high explosive, chemical and biological weapons. His strategy stressed control, of large targets, "…objectives should be large; small targets are unimportant and do not merit our attention here."[5] While some historians characterize Douhet's theory as being one of punishment,[6] it is likely he believed that chemical or biological weapons targeted against a civilian populace would produce the same shock and terror it did when it was first introduced on the WWI battlefields. Douhet sought airpower for strategic effect through rapid shock followed by moral collapse. He writes, *"…the objective must be destroyed in one attack, making further attack on the same target unnecessary* (emphasis in original)*."* From these ideas, Douhet clearly attempted to control the things of value to the enemy nation and proposed the shock and fear of massive attack. While limited technically, he proposed to use the best technical means available, including the

use of high explosive, chemical and biological weapons, to achieve a rapid victory. These thoughts clearly demonstrated effects-based thinking.

Billy Mitchell demonstrated a thinking about effects in his struggle for a greater role for airpower in the period between WWI and WWII. Mitchell's early experiences, like Douhet, was a result of WWI. As a colonel in command of the Army Air Corps forces in 1917, he too became mesmerized in the superiority of airpower. His initial ideas differed from Douhet in that Mitchell believed the enemy forces were the principal target. Shortly after the war, Mitchell wrote that "…an air force's principal mission was to destroy the enemy's air force and attack military forces on the ground."[7] In his 1925 work entitled *Winged Defense,* he changed these beliefs and switched to strikes against the enemy centers of gravity: manufacturing and food centers, railways, bridges and canals. The term 'centers of gravity' came from Clausewitz, who defined it as the "hub of all power and movement."[8] Mitchell wrote "no longer will the tedious and expensive process of wearing down the enemy's land forces by continuous attacks be resorted to. The air forces will strike immediately at the enemy's manufacturing and food centers, railways, bridges, canals and harbors."[9] Mitchell did not get to implement these ideas in battle, but like Douhet, is characterized as having pursued a theory of punishment. However, it is from another series of events, more so than any writings, that he demonstrated his adaptation of strategy and ways to render ineffective his perceived enemy.

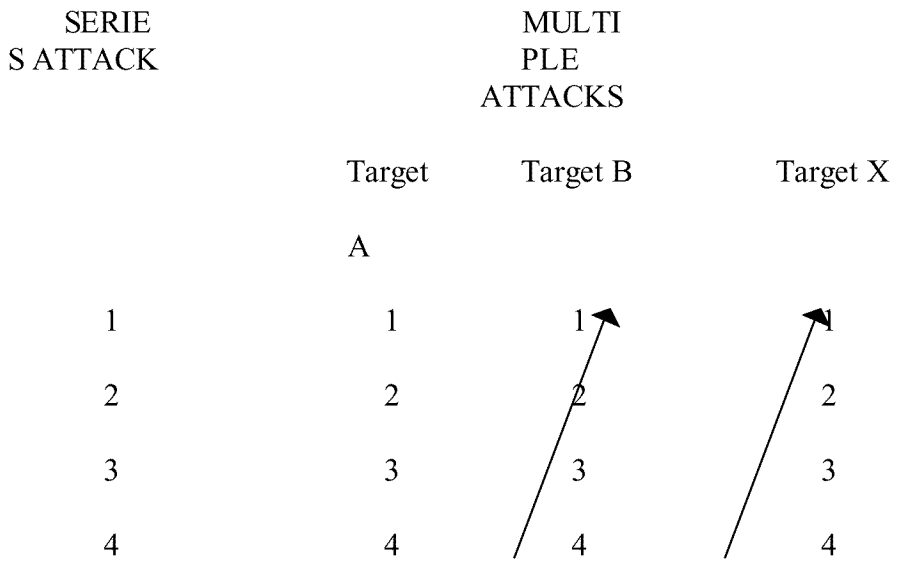
This critical event was his quest to demonstrate the superiority of the airplane over the battleship *Ostfriesland.*[10] During this event, Mitchell demonstrated the use of destruction as a means to control the debate on the importance of airpower and the need for a separate air service. The record suggests Mitchell surmised the effect of destruction

of this prized ship, a key strategic target, which would send a shocking blow to the claims of the Navy and increase funding for the Air Corps. While not a wartime example, Mitchell demonstrated controlled destruction as a means to render ineffective the Navy claims of invincibility of the battleship and garner control over the national debate. He knew the mere demonstration of the capability would radically alter the balance of discussion on the use of battleships as the primary means to defend the nation in the post WWI period. While Mitchell had to destroy the ship to demonstrate his point, he used limited destruction to demonstrate and control the debate. This eliminated the key target and forced decisions against the Navy resulting in the building of fewer battleships and more funding for airpower.

The period of 1919 to 1939 was dominated not only by a struggle for recognition of airpower, but also with the establishment of a strategic thought and the resources to implement it. Strategic thought found a home at the Air Corps Tactical School (ACTS) which was established at Langley Field, VA in 1920 and where "…early visionaries and proponents had made great claims for air power"[11] ACTS believed they could reach and destroy their targets, and rested these beliefs on certain basic principles:

> 1. Modern great powers rely on major industrial and economic systems…the disruption and paralysis of these systems undermine both the enemy's *capability* and *will* to fight (emphasis in original).
>
> 2. Such major systems contain critical points whose destruction will break down these systems, and bombs can be delivered with adequate accuracy to do this.
>
> 3. Proper selection of vital targets in the industrial/economic/social structure of a modern industrialized nation, and their subsequent destruction by air attack, can lead to a fatal weakening of an industrialized enemy nation and to victory through air power. [12]

These ideas formed by ACTS are characterized as a theory of denial.[13] Airpower could break down the enemy's "will to resist" and "capacity to fight" by "destroying organic industrial system in the enemy interior that provided for the enemy's armed forces in the field, and paralyzing the organic industrial , economic, and civic systems that maintained the life of the enemy nation itself."[14] Strategists carefully studied the connectivity between key systems in defining vital targets.



Source: Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, p. 11.

Figure 2. WWII Air Campaign Attack Scheme

The belief in paralysis of the enemy systems led to the targeting decisions for the WWII strategic air campaign. "(ACTS) favored…paralysis of national *organic systems* on which many factories and numerous people depended…(emphasis in original)."[15] Another way to think of this strategy is shown in Figure 2. As a result of resources limitations, targets were attacked in series. Typically, all of the resources went to a single target set. WWII planners had to completely destroy a target because if not, they would

seldom be able to go back without potentially high attrition of aircraft and aircrews. Multiple attacks were rarely possible and really were a continuation of the series methodology extended over time. The more resources available, the more targets to be attacked simultaneously. During this same period, improvements in precision, led to the point that "planners now believed air power, given sufficient resources and opportunity, could attack the vital centers of Germany and Japan to win decisively without defeating their armies on the ground."[16] Targeting was a critical part of the strategy, and selection of target A, B, etc. became critical. Sometimes, the target was one that needed to be destroyed simply to get to the vital targets themselves. For example, planners could not afford to lose significant numbers of aircraft on any mission to fighters or flack. Therefore, warning radar's and aircraft airfields were likely to be hit before the vital targets to keep losses within acceptable levels.

The targeting decisions from ACTS led to the approach used by the new Air War Plans Division (AWPD)[17] in July 1941 to breakdown the industrial and economic structure of Germany. These planners were previous instructors in ACTS and conducted target selection based on effects. They "...attempted to identify "service systems," i.e., systems which motivated or connected industries, rather than industries themselves. Electric power, for example, was vital to all industries, including manufacture of all munitions."[18] The team selected 154 select targets that "…were analyzed and prioritized according to their paralyzing *effects* (emphasis added)."[19] Vital targets included ball-bearings, oil, and electric power. As the planners assessed, "the minimum effect, we concluded, should be a significant decline in operational effectiveness…"[20] Two key areas related to effects come from this discussion. First, the planners *did not target every*

specific industry, but attempted to control the enemy by attacking motivating or connecting industries to see if these would have a greater effect then direct attack. Second, the goal was to provide sufficient bombing for a paralysis of the enemy, a term later used during Desert Storm. Planners

> concluded that many targets, with the possible exception of electric power generating and switching equipment, could be reconstructed or repaired within a period of two to four weeks after heavy attack. It would be necessary, therefore, that most of the targets be subjected to repeat attacks.[21]

Unfortunately, accuracy never allowed paralysis or met the strategists hopes, causing the air campaign to take much longer than expected. While attempting to deny the enemy, the lack of precision led to a strategy causing multiple attacks.

> The World War II campaigns against the German ball-bearing and aircraft production industries took seven months- in part set back by the lack of air superiority over Germany. Even with air superiority however, the transportation campaign took five months, and the oil campaign took six months.[22]

A current day evaluation suggests this approach made sense. "Against Germany and Japan, the concept of massive urban strategic attacks against the enemy homeland and their industrial capacity was a sensible approach when bombing *accuracy was not good*, precision weapons did not exist, and the war would, in any case, *last for a long time* (emphasis added)."[23] However, the ACTS planners did attempt to control Germany and render it ineffective by denying the products of their key industries. Instead, they attempted a theory of denial so airpower "…was decisive in the war in Western Europe."[24]

Historians of the period between WWII to Desert Storm often incorrectly consider airpower strategy became preoccupied with nuclear deterrence and demonstrating limited

effects based thinking. However, examples show a clear understanding of continued evolution of thought in these areas. One example is the April 1986 Libyan airstrike. When asked about the what targets to strike on the ramp at Tripoli, the response from one of the planners in his own words was "it was important to remember there was NOT a military objective in this attack. The purpose of such a raid was to demonstrate national resolve to combat state-sponsored terrorism. The target was the ramp (emphasis in original)!!"[25] As one analysis concludes, "of course, damage- particularly large scale damage- was explicitly not a major element of the strategy."[26] This raid illustrated that sometimes, the objective is simply to demonstrate national resolve and not destruction.

The Desert Storm air campaign came from the capability to conduct multiple attacks and a strategy based upon effects. In his book titled *The Air Campaign*, Col. John Warden says "the Air Campaign is, very simply, a philosophical and theoretical framework for conceptualizing, planning, and executing an air campaign."[27] This air campaign framework advanced a new theory called parallel war. This theory comes from the thinking of the enemy as a system and the characterization of this system using a five ring model. Although this model was not published in the original work and did not come about until after the experience of Desert Storm, this critical aspect of the framework was understood by the air campaign planners. These rings are: (1) fielded forces on the outside ring, (2) the population, (3) the infrastructure, (4) organic essentials, and in the center, (5) leadership. "The theory of parallel war holds that simultaneous and coordinated operations against all the key nodes in the system and in each of the rings are the essence of a new kind of offensive military campaign."[28] Figure 3 shows the concept

of parallel war as the ability to attack all the enemy centers of gravity simultaneously. Targets can be attacked across a full spectrum and not just in a sequential pattern. A key

MULTIPLE
ATTACKS

Target A	Target B	Target X
1	1	1
2	2	2
3	3	3
4	4	4

Source: Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 11.

Figure 3. Desert Storm Air Campaign Parallel Attack Scheme

part of the strategy then becomes the prioritization of the targets to gain the greatest effect. Parallel war results from "…the combination of mature airpower technologies with a strategy based upon achieving systemic *effects* rather than individual target destruction."(emphasis added)[29] Planners used the five rings as a guide to select targets that would have the greatest effect. "Action to induce specific effects rather than simply destruction of the sub-systems making up each of these strategic systems or 'centers of gravity' is the foundation of the concept of parallel war."[30] One of the powerful aspects of parallel war and effects comes from an understanding of "…how time and space are exploited in terms of what effects are desired."[31] Timing and the ability to attack all targets simultaneously are critical, with emphasis on the leadership followed by organic essentials, and the infrastructure. This inside-out approach, as it is known, sought to best

"isolate Hussain, eliminate Iraqi offensive and defensive capability, incapacitate national leadership, reduce threat to friendly nations and minimize damage to enhance rebuilding."[32]

The strategic ring methodology helps to better explain the changes in methodology that developed over time. Surface battles historically proceeded from ring five to ring one in sequence and can be symbolized by sacking the capital and capturing or executing the opposing monarch. Douhet wanted to skip ring one and go directly to ring two. Mitchell wanted to attack ring 1 but later switched to ring three. AWPD-1 sought to skip rings one and two and go directly to attack rings three and four. Warden sought to attack all the rings simultaneously. If there are more targets than capabilities, the most important targets would be determined and attacked based on their strategic importance. A lot of thought went into the development of what targets to attack, and some important points about this terminology must be clearly understood.

It is important to summarize the theories and targeting strategies of airpower discussed in this chapter and how they relate to effects. The theories discussed represent how we can characterize a given capability in terms of its ultimate end result: to punish, to deny, or to paralyze.[33] To accomplish these ends, Douhet, Mitchell, ACTS and Warden developed the targeting strategies summarized in Figure 4. When discussing and effects.

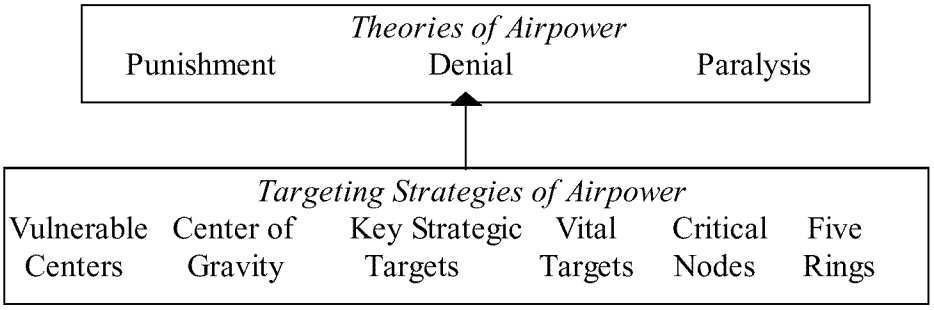


Figure 4. Theories and Strategies of Airpower

based strategy, we are discussing a strategy that has elements in each of the targeting strategies described. These strategies, whether designed to attack the center of gravity or critical nodes of the enemy, were developed primarily based on destruction and describe the best beliefs on what to target to achieve the desired ends. From the discussion above, it is reasonable to conclude that effects did play a role in what targets were selected. So why is this important to effects?

Subtly, we all already have a basis of thought and personal examples of the usefulness of effects. We exercise these same ideas when we choose to punish our children for being bad by sending them to their room without supper rather than spanking them. Why don't we always spank them? Maybe we believe there's a better way. But sometimes, maybe we just can't find the belt. It was not until the improvements in precision that planners could capitalize on effects in ways their predecessors could not. effects thinking is already a subtle part of our current targeting thought process. If this is true, it may be more difficult for us to admit we do not really do effects planning and complicate the problem of admitting we do not do it well. This history sets our frame of

reference about how we think about effects. It is important to understand this fact along with the parallel evolution of precision in setting any future strategy.

Notes

[1] Handel, Michael I. *Sun Tzu and Clausewitz Compared*, (Strategic Studies Institute, U.S. Army War College, Carlisle Barracks, PA, 1991), 5.

[2] Air Force Office of History, *Command of the Air* (using the version reprinted from the USAF Warrior Studies by the Air Force Office of History as part of material provided to students at Air War College, Class of 1997), 333.

[3] Ibid., 332.

[4] Ibid., 315.

[5] Ibid., 329.

[6] From a briefing presented to Air War College on 23 September 1996. Under the schools non-attribution policy, the briefer is not listed.

[7] Air Force Office of History, *Command of the Air* (using the version reprinted from the USAF Warrior Studies by the Air Force Office of History as part of material provided to students at Air War College, Class of 1997), 329.

[8] Carl von Clausewitz, *On War*, ed. And trans. Michael Howard and Peter Paret (Princeton N.J.: Princeton University Press,1976), 357.

[9] Air Force Office of History, *Command of the Air* (using the version reprinted from the USAF Warrior Studies by the Air Force Office of History as part of material provided to students at Air War College, Class of 1997), 358.

[10] From a television show on Public Broadcasting Service entitled *Billy Mitchell versus Military Tradition: Trial in Airpower*. This show was part of a series entitled *Men In Crisis*, A David L. Wolper Production. Also see Wesley Frank Craven and James Lea Cate, *The Army Air Arm Between Two Wars, 1919-1939*, (Reprinted from The Army Air Forces In World War II, Volume 1, Chapter 2, 1983), 17-33, 672-673.

[11] Maj. Gen. Haywood S. Hansell, Jr., *The Strategic Air War Against Germany and Japan: A Memoir*, (Office of Air Force History, Washington DC, 1986), 7.

[12] Maj. Gen. Haywood S. Hansell Jr., *The Air Plan That Defeated Hitler*, (Higgins-McArther/Longino and Porter, Atlanta GA, 1972), 7-10.

[13] From a briefing presented to Air War College on 23 September 1996.

[14] Maj. Gen. Haywood S. Hansell Jr, *The Air Plan That Defeated Hitler*, (Higgins-McArther/Longino and Porter, Atlanta GA, 1972), 11.

[15] Ibid., 12.

[16] Mark A. Gunzinger, "Towards Flexible Theater Air Warfare Doctrine", *Air Power History,* (Winter, 1996): 54.

[17] The Combined Bomber Offensive can be considered in many ways a an effects-based strategy. It used a lot more resources and took longer than a similar campaign today with precision. The difference is based on precision that will be described in Chapter 3. Effects has to be thought of as outside the realm of destruction.

[18] Maj. Gen. Haywood S. Hansell Jr., *The Air Plan That Defeated Hitler,* (Higgins-McArther/Longino and Porter, Atlanta GA, 1972), 84.

Notes

[19] Maj. Thomas P. Ehrhard, *Making the Connection, An Air Strategy Analysis Framework*, (Air University School of Advanced Airpower Studies, Air University Press, April 1996), 36.

[20] Maj. Gen. Haywood S. Hansell Jr., *The Air Plan That Defeated Hitler,* (Higgins-McArther/Longino and Porter, Atlanta GA, 1972), 85.

[21] Ibid., 86.

[22] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), a similar version of this chart is contained on page 11.

[23] Frederick L. Frostic, Former Deputy Assistant Secretary of Defense (Requirements and Plans), Washington D.C., "The New Calculus: The Future of Airpower in Light of Its Growing Qualitative Edge*"*, *Draft Version*, (December 1996): 34.

[24] The United States Strategic Bombing Surveys, (Reprinted by Air University Press, Maxwell AFB, AL. October 1987), 37.

[25] Maj. Thomas P. Ehrhard, *Making the Connection, An Air Strategy Analysis Framework*, (Air University School of Advanced Airpower Studies, Air University Press, April 1996), 46.

[26] Ibid.

[27] Col. John Warden, *The Air Campaign*, (Pergamon-Brassey's International Defense Publishers, 1989), xvii.

[28] Colonel Richard Szafranski, "Parallel War, Promise and Problems", *U.S. Naval Institute Proceedings*, (August 1995): 57.

[29] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 12.

[30] Ibid., 5.

[31] Ibid., 4.

[32] Richard P. Hallion, "Precision Guided Weapons and the New Era of Warfare*"*, *Air Power History*, (Fall 1996): 10.

[33] The discussion of theories may cause some readers confusion when applied to effects. Each of the various theories being discussed by various authors such as Pape, Warden or Schelling, as examples, go into significantly greater detail and discuss more the connection of ends and means. For example, there are volumes of literature on compellence theory which has many similarities to effects. My only purpose here is to use these to show how these theories connect to effects and that effects is not a theory. It is instead more akin to a targeting stratgey that is somewhat Wardenesque in its view.

Chapter 3

The Parallel Evolution of Precision

Prudence dictates that promise of change and revolution in the conduct of war should be viewed with a healthy dose of skepticism.

—Col. Dave Deptula

One of the most important capabilities in airpower since WWI is precision[1] and the precision weapon "…which can be aimed and directed against a single target, relying on external guidance or its own guidance system."[2] Imagine a WWI aircraft, flying over the trenches, with an accuracy to drop bombs within a few feet of its intended target. Just as capabilities of the aircraft evolved from the Wright Flyer to the B-2 Spirit, so has precision. Imagine a WWI aviator being brought back to life today, being told of the new capabilities. We would probably expect a considerable amount of prudence and skepticism. The terms precision and its application in precision weapons has undergone a remarkable change in the last fifty years. Starting with the development of non-precision weapons in WWI, the improvements to accuracy can be considered nearly revolutionary. "One of the major advances in air warfare…has been the remarkable improvement in bombing precision."[3] It is hard to imagine, even today, how the strategic bombardment campaign of WWII could have been conducted if the precision of the day was improved. While the strategic thought of the previous chapter evolved from WWI to the present, so

did the capabilities of precision. This chapter will address this evolution of precision and how they have advanced an effects-based strategy of precision weapons.

The background of non-precision weapon development helps explain the limited capabilities of precision and precision weapons in WWII. Precision implies a quality of exactness. When one thinks of exactness, they usually think of some scientific number, some measurable standard to quantify results. Unfortunately, this application of exactness for munitions is measured in probabilities. Precision is not an absolute measure, and our understanding of precision's measure has changed over time. While some historians trace the development of precision weapons to advances in artillery bombardment in WWI[4], most agree the concept of precision gained it's first true test in the strategic bombing campaign of WWII. Day after day, allied air crews risked their lives, attempting to drop unguided bombs within lethal range of their targets. Prior to WWII, planners had to account for many uncontrollable factors that determined the weapons ultimate accuracy. Due to the uncontrollable nature of some of these parameters, planners actually used the results from bombing tests to determine probabilities, and then used these to determine the number of munitions and aircraft required. "We worked up tables of probability based on peacetime, daylight, visual bombing practice. These served as a guide in selecting the size force that would assure the desired bomb hits and destruction."[5] Part of the problem of precision was self-induced, as planners based all of their decisions on mathematical models to assess performance.[6] In these theoretical calculations, planners determined the probability of success as measured by the size of an imaginary circle where a certain percent of the bombs would fall.

> After further analysis of the 154 targets, we concluded that we were in a position to determine the total number of bombardment operations

> necessary to achieve the required degree of destruction, disruption, or neutralization of each system for a period of six months or longer. This in turn was based on a fairly detailed analysis about the proper bomb to use against each particular structure, and the number of hits that would be required to cause the necessary damage. After that, we could determine the number of bomb drops required to achieve a high probability (90 percent) of obtaining that number of hits on each target....Using probability tables for multiple attacks, the number of bombs which should be dropped to obtain 90 percent chance of securing at least the desired number of hits on each target was computed, taking into consideration the size of the target and the 1,250 foot probable error.[7]

This approximation for precision was called circular error probable (CEP). The calculated CEP was based on a variety of factors. These included bomb aerodynamics, bombsight technology, release altitude and navigation techniques, just to highlight a few factors. As these various factors influencing bombing accuracy improved, so would the CEP. Consider the results of a 2,000 pound bomb trying to hit a 60 by 100 foot target from medium altitude with a hit probability of 90 percent. It required 3,024 aircraft dropping 9,070 bombs for destruction of this single target.

The hoped for improvements in accuracy developed in training and testing could not be applied in practice and ACTS was never able to achieve its desired accuracy.

> Before the war, the U.S. Army Air Forces had advanced bombing techniques to their highest level of development and had trained a limited number of crews to a high degree of precision in bombing under target range conditions, thus leading to the expressions "pin point" and "pickle barrel" bombing. However, it was not possible to approach such standards of accuracy under battle conditions imposed over Europe.[8]

Unfortunately, precision remained a problem as "in the fall of 1944, only 7 percent of all bombs dropped by the 8th AF hit within 1,000 feet of their aim point."[9] The strategy of ACTS was unable to be achieved due to the limitations of precision. Would the strategy still be hostage to these limitations forever?

While non-precision weapon accuracy improved tremendously from WWII to Vietnam, it's inherent limitations still made targets such as bridges extremely difficult to destroy, especially in light of the increasing capability of defensive systems. Continued technological improvements led to some significant changes in precision between WWII and Vietnam, as shown in Table 1.[10]

Table 1. Comparison of Unguided Munition Accuracy

War	Number of Bombs	Number of Aircraft	CEP (feet)
WWII	9,070	3,024	3,300
Korea	1,100	550	1,000
Vietnam	176	44	400

Despite the improvement from 3,330 feet to 400 feet during Vietnam, many limitations existed, including the lack of consistent weapon ballistics.[11] These problems led to the search for techniques to improve precision. The increasing defensive capabilities of surface to air missiles coupled with the inaccuracy of non-precision weapons meant that key targets could not be destroyed without considerable risk to air crews.

The key breakthrough turned out to be an ingenious combination of new and old technologies: laser (light amplification by stimulated emission of radiation) technology coupled with the development of modular guidance units and stabilizing fins. Air Force scientists, contemplating the potential of the lasers narrow and pointable beam, investigated its potential for military applications. In 1965, the Air Force launched a laser guided bomb (LGB) development effort called Paveway that lead to the first tests in

1968.[12] The first laser guided weapons were developed as general purpose bombs with the addition of a detection system to detect the reflected laser energy along with the addition of a set of canards to provide steering controls and finally, a wing assembly to provide additional lift. The modular guidance units and fins were added to existing weapons such as Mk. 84 (2000 pound) bombs. The addition of lasers required the development of a small receiver in the nose of the weapon and the development of small laser guns to illuminate the target. Air crews would operate these devices by holding the spot of light from the gun on the target until weapon impact. Pointing a laser gun at 450 knots was a problem and eventually, lasers were coupled with other more sophisticated pointing systems to make it easier for the air crew to keep the laser energy on the designated target. Despite the potential of this new capability, "the results were mixed, in part because of the newness of the weapon and inexperience of the operators."[13] Considering the tremendous technological hurdles these new weapons needed to overcome, these new devices were still able to achieve accuracy's on the order of 20 feet of the aiming point.[14] Non-precision weapons, with accuracy's of 400 feet, could now be replaced by precision weapons that could achieve a 20 fold increase in accuracy. The demonstration of this striking new capability was when laser guided bombs achieved "graduation day" against a target, non-precision munitions could not destroy. "The modern precision weapon era may be said to have begun on May 13, 1972, when four flights of laser-guided-bomb-armed McDonnell F-4 Phantoms perfunctorily took down the Thanh Hoa Bridge in North Vietnam, a notorious graveyard for dozens of strike aircraft and airmen for the previous seven years."[15] Precision, when defined as the ability of a single bomb to be able to hit it's intended target, had finally arrived. Later, these

weapons played a major role in support of the Linebacker campaigns. During this campaign, continued improvements led to "...the 2,000-pound Mk. 84s demonstrated accuracy's within six feet of their aiming point when used against bridges and other targets."[16] Unfortunately, the lack of any number of meaningful targets like those identified in WWII led to an improved technology and ineffective strategy for its employment. So while these new systems significantly improved the bombing accuracy over non-precision weapons, few looked to new strategies for employment but instead, continued to focus on improvements in accuracy in the post-Vietnam era.

"Developing even more sophisticated and capable LGBs in the post-Vietnam years assumed a high priority…"[17] and led to the capabilities available during Desert Storm and Bosnia. The Paveway I and later Paveway II series of laser weapons from Vietnam developed several GBU-10, GBU-12 and GBU-16 variants.[18] The Paveway II series had folded wings and improved proportional guidance, improved aerodynamics along with a more sensitive seeker. Proportional guidance allowed for additional improvements in weapon accuracy, improving the CEP below six feet. Despite the vastly improved performance of the Paveway II series, the designers had optimized it for release from medium altitudes. This placed the air crew in a position of being unable to identify targets in many areas of the world where heavy defended threats and persistent clouds exist. Tactics changed based on the intensifying threat conditions, but the weapons also needed to change to adjust. This led to the development of the Paveway III series continued improvements such as the GBU-24 in 1976.

Paveway III's contained an on-board auto pilot stabilization for better release and in-flight performance, a scanning seeker to improve target acquisition, as well as an

expanded release envelope allowing lower altitude releases. Low altitude releases included a pre-programmed increase in altitude through the auto-pilot to help avoid enemy defenses. The robust Paveway III's design could be fitted to Mk. 84 conventional bombs with the BLU-109 or I-2000 hard target penetrator. F-15E's and F-16's could carry the GBU-24.[19] A derivative, the GBU-27, was developed with slight modifications for carriage on the F-117A. While the accuracy of non-precision weapons continued to improve during this same time frame, the capability of these precision weapons far exceeded its non-precision brother. The combination of improvements provided the military with weapons of accuracy's below 6 feet and the ability to destroy hard targets such as underground bunkers and hardened shelters. This GBU series of precision munitions, developed from the experience of Vietnam, served as the primary weapons used during Desert Storm. The weapons used in Bosnia utilized the same precision capabilities as during Desert Storm. These capabilities, tested in the desert, were now being asked to perform in a new role.

This historic view of precision helps to further explain how the various strategies from WWII to today are limited by the capabilities of precision. The embryonic capabilities of WWII led to the emerging capabilities of Vietnam and not until Desert Storm did it produce the substantially matured result. Improved aerodynamics, fuses, guidance units, reliability, testing and training all played a contributing role. The discussion highlights the role of precision to the application of a given strategy. The development and understanding of precision became an integral part of the strategy used in the Desert Storm air campaign. This capability forms a fundamental pillar of parallel war and an effects-based strategy. The advent of the precision weapon reduced the

number of assets, both aircraft and weapons, required to destroy a critical target making parallel war possible. With this background on precision, it is now possible to look further at the evolution of effects-based capabilities in Desert Storm through an analysis of the actual results achieved. Now, the capabilities for a single aircraft and bomb to destroy a target could eclipse what during WWII might take several hundred aircraft and thousands of munitions to accomplish.

Notes

[1] In *Firing for Effect*, Col. Deptula suggests there are three primary reasons simultaneous air attack never evolved to the degree demonstrated in Desert Storm prior to that time: the requirement for mass to overcome precision; the resources required to suppress the defenses; and the absence of an operational concept focusing on effects. I fully support this analysis. However, for the purpose of this paper, I am assuming that the enemy defenses are either limited or can be easily destroyed and we are in a situation such as Desert Storm where air superiority was achieved after the first several days. This is not to minimize the importance of stealth but simply to limit the topic. This section on precision is not intended to reduce the importance of stealth technology to today's airpower capabilities. My last assignment in the F-117 Systems Program Office at McClellan AFB, CA, I am well aware of the critical importance of stealth to defeating the growing defense threats to aircraft. However, in conflicts where we can easily achieve air superiority and non-stealth aircraft can fly and utilize precision bombs (i.e. Bosnia), precision becomes a dominant driver of an effects-based strategy.

[2] Richard P. Hallion, *Storm Over Iraq: Air Power and the Gulf War*, (Smithsonian Institute Press, 1992), 6.

[3] Ibid., 282.

[4] Some historians believe precision began with the advent of artillery during WWI. Others trace the development of precision to thoughts of strategists such as J.F.C. Fuller. See Richard P. Hallion "Precision Guided Munitions and the New Era of Warfare," *Airpower History*, (Fall 1996): 6 for additional discussion.

[5] Maj. Gen. Haywood S. Hansell Jr., *The Strategic Air War Against Germany and Japan: A Memoir* (Office of Air Force History, Washington D.C., 1986), 10.

[6] Special thanks to Lt. Col. Pete Faber, a student at the Naval War College during the fall of 1996 who discussed this subject with me and helped me gain additional insight into the problems associated wit the early attempts to characterize precision.

[7] Maj. Gen. Haywood S. Hansell Jr., *The Air Plan That Defeated Hitler,* (Higgins-McArther/Longino and Porter, Atlanta GA, 1972), 86.

[8] The United States Strategic Bombing Surveys, Reprinted by Air University Press, Maxwell AFB, AL, 36112-5532, October 1987, page 13.

Notes

[9] Richard P. Hallion "*Precision In the Modern Era*", *Airpower History*, (Fall 1996): 7.

[10] Ibid.

[11] Thanks to Lt. Col. Tom Bell, AWC who helped in understanding the problems in unguided munitions ballistics. While scientists have made tremendous improvements in unguided munitions, they inherently have certain limitations, even today. While precision allows the ability to strike targets within small CEPs, LGBs still overcame the problem of unguided weapon differences in production.

[12] Richard P. Hallion, *Storm Over Iraq: Air Power and the Gulf War*, (Smithsonian Institution Press, 1992), 304.

[13] Ibid., 309.

[14] Ibid., 305.

[15] Ibid., 305.

[16] Ibid.

[17] Ibid.

[18] GBU stands for Guided Bomb Unit

[19] F-111F aircraft were also used during Desert Storm but are no longer part of the active inventory. According to the GAO, the most effective platform of the Gulf War was the F-111F.

Chapter 4

The Demonstration of Precision and Effects

We don't go to war just to destroy something-but to attain something

—Col. John Warden, USAF

"The first night of the Gulf War air campaign demonstrated that the conduct of war had changed"[1] From the weapons literally 'thrown over the side' during WWI, and in comparison to the massive tonnage dropped in WWII, "(t)he Gulf War began with more targets in one day's attack plan than the total number of targets hit by the entire Eighth Air Force in all of 1942 and 1943."[2] Our forces went to war with a plan—to control the enemy. To better understand the capabilities of effects, we begin with examples from Desert Storm and Bosnia where an effects-based strategy was employed. Using a variety of unclassified sources, it is possible to describe our strategy and results. These real world scenarios also offer some important additional examples. From them, it is possible to better understand some of the factors that can enable or restrain any effects-based strategy. By reviewing these real world factors, it is possible to better understand the current capabilities to employ an effects-based strategy.

The plan developed for the Desert Storm air campaign was called "Instant Thunder" and identified 84 targets in 12 target sets. The target sets were:

> First, command of the air was to be gained by attacks on the Iraqi strategic air defense system and airfields. The most important centers of gravity

> were leadership and command, control and communications facilities. To eliminate long-term Iraqi offensive capabilities, the nuclear, biological, and chemical weapons research, production, and storage facilities, and the Scud missiles, launchers, and production and storage facilities were targeted. The key elements of the Iraqi armed forces and their supporting industries made up the remainder of the targets sets: the Republican Guard forces , military storage and production sites, naval forces and ports, railroads and bridges, electricity production, and oil refining and distribution facilities.[3]

These targets, as shown in Table 2, later grew as a result of a significant greater knowledge of the Iraqi leadership and military forces "after the United States focused its reconnaissance capabilities on Iraq in the fall of 1990," along with gaining a greater number of aircraft for targeting.

Table 2. Targets in Desert Storm Plans

Target Sets	**21 August**	**20 December**
Strategic Air Defense	10	27
Chemical, Nuclear, and Biological Facilities	8	20
Leadership	5	27
Command, Control, and Communication Sites	19	30
Electric Power	10	16
Oil Facilities	6	8
Railroads and Bridges	3	21
Airfields	7	25
Naval Ports and Facilities	1	4
Military Support Facilities	15	46
Scud Facilities	na	13
Republican Guards	na	0
Totals	84	237

Source: Thomas A. Keaney and Eliot A. Cohen, *Gulf War Airpower Survey Summary Report*, (Washington DC, 1993), 41.

To attack these targets, more than 17,109 precision guided munitions were expended. The largest number were laser guided bombs, with 9,368 employed.[4] The other

munitions, in order of numbers used, were air-to-surface missiles (Hellfire, Maverick), anti-radiation missiles (HARM) and cruise missiles (TLAM, ALCM) with the actual quantities shown in Table 3.[5] Compare the 9,368 laser guided bombs dropped in

Guided Weapons				
Laser Guided	Air to Surface Missiles	Anti-Radiation Missiles	Cruise Missiles	Total
9,368	5,605	1,835	301	17,109

Table 3. Guided Weapon Totals for Desert Storm

the Gulf War to Table 1 shown earlier for the number of bombs dropped in WWII. We dropped as many guided weapons in *all* of Desert Storm to destroy *all* targets as we did unguided bombs during WWII just to destroy a single 60 by 100 foot target. Guided weapons covered not only the key strategic targets, but also later, the bombardment of Iraqi aircraft shelters using to attack Iraqi armor in Kuwait.[6] With this background on the targets and weapons, there are several examples where effects-based thinking was utilized in Desert Storm.

Two specific examples from Desert Storm illustrate aspects of effects-based planning. "While the virtues of planning to achieve systemic effects were discussed early in the conceptual phase of the air campaign planning effort, initial attack planning was done on the basis of traditional destruction-based methodology."[7] In the early planning, intelligence identified two major sector operations centers (SOC's). Since each was hardened and weapons experts determined it would take 8 F-117's to destroy them. Since only 16 F-117's were available for planning at that time, destroying these targets

would use all available aircraft. This problem led to the evaluation of an effects-based solution.

> Postulating that a 2000 pound bomb could go off in the other end of the building in which the air campaign planners were working, one of the planners made a case that while the planning group might survive, if so they would abandon the facility to seek shelter. The point was that the SOC's…did not require destruction. Targeting only had to render them ineffective, unable to conduct operations through the period of the ensuing attacks by non-stealthy aircraft.[8]

The attacks on the industrial power serves as an example of how effects was a more integral part of the planning. There were two objectives in attacking these targets. One objective was "…to "cripple production" and "complicate movement of goods and services."[9] A second objective was to convince the Iraqi populace that replacement of the current leadership would provide a brighter future and we would limit damage to the economy could quickly recover.

> To comply with this guidance, targeting attempted to distinguish between short-term and long-term damage to electric power generation and oil facilities. For oil targets, this meant that Coalition aircraft would hit oil refining and storage facilities, but not oil production facilities. Within the refining target subset, aircraft would hit distribution points, not cracking towers. For electric targets, they would strike transformers, which were thought to take months to repair, instead of the generator halls, which were thought to take years to repair.[10]

Beyond these examples, it is difficult to find many examples where planning for effects overcame the pace and tempo of the daily planning cycle.

To better understand an effects-based strategy in action, one approach is to highlight some of the key factors from real world results and how they enabled or restrained the strategy. The following paragraphs will highlight some of these factors including: intelligence, rules of engagement, aircraft sensor, weapon types, and possible weapon

failures. It is important to note that these elements are not unique to effects and their specific contribution to an effects-based strategy is not always measurable.

The first factor is the collection and use of intelligence information. Intelligence provides the critical information on targets and how these targets control enemy activities. Planners use intelligence information to identify targets and route information to guide the air crew to the correct target. To fully utilize accurate precision munitions requires at least the same level of accurate intelligence. Intelligence has become the critical input prior to the use of any precision munitions accuracy. Planners also collect information on the target such as construction, size, aimpoints and the desired mean point of impact. This information helps determine the best type and quantity of munitions. Along with target selection is the need to determine the altitudes and routes. Planners must carefully select routes and headings to attack targets based on the location of surface-to-air missiles (SAMs) or antiaircraft artillery (AAA), or other threats to reduce risk of the aircraft being lost. When targets are not fixed, but mobile, such as mobile SAM's, good intelligence may not be available. All of these parameters are usually placed into some type of mission planning system to provide route and timing information to allow for the pilot to plan and execute this mission. Consider this account from Desert Storm of the difficulty in target intelligence.

> As supervisor of mission planning at Khamis Mushait, Letterman (the pilot) knew the geography of Baghdad as well as any pilot in the wing. He also knew that sixty surface-to-air missile (SAM) batteries and three thousand antiaircraft guns protected the capital. What he did not anticipate was that all of those guns and missile sites ,…would begin shooting before he made his final approach into the Iraqi capital. [11]

This was not the only incident of problems with intelligence during Desert Storm. "Failures in the intelligence and BDA process almost derailed the Gulf War air and land

campaigns, and caused serious concerns in the minds of policy-makers as to whether their goals were being met."[12]

After an attack, accurate battle damage assessment (BDA) serves as post-mission intelligence to determine the correct level of target destruction. BDA is critical to determine the level of target damage. It is an important element of effects as it helps to decide on exactly what level of re-attack is necessary. The principal source of this assessment is the intelligence community, who use a multitude of sources to assess if the desired levels of destruction have occurred. The primary source of data is imagery, with the addition of mission reports and video recordings, if available. Timeliness and accuracy of the information become critical attributes. It is essential to know the results of previous days missions to plan for the next missions targets. All of these aspects of intelligence are essential to determine if the desired effects have been achieved. Post-mission intelligence is even more critical when the specific task is not destruction but some other form of effects such as deception.

The second factor is the limitation posed by rules of engagement (ROE's). ROE's can significantly influence the selection of targets in an effects-based strategy. One common ROE is to reduce collateral damage. Senior military and civilian leaders may direct planners to ensure targeting minimized casualties and damage to civilians. As a result, specific ROE's might include prohibitions when damage might impact historical, archaeological, economic, religious or politically sensitive installations. ROE's can cause air crews to return after a mission without having released any weapons. Given these limitations in mission planning, the aircraft and air crew may be very constrained in how they deliver the weapon. "Since JFACC directives required air crews to avoid collateral

damage, some aircraft returned to base with their weapons."[13] Collateral damage was not a significant problem except for several highly publicized cases, such as the Al Firdos bunker, where "the resulting controversy over several hundred civilians resulted in tightened control from Washington of attacks into downtown Baghdad."[14]

The third factor is the type of aircraft sensor for target identification. The old adage "you can't hit what you can't see" is applicable here. Effects-based thinking requires the ability to attack targets at the desired times, and the key factor of setting the time of operations must not be limited. Low cloud ceilings can play a significant role and hinder the identification of targets. When an aircrew arrives at the target area, the aircraft's onboard sensor is typically used to identify the target. A typical system might include an onboard infrared system to acquire and identify the target and also point a laser designator. The ability of the air crew to identify targets is a direct relationship to the resolution of the infrared sensor suite and the aircraft altitude. Newer aircraft may also contain an additional navigation systems, such as the inertial navigation system or global positioning system to help in target acquisition. Unfortunately, the systems used in Desert Storm were very limited in weather capabilities. Reports correlated the performance of the F-117 and estimate they lost approximately 20 percent of its capabilities to weather restrictions alone. Overall, "…nearly nineteen percent of the strikes attempted by F-117's were adversely affected by weather (misses and no drops)."[15] This led to specific limitations on how precision munitions were selected for strategic targets. As a result "…only PGMs were used to destroy key targets in downtown Baghdad in order to avoid damaging adjacent civilian buildings."[16] As weather impacted the weapon delivery sorties, it also limited key data collection on the location of strategic targets. "Heavy overcast

during the early days of the war prevented adequate reconnaissance of many strategic targets."[17] Overall, weather was a significant problem in Desert Storm in the effects-based strategy.

Some additional results from Desert Storm highlight related problems from these three areas that can limit effects planning and operations. For example, "even the F-117s with their precision-guided munitions were bedeviled enough by clouds, enemy gunfire, and pilot error to miss their targets with a least one bomb out of four- and more than that on some missions."[18] Performance problems started the opening hours of a campaign when destruction of key targets under the concept of parallel war were essential to destroy. Concerns over weapon delivery from the F-117 was especially criticized during the first few days attacks against the enemy command, control and air defense networks.

> The three waves of stealth fighter planes flown on the night of January 30 were not atypical. Wave one-dispatched against bridges, communications facilities, a telephone exchange, and Ali al Salem Airfield- reported nine hits and five misses. Wave two struck more bridges, three airfields, and communications targets in Basrah and Umm Qasr in southeastern Iraq, with sixteen hits and twelve misses recorded. The final wave involved seven planes- three others aborted because of technical problems- that hit ammunition dumps and suspected chemical and biological facilities at Salman Pak and Abu Ghurayb; these tallied eleven hits, one miss, and two "no-drops" because of foul weather.[19]

Weather also complicated the planning and execution. Unfortunately for the Gulf War allies, "(t)he worst weather in at least 14 years… was a factor during all phases of the war."[20] The combination of weather and fears over collateral damage led to a requirement for visual identification of targets before weapon release and this had an impact on performance.

> This self-imposed constraint-a constraint not imposed by technology limitations, but rather an insurance against "collateral damage"- particularly hit the F-117s. During the Gulf War, F-117s flew 1,270

> combat sorties, and dropped 2,041 tons of bombs, 1,616 of which-79 percent hit their targets, that is, fell within 10 feet of their aiming points. Weather severely impacted F-117 operations in the first two weeks of the war, although even late in the campaign, it posed problems.[21]

The fourth factor is based on the type of aircraft and weapon selected. It is important to effects since each weapon type offers its own constraints. For example, many aircraft in Desert Storm did not have the capability to launch precision weapons. If they could, laser guided bombs still require clear line-of-sight to the target during the entire delivery phase. For laser systems, the air crew has to keep the aircraft in the target area and the designating system has to remain within line-of-sight of the target until bomb impact. One technique used by some air crews includes "buddy lasing"[22], where another aircraft uses it's laser to direct the weapon to target impact while the release aircraft performs an escape maneuver and attempts to avoid any enemy air defenses. However, this technique does not eliminate the atmospheric attenuation problems of weather and obscurants that lasers and infrared sensors both have. "Weather and cloud cover also effected the delivery of LGB. Clouds could interfere with the laser beam used to illuminate the targets, causing the LGB to lose guidance.[23] Another aspect of the weapon type clearly displays the planning for effects. "The Navy used carbon fiber warheads on Tomahawk cruise missiles during Operation Desert Storm."[24] These warheads release thousands of strands of wire or clouds of fine carbon fibers that short out power grids and produce intense, short duration fires that can disable electrical equipment. These type of weapons are designed more for specific effects than current destruction only munitions. Despite he limited number of aircraft with a precision weapon capability, the weapons used in Desert Storm proved very supportive of the effects-based strategy.

The fifth factor is rare, but material failures sometimes can occur with disastrous results. This can be critical to an effects-based strategy, especially when collateral damage is a major criteria. While rare, a fin can stick or weapon electronics package fail. Any failures in this area must be accounted as a key risk, especially in situations where collateral damage is an important consideration. One of the most significant failures of a laser guided bomb was shortly after the Al Firdos strike, when hundreds of civilians were injured due to weapon failure when "…four British Tornado's from Dhahran darted up the Euphrates to attack a highway bridge in Fallujah. A laser guided bomb, apparently equipped with defective fins, veered sideways from the river and killed an estimated 130 people in a crowded marketplace."[25] The record of performance based on pilot error, mechanical or electronic malfunctions may have been significantly worse than most official reports indicate.

> Of 167 laser guided bombs dropped during the first five nights of combat by F-117s, considered the most accurate aircraft system in the allied arsenal, seventy six missed their targets because of pilot error, mechanical or electronic malfunctions, or poor weather. None of those was acknowledged by Riyadh or Washington.[26]

From the discussion above, it is clear that the results from Desert Storm should cause some concern in the development of any effects-based strategy. A sensitivity of each of these factors to any strategy must be evaluated and thoroughly understood. Conditions established by military and civilian leadership can significantly impact results, such as altitudes and ROEs. The air crew may be given conditions that bound their capabilities in the conduct of their mission. It is critical to use these inputs to describe current and potential limitations from strategy or tactics in precision munition employment. "Accuracy of intelligence estimates was the single most controversial issue during the

entire air campaign, particularly bomb damage assessment."[27] Serious disagreements between planners and intelligence arose over the level of destruction. Satellite photographs and aircraft video analysis were not effective from the medium altitudes to accurately determine the BDA. Precision munitions penetrated targets such as aircraft shelters leaving only a small entry hole. It was nearly impossible to determine the amount of destruction internal to the target.

> Unlike the saturation bombing of World War II, when destruction of a ball- bearing plant or aircraft factory could be gauged by the depth of the rubble or square footage of roof demolished, the damage wrought by precision munitions was often hard to assess." A 2000 pound laser-laser guided bomb might punch a hole in the roof and vaporize the contents of a building, but BDA analysts, limited to photographs of the penetration hole, would report, "possible damage to roof.[28]

Poor weather also plays a key role in incomplete BDA. The result was many unnecessary re-attacks against targets already destroyed. "Classic examples exist of intelligence underestimation of Iraqi losses, each of which might have resulted in unnecessary follow-up strikes that could have produced lost aircraft and captured or killed air crews."[29] These examples, as the example of the hole in the roof noted above, were not fully understood until after the war, when planners were able to inspect the actual damage at Iraqi airfields. Timing becomes one of the critical elements in BDA. Due to the quicker speed in obtaining and reviewing the aircraft video, planners had videotape recording flown to Riyadh for analysis and used it for BDA purposes. All of these factors proved to be extremely important and led to varying degrees of success for effects in Desert Storm.

Since Desert Storm, the operations in Bosnia as a part of Deny Flight and in Deliberate Force followed the success in Iraq. "The U.S. success in Operations DESERT STORM and PROVIDE COMFORT helped strengthen the airpower option. In northern

Iraq, PROVIDE COMFORT was effectively changing Iraqi aggression against a lightly armed Kurdish population."[30] Based on these successes and in response to Bosnian Serb forces in the former Yugoslavia, Operation Deny Flight started on 12 April 1993. Its objective to was to conduct aerial monitoring and enforce compliance with United Nations Restrictions which banned flights by fixed-wing and rotary-wing aircraft in the airspace of the Bosnia-Herzegovina No Fly Zone.[31] While Deny Flight did demonstrate UN resolve, the widespread use of helicopters by all sides required such complex rules of engagement that NATO "defined away" the problem. [32] Continued shelling with weapons prohibited by the United Nations continued and a mortar attack on the Mrkale market in Sarajevo, broadcast on CNN immediately after the attack, led to the initiation of Operation Deliberate Force. Deliberate Force was a denial campaign to reduce offensive military action.[33] From August 30 through September 14, 1995, American airpower dropped 622 precision munitions, consisting of 567 laser guided bombs. [34] Targets consisted of command and control, communication and integrated air defenses. The results were outstanding and "a total of 67 percent of all such targets engaged were destroyed; 14 percent experienced moderate to severe damage, 16 percent light damage, and only 3 percent were judged to have experienced no damage."[35]

Following the previous discussion on key factors, some important observations can be made about effects. One key consideration was the targeting of the enemy integrated air defense system as a part of gaining air superiority. Unfortunately, targeting an area around Bajja Luka "…caused consternation among our allies, and enraged the Russians."[36] Avoiding the threat by changing ingress and egress routes may have been a better option. Intelligence also was very important. Unfortunately, the battlefield maps

and intelligence scenario changed daily. While various positions conducted mortar attacks against Sarajevo, intelligence was unable to determine who fired the rounds. Another intelligence failure was the incorrect identification of a Bosnian Serb SA-6 battery that shot down Captain Scott O'Grady's F-16 over Northern Bosnia. "Consequently, NATO sent HARM (High Speed Anti-Radiation Missile) equipped aircraft into Bosnian airspace and reassessed the intelligence failure that contributed to the shootdown."[37]

Another key factor from Deliberate Force was the establishment of Rules of Engagement. These rules, like Desert Storm, had to worked out with coalition partners. In an attack at Udbian to damage the runway, Gen. Ryan said "our intention was to limit collateral damage. We did not want to go outside the airfield area, and we wanted to limit the number of people on the ground who might be casualties."[38] Weapon selection was also based on concern over collateral damage. "Targets located close to concentrated populations were hit by precision weapons and the non precision weapons were used where the risk of collateral damage was lower."[39] These sensitivities came from Gen. Ryan, who did everything he could to avoid collateral damage and "…was directing a NATO operation with allies that would have been much more alarmed than the US by significant amounts of collateral damage."[40] All fifty-six targets were pre-approved by Gen. Ryan personally along with their 338 associated DMPI's (desired mean point of impact).

Two additional factors that contribute to effects and were factors in Bosnia were the types of munitions and aircraft used along with the threats encountered. One dilemma was the lack of precision delivery capability by all the NATO aircraft. As a coalition

effort, it was important, as during Desert Storm, for all participants to contribute. As a result, "targets located close to concentrated populations were hit by precision munitions and the non precision weapons were used where the risk of collateral damage was lower."[41] The second concern was from the type of threat systems and the adoption of tactics from higher altitudes as in Desert Storm to avoid anti-aircraft artillery. "Because optically guided anti-aircraft artillery and infrared hand-held missiles are harder to target, NATO aircraft stayed high to avoid this threat, exposing themselves to a radar threat which HARM-shooters could target…"[42] An important element of coalition warfare is the importance of effectiveness. As Gen. Ryan said, "It may not have been an efficient use of airpower, but it was effective."[43]

The analysis of Desert Storm and Bosnia help to better understand some of the new missions an effects-based strategy must be able to support. The first is peace enforcement, as in Deny Flight. A second is as highlighted by the activities of Deliberate Force, which was a coercive catalyst to force the Bosnian Serbs to lift the siege of Sarajevo and bring the warring parties to the negotiation table. In many respects, this may be very similar to the coercive strategy employed in Vietnam to bring the parties to the peace discussions. However, concerns over collateral damage demonstrates a series of new constraints. While some of these are self imposed constraints, such as Rules of Engagement, others are factors beyond our control, such as weather. "Many proponents of air power point to the Balkan peace accord following Deliberate Force as clear proof of NATO's aerial victory."[44] While the use of airpower did not lead to a clear victory, "…it did have the effect of balancing the level of military power in Bosnia-Hertzgovina, and it demonstrated coalition resolve to end the conflict."[45] Adequate preparation,

planning and a clear understanding of he desired outcomes all played a major role in each campaigns results. The results from Bosnia and Desert Storm is "expected to serve as a template for future US conflict with a greater reliance on airborne technology, precision strike and integrated planning, and a de-emphasis of the American military's ground role."[46]

Overall, both Desert Storm and Bosnia demonstrated key aspects and limitations of an effects-based strategy and success against what we went to attain. Desert Storm showed some effects-based thought, but the predominant planning was still destruction-based. The limitations discussed in this chapter should not be construed to say that an effects-based strategy should not be pursued. In addition, "…one must not overlook the *situational* limits of air power in celebrating its signal achievement in Iraq (emphasis in original)."[47] The weather, clouds and restricted air operations and almost had a significant effect on all operations. We will never be able to control these variables. This methodology demonstrates the many variables to any strategy and the importance of having a clear plan of what you hope to attain. The following chapter continues this discussion, with a focus on several especially essential to effects- resources, planning and targeting.

Notes

[1] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 1.

[2] Ibid.

[3] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Airpower Survey Summary Report*, (Washington DC, 1993), 40.

[4] Dr. Edward N. Luttwak, "Air Power in US Military Strategy", *from The Future of Air Power in the Aftermath of the Gulf War*, (Air University Press, July 1992), 33-35.

Notes

[5] Ibid. It did appear that air launched cruise missiles were absent from the data. I believe approximately 32 were actually used.

[6] Maj. Gen. Haywood S. Hansell Jr., *The Air Plan That Defeated Hitler,* (Higgins-McArther/Longino and Porter, Atlanta GA, 1972), 86.

[7] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 9.

[8] Ibid.

[9] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Airpower Survey Summary Report*, (Washington DC, 1993), 44.

[10] Ibid.

[11] Rick Atkinson, *Crusade*, (Houghton Mifflin Company, 1993), 36.

[12] Richard P. Hallion, "Precision Guided Munitions and the New Era of Warfare", *Air Power History*, (Fall 1996): 15.

[13] Richard P. Hallion, *Storm Over Iraq: Air Power in the Gulf War*, (Smithsonian Institute Press, 1992), 305.

[14] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Airpower Survey Summary Report*, (Washington DC, 1993), 22.

[15] Ibid., 225.

[16] U.S. Department of Defense, *Conduct of the Persian Gulf War*, Final Report to Congress, (Washington D.C.), 131.

[17] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Airpower Survey Summary Report*, (Washington DC, 1993), 140.

[18] Rick Atkinson, *Crusade*, (Houghton Mifflin Company, 1993), 226.

[19] Ibid., 62.

[20] Ibid. 227.

[21] Richard P. Hallion, *Storm Over Iraq: Air Power in the Gulf War*, (Smithsonian Institute Press, 1992), 177.

[22] William Scott, "Revived Killer-Scout Tactics Leverage PGMs," *Aviation Week and Space Technology,* (October 21, 1996): 48.

[23] Thomas A. Keaney and Eliot A. Cohen, *Gulf War Airpower Survey Summary Report*, (Washington DC, 1993), 62.

[24] David A. Fulghum, "Long Range Strike Needs Drive Black Programs," *Aviation Week and Space Technology,* (February 6, 1995): 20.

[25] Rick Atkinson, *Crusade*, (Houghton Mifflin Company, 1993), 288.

[26] Ibid., 160.

[27] Richard P. Hallion, *Storm Over Iraq: Air Power in the Gulf War*, (Smithsonian Institute Press, 1992), 204.

[28] Rick Atkinson, *Crusade*, (Houghton Mifflin Company, 1993), 233-234.

[29] Richard P. Hallion, *Storm Over Iraq: Air Power in the Gulf War*, (Smithsonian Institute Press, 1992), 205.

Notes

[30] Michael O. Beale, *Bombs Over Bosnia: The Role of Airpower in Bosnia-Herzegovina*, (School of Advanced Airpower Studies, Air University, Maxwell AFB, AL, June 1996), 31.

[31] Ibid.

[32] Ibid., 65.

[33] Ibid., 55.

[34] Richard P. Hallion, "Precision Guided Munitions and the New Era of Warfare", *Air Power History*, (Fall 1996): 13.

[35] Ibid.

[36] Michael O. Beale, *Bombs Over Bosnia: The Role of Airpower in Bosnia-Herzegovina*, (School of Advanced Airpower Studies, Air University, Maxwell AFB, AL, June 1996), 74.

[37] Ibid., 52.

[38] Ibid., 45-46.

[39] Ibid., 58.

[40] Ibid., 70.

[41] Ibid., 58.

[42] Ibid., 74.

[43] Ibid., 73.

[44] Ibid., 49.

[45] Frederick L. Frostic, Former Deputy Assistant Secretary of Defense (Requirements and Plans), Washington D.C., "The New Calculus: The Future of Airpower in Light of Its Growing Qualitative Edge", *Draft Version*, (December 1996):14.

[46] David A. Fulghum, "Glosson: US Gulf War Shortfalls Linger," *Aviation Week and Space Technology*, (29 January 1996): 58.

[47] Dr. Edward N. Luttwak, "Air Power in US Military Strategy," from *The Future of Air Power in the Aftermath of the Gulf War*, (Air University Press, July 1992), 23.

Chapter 5

Clarifying Effects: Resources, Planning and Targeting

Victory smiles upon those who anticipate the changes of war, not upon those who wait to adapt themselves after the change occurs.

—Guilio Douhet

While both Desert Storm and Bosnia advanced our understanding of what an effects-based strategy is and its limitations, there are still many key elements that make up such a strategy. A critical analysis of the results from Desert Storm and Bosnia suggest several specific areas where to focus our study. If effects is to be a strategy of the future, it is essential to continue to anticipate the changes of potential enemies and incorporate it into our strategy or find another opponent who will give us 4 months time to plan such as in Desert Storm. The previous chapters allow us to now return to our iceberg analogy as shown in Figure 5 and review some of the elements. Chapters 1 and 2 highlighted what effects are and why it is important to pursue this approach. The ideas of airpower theorists, along with discussion on how effects can potentially help to control and enemy in ways beyond destruction, explains why this area has such potential as an airpower strategy. Thinking about effects is not new, but was always limited by the resources of which precision is a key factor. This resulted in the development of various targeting strategies which supported the available knowledge of the enemy and existing capabilities

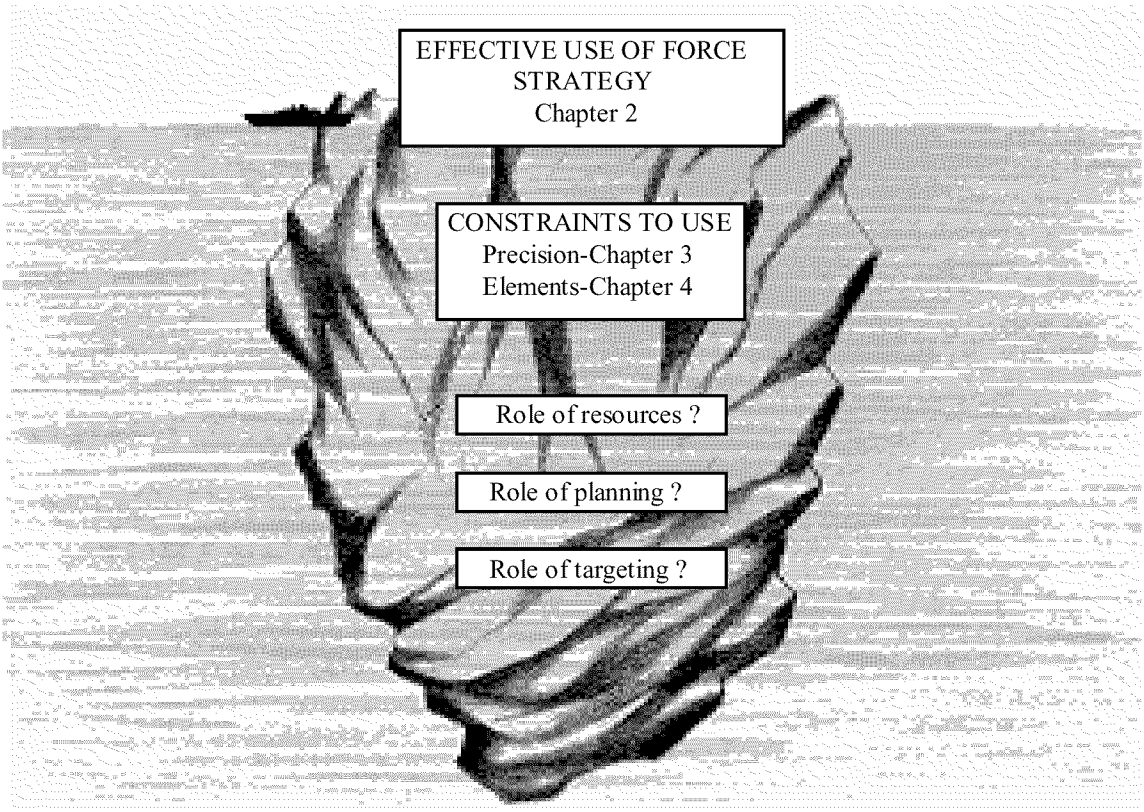


Figure 5. Critical Elements of Effects to Address

against such enemy systems. These elements of effects are the ones most commonly discussed and analyzed. Chapters 3 expand the discussion to include greater depth into the critical role of precision. While often given credit for the outstanding performance of airpower in Desert Storm, Chapter 4 demonstrated the actual performance of precision munitions deserves additional analysis as a supporting factor in effects. Desert Storm and Bosnia offer critical lessons for future planners if properly evaluated. While the discussion highlights many cautions, they should not be considered to suggest that this strategy should not be pursued. The purpose of this chapter is to further extend the discussion into three critical areas suggested by the previous discussions. These areas are resources, planning and targeting. It is important to note that any airpower capabilities are a function of the time in which they are discussed. Today's capabilities are a function

of what systems we have and how we plan to employ them. This framework is not intended to define a specific effects-based strategy to use, but instead, to suggest where additional efforts might be placed such as in improved resources.

The current and future resources available to the planner directly determine what kind of effects-based strategy that can be implemented. "Since a campaign plan is highly dependent on the weapon systems available, an effective plan must extract maximum impact from these systems."[1] Current resources determine how many of the capabilities and limitations of this strategy can be accomplished today while future procurements determine potential capabilities. The accuracy, penetration, standoff range and other key attributes of today's precision munitions are also an important part of any effects-based strategy. These weapon capabilities of the systems developed in the post-Vietnam period and used in Desert Storm and Bosnia are well understood. These weapons ultimately determine if a target can be destroyed, neutralized, or disabled. As demonstrated by the discussion of laser guided weapons in the previous chapter, the current weapons have limited capabilities beyond destruction.

The future weapons currently in development and procurement are designed to meet the primary requirements for increased standoff range and be smaller, lighter, more lethal and affordable. Their common theme is simply increased destruction at a lower cost. These systems include the B-2 Global Positioning System-Aided Targeting System/GPS-Aided Munition (GATS/GAM), the Joint Direct Attack Munition (JDAM), the Joint Air-to-Surface Standoff Missile (JASSM), the Joint Standoff Weapon (JSOW) and the Wind Corrected Munitions Dispenser (WCMD).[2] While the specific requirements for many of these systems are classified, the words such as standoff in their names clearly highlights

one aspect of their requirements. In addition, a second key driver from Desert Storm is to decrease weapon costs. With reduced budgets and the increasing criticism of the high cost of weapons, cost has gained greater emphasis. "Cost trends in precision weaponry are likely to force an evolutionary "survival of the most capable for the least cost," particularly for those military services with scarce acquisition funding."[3] The Government Accounting Office (GAO) was very critical of this in their conclusions to a recent report on service performance in Desert Storm :

> The cost of guided munitions (now estimated to be over $58 billion), their intelligence requirements, and the limitations on their effectiveness demonstrated in Desert Storm need to be considered by DOD and the services as they determine the optimal future mix of guided and unguided munitions.[4]

The GAO as well as the services are aware that the cost of munitions is critical to how many will be available for future use. GBU-24's cost approximately $73K each. JDAMs are projected to cost approximately $40K and the new GAM is projected to cost $18K.[5] Compare this to the approximate cost of a cruise missile such as TLAM that was reported by the press during Desert Storm to cost $1M each.

The debate over the future needs for precision further complicate the debate. Some analysts believe that the overall requirements for precision are anticipated to grow to account for tougher targets and collateral damage concerns. Others believe that nearly 62 percent of all interdiction type targets in a conflict in Iraq could be tasked to either guided or unguided munitions, but could fall to approximately 40 percent by 2002.[6] Despite these concerns, the continuing revolution in technology will undoubtedly continue to impact what systems are developed. While clearly improving destruction, it is unclear if these new designs are improving their use in any future effects-based strategy. Specific

details about the kinds of weapons that are best for effects are beyond the scope of this paper.

It also appears that the small number of classified weapons in development also are being designed to support a destruction-based strategy. Aviation sources report at least eight weapons programs in development.[7] "Some officials note that…current black projects concentrate more on sensors, guidance and warheads."[8] These weapons, developed secretly and not used until time of conflict, offer a key element to effects- the element of surprise when first employed. Unfortunately, many of these developments may not be based on effects-based thinking. Instead, they may be designed simply to extend the operational survivability of current generation fighters such as the F-16, F/A-18 and F-15E. Sources indicate a common theme of these developments is to "go a very long distance with great precision."[9] The development of a small number of specified weapons to support an effects-based strategy would be highly desirable.

One key future capability that could support many strategies including effects, especially in contingencies, is the ability to rapidly develop small numbers of weapons with a unique capabilities. The development of the GBU-28 during Desert Storm is one such example. As a result of the requirement to destroy some especially hardened targets in Iraq, the Air Force developed a crash program during Desert Storm to build a 4,000 lb. laser guided weapon. The weapon, designated the GBU-28, was the result of a six week effort from the initial design to operational use over Iraq. Only two were dropped just prior to the end of the campaign, the first missed the target by 500 feet due to aircrew misidentification and the second destroyed the target.[10] This capability to rapidly develop a limited number of unique systems, specifically related to effects, could provide

improved capabilities by coupling surprise with the ability to target and control an enemy in new ways. Unfortunately, it is unclear that this capability exists in any but national crises and the length of time to procure systems under the current acquisition system cannot support such developments. One hope beyond the current weapons and development difficulties is in the area of non-lethal weapons.

Non-lethal weapons offers an effects-based strategy its greatest potential resources. They include "…nonconventional weapons technologies which disrupt, degrade, or destroy (or enhance the ability of other weapons to do so) enemy capabilities throughout the conflict spectrum, and whose intent is to prevent or reduce loss of life or catastrophic destruction of equipment."[11] One such example is a high powered microwave warhead. This warhead could "…overload sensitive circuits, for example, in an underground facility with a short duration blast of microwaves and isolate the site."[12] High Power RF (HPRF) weapons could be used against vehicles and electronic devices and can be effective against vehicle ignition systems and aircraft control systems.[13] A variant of this weapon, the details of which are classified, suggests that it "…can have a very large impact on urban warfare and hostage situations."[14] Other ideas include those with extreme precision where you could destroy the room, or even a part of the room, without damage to the building or other occupants. Weapons with reversible effects also offer interesting capabilities. An example would be a weapon where we could disable an electrical production capability, yet the effects could be reversed if desired. While these ideas become more and more futuristic in nature, it is these type of weapons that allow for greater control rather than simply destruction of an enemy system.

Some of the current acquisitions are a result of the limitations from Desert Storm previously discussed and will help overcome some of the limiting factors previously discussed. Since Desert Storm, DOD has initiated acquisition programs and studies such as improved sensors for better all weather capabilities and improved battle damage assessment. A status of DOD programs to address the deficiencies identified in GAO studies after Desert Storm demonstrates significant progress is being made. A key limitation was the weather and it's impact on sensor performance. Many missions were impacted or canceled by weather and the ability of pilots to identify targets. Since then, the services have several programs such as Advanced Concept Technology Demonstrators (ACTDs) in place to develop improved sensor all weather capabilities.

> The Precision Strike Architecture Study and several proposed FY 1997 ACTDs (Counter CC&D, Integrated Sensor Tracking, Operator/Intelligence, Precision Identification/Engagement,) will give insight into improvements to the DOD's ability to locate targets, discriminate among them in varying weather and environmental conditions, assess battle damage done by prior attacks and the need for re-attack, and rapidly provide targeting-quality data to weapons/delivery platforms.[15]

These programs offer the possibility of integrating a variety of information sources together to greatly improve targeting capabilities. This fusion of sources offers the possibility to find targets in weather, locate difficult targets such as missile launchers as well as provide a real time mission planning capability onboard the aircraft.

Battle damage assessment remains one of the most controversial aspects of the Gulf War. The need for bomb damage assessment to determine success not only against specific targets, but to assess overall campaign results, is often overlooked. "Failures in the intelligence and BDA process almost derailed the Gulf War air and land campaigns, and caused serious concerns in the minds of policy makers as to whether their goals were

being met."[16] Since the war, increased cooperation between the military and other intelligence sources has begun. These improvements are essential to conducting future wars, where information warfare is expected. In these cases, "...the connection between intelligence, sensor suitability, targeting, and combat operations is obvious."[17] While overall progress is being made, it is unclear if it is directed towards effects-based thinking. Assuming we did have the resources available, what type of planning activity determine their usage?

The second element is to determine where targeting is accomplished and who is responsible for effects planning. "Targeting offers its own particular challenges for appropriate precision weapons use."[18] Just as precision munitions have evolved, so has the way we command and control air operations. Within this process must be a basis of planning for effects with properly trained and experienced personnel. The Tactical Air Control Center (TACC) from Vietnam formed the basis of the Air Operations Center (AOC) today. In Vietnam, the Tactical Air Control System (TACS) served as the command and control organization responsible for planning and execution of air resources. During Vietnam, "…ground commanders selected and prioritized targets for the majority of operations processed by the central element of the TACS, the Tactical Air Control Center (TACC)."[19] Using primarily unguided munitions, target selection and the effectiveness of destroying these targets became a key element of the TACC planning and execution. The limited number and accuracy of these earliest precision munitions was not coupled with any significant planning for effects. Problems with this system resulted not only from the lack of precision, but from process used by the TACC itself. "Improvements…between Vietnam and the Gulf War focused on improving

responsiveness, enhancing sortie production rates, and incorporating modern systems to quickly process large air tasking orders (ATO's)."[20]

The Desert Storm air campaign, as previously described, came together in late 1990 through the work of planners in the Pentagon and later in the Air Operations Center in Saudi Arabia. The initial plan entitled "Instant Thunder" described the overall concept of attacking key targets in such a manner to cause a paralysis effect on Iraq using the ideas about parallel war previously described. After a series of critical briefings to garner support for the plan, the was then handed over to a planning group in Saudi Arabia to make the modifications desired by the planners responsible for its actual implementation. This planning group was known as the Black Hole "…because of its highly classified status requiring special access clearance."[21] It was the work of these individuals who shaped the initial 84 target plan into the 237 target plan actually employed. Some of the planners who had worked in the Pentagon later became a part of (the AOC in Saudi Arabia also known as) the Black Hole effort.[22]

Since Desert Storm, the AOC structure remains the primary location for planning activities. This center is staffed by experts from each of the weapons systems; i.e. F-117 pilots, F-15 pilots and intelligence officers. According to intelligence officers familiar with the work in AOC's, there is no one trained specifically to look for effects options.[23] Using today's organizational structure, the AOCs appear ill prepared to support effects-based planning. During Desert Storm, planners relied on the Computer Aided Force Management System (CAFMS) for preparing and sending the Air Tasking Order (ATO). The interaction of the huge sortie rates and CAFMS caused problems.

> If the prime purpose of the air campaign was to attack the Iraqi ability to understand what was happening to them and defend, then attention to

> absolute physical destruction of targets-as the intelligence community recommended and the planners rejected-was unnecessary.[24]

Unfortunately, the same measures of efficiency used in Vietnam prevailed in Desert Storm. These planners "…did not limit themselves to the 'servicing of a target list' approach. The design of the air campaign grew out of a mindset questioning how to impose force against enemy systems so every effort would contribute directly to the military and political objectives of the Coalition."[25] While these planners did indeed attempt to plan for effects, as one planner from the Black Hole acknowledged, effects-based planning must still overcome the destruction-based thinking. "While the virtues of planning to achieve systemic effects were discussed early in the conceptual phase of the air campaign planning effort, initial attacks were done on the basis of traditional destruction-based methodology."[26] Despite the improvements in command and control from Vietnam to Desert Storm, the same measures of effectiveness were used. "The Air Force's measure of effectiveness in the South (Vietnam) was it's ability to strike targets requested by ground commanders efficiently. (In the Gulf War),…the Air Force's primary measures of effectiveness are still measures of efficiency."[27] Since the work of effects-based planning must be more than simply the generation of the ATO or use of the JMEM calculations to determine the best weapon and number to use. Effects requires a trained staff and process to develop effects based plans. Additional tools are available for the AOCs and improved training is increasing the capabilities of the AOC, especially in the development of the ATO. Once the ATO is published, there is little opportunity for effects-based execution.

When the ATO is published, this information is then sent to the appropriate squadrons who are ill equipped for effects-based planning and execution. At this level,

targets officers try to determine the number and type of weapons needed to achieve a specified level of damage. Planners are often given a very limited amount of time to prepare the necessary information for the next series of attacks.[28] Each wing usually has a mission planning cell composed of planners familiar with the unique characteristics of their weapons system. Here, planners determine the weapon type, aircraft performance calculations, range, route selection and a variety of other factors. At the wing and squadron level, the latitude for employment is very narrow. Within the mission planning cell is usually some type of mission planning equipment to help plan mission details. In many modern aircraft, the mission planning system produces some form of output device, like a disc for a computer, that is later loaded in to the aircraft with the planned route and other information. A common system in development for the entire Air Force is called the Air Force Mission Support System (AFMSS).[29] This system interfaces to other outside intelligence sources and prepares the output device for the aircraft. Threat and critical intelligence information is a part of the system and is constantly updated. With all of these constraints, squadron planners do not have the process, nor training to look at effects-based solutions.

Current training programs and targeting instruction offer little insight into effects-based planning. "Technology and training go hand-in-hand and a force lacking either is in serious trouble."[30] It is unclear to what extent current JFACC training programs offer effects-based planning. Written instructions, such as AFP 200-17, *An Introduction to Air Force Targeting,* also offer little methodology on effects. This particular pamphlet has not been updated since 1978. Aircrews do train for some aspects of effects, but it is unclear if all of the efforts really are effects-based or a misunderstanding of the

terminology across functions. Do we have a common language for effects across intelligence, planning and employment units? Training and support tools are needed to better understand how to plan and execute for effects. Not only must effects be well understood, but experience at conducting simulations and large scale exercises is also essential. One idea could be to develop war games at the USAF Wargaming Center at Maxwell AFB, AL, with additional tools specifically to evaluate effects. Many of the factors discussed in this paper could be used as inputs to determine the sensitivity of each factor to achieving particular results. In addition, exercises such as Green Flag and Blue Flag could be adapted to test the use of effects-based planning. Assessment tools are also necessary, and statistical and effects-based evaluation techniques could be developed.[31] The ultimate result of this effort needs to be a clear targeting strategy for effects.

The critical concern is whether the targeting strategy used in Desert Storm is the best overall strategy for effects. "As regards the use of airpower in war, all the strategy lies in the selection and prioritization of targets."[32] If this is true, a key to effects lies in the target selection process. The previous discussion on parallel warfare did not highlight that this approach does not support conflicts against *non-state systems*. If we support the parallel war model as the guide for targeting prioritization, it

> is ill-equipped to cope with organisms that are not industrialized or industrializing state systems. A terrorist or insurgent organization is a "system" that has separate component parts, and theoretically it is possible to differentiate among them, but it is not always easy actually to identify or to isolate these parts.[33]

A strategy not able to support all types of contingencies offers little help in the current environment. Clearly, the development of the ideas of effects are a means to not only to gain control over an enemy, but also to develop methods to support the many new

type of conflicts we find ourselves engaged in. The strength of the parallel war strategy is it's "promise to reduce the warmaking capacity of an *industrialized state* more rapidly (emphasis added)."[34] In cases where the enemy is not an industrialized or industrializing state system, do we follow the model directly and target their leadership, possibly being so bold as to tell them this is our intention from even before any military actions occur? If parallel war cannot address the non-industrialized states, a targeting strategy that can account for these cases must be developed. The key may not be in whether the state industrial or non-industrial, but in what knowledge of the potential enemy we possess.

It is essential to distinguish between the difference between effects and parallel war. Examples provided throughout this paper demonstrate the two terms used almost interchangeably when describing Desert Storm. However, there are important differences. The ideas of parallel war come from the improvements in precision, where one bomb can attack a single target and eliminate the need for hundreds of bombers per target. This allows the ability to strike at more key centers of gravity at the same time. The results from Desert Storm strongly suggest that parallel war using a targeting strategy of destruction can achieve the desired result and airpower can play a major role. Effects look not only at destruction, but at a variety of means to render control of the enemy. A further clarification of this point will be made in Chapter 6.

As an example of the type of analysis that is necessary to support a future effects strategy, consider the targeting of a telecommunications system. "Because telecommunications affects every aspect of a society, and is probably the most important medium which military information is exchanged, (it is important to provide) an understanding of the telecommunications system and how to best exploit it across the

spectrum of conflict."[35] Modern systems are extremely complex, and "this analysis requires a great deal of intelligence collection, therefore, it is critical to gather information on an enemy's systems well before hostilities."[36] In an excellent study on how to target such a system, the author, Maj. Gerald Hurst, identifies three attack methods-physical, jamming or spoofing.[37] Physical attack can be achieved by conventional, nuclear or non lethal weapons. Jamming focuses on particular links, messages or time periods to disrupt the network. Spoofing attempts to disrupt communications by injecting false information into the network. The strength of this study, as related to effects, is the many options and complexity of analysis displayed. The study further looks at a series of mechanisms and effects. A partial list in Table 4 demonstrates the depth of analysis and options available. "Non-lethal technologies are the only way to fully exploit telecommunications, and depending on campaign objectives, they may be

Table 4. Mechanisms and Effects for Telecommunications

MECHANISM	EFFECT
Electro-magnetic pulse (EMP)	- damage communications systems - explode ammo dumps
Antimaterial biological agents	- thicken fuels - dissolve electronics, plastics, solder and other substances
Superagents, acids, oxidizers, and solving agents	- damage tires - disable mines - blind optical ports and sensors
Polymer chemistry agents	- polymerize fuel systems - runway and roadway slippery/stick - damage power grid (colloidal dust)

Source: Major Gerald R. Hust, Taking Down Communications, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, AL, September 1994, 36.

cheaper, more effective, and less destructive (than precision guided munitions)."[38] Consider the kind of weapons necessary to cause the effects described in Table 4 and based on the previous discussion, the lack of initiatives in these areas.

Another study looks at the complex behaviors and characteristics of economies. In this analysis, the author, Maj. Steve Rinaldi contends that planners have overlooked the interrelated nature of a nation's infrastructure and employed reductionist targeting techniques. "Typically, they split the an economy into individual target sets. Then, they select targets in each set in isolation from other targets, without anticipating the *holistic effect* of air bombardment."[39] This holistic approach is an essential element of any effects-based strategy and would help identify potentially different targets based on the highly interconnected nature of systems. These efforts represent the kind of planning and thought necessary to really understand and plan for effects. It is unclear if the challenges to collect and assess this type of information is any more or less difficult for non-industrialized states. A clear mistake would be to assume it is significantly easier.

One key to the development of any strategy, especially effects-based, is to develop the strategy and resources in parallel. "Ironically, air power doctrine (and strategy) has not really advanced at the same pace as the technology and experience of the air forces."[40] The greatest improvements in capabilities come from the near parallel development of both the strategy and resources. With the rapid rate of technological advancement today, it is possible to advance certain technologies vary rapidly, such as through ACTD's. While major acquisition programs still endure the arduous pain of the milestone process under current acquisition rules, ACTD's now offer at least one process to field system improvements faster than in the past. While some purists contend that

strategy should drive all requirements, the length of time to complete major acquisitions with the advancing speed of technology may suggest a more interactive process is necessary where the dynamic of change may be initiated from either element. Along with the technology and strategy is the essential training for air crews and coordination with intelligence sources. The development of non-lethal weapons and an effects-based strategy to employ them could have a tremendous leveraging effect by allowing control over enemy systems through less destructive means.

A final note related to targeting is the need to develop a mechanism to account for the friction of war. How do we plan for adaptation, transformation and recovery by the enemy? Consider again the earlier example where we desired the enemy electric system to be temporarily shut down.

> If, for example, electrical power production comes under attack, the adversary might respond by shutting down all visible electrical power. This unexpected mutation makes damage assessment difficult. The air campaign planner may cope with this difficulty by forcing an extensive search for corroboration that attacks have achieved required damage expectancies, may fall into the trap of wishful thinking and reallocate sorties to other roles, or may to adhere to the installation- or target-driven air campaign plan.[41]

Consider the problems such as incomplete intelligence, bad weather limiting the number of effective flying days, or the inability to find mobile systems. All of these were realities of Desert Storm. Despite all attempts, "…the Scud missile launcher hunt was also "too hard to do" with the assets available in Desert Storm."[42] Planning must have a clear understanding not only of the desired targets and the effect the available resources can impose, but a way to correct for the inevitable failures not anticipated in the planning process. While correct planning is important to all operations, the ideas of control

suggest it is even more sensitive to mistaken intelligence or errors in execution that destruction based plans.

The three elements of resources, planning and targeting cannot be underestimated as a part of any effects-based strategy. While current and projected resources appear focused on destruction-based systems, the rapid advances of technology offer tremendous potential if we provide these requirements to the technical and acquisition communities. Planning tools and the training of effects-based planners will be challenging, but might be advanced by the use of simulations and wargaming. These modeling approaches would allow planners to see and assess the results of various strategies and also evaluate what new weapons or tactics could bring to a scenario. Targeting has always been a difficult process, but examples such as the study on telecommunications demonstrates what can be achieved. Whether you agree that these are indeed the specific actions required or not, a key goal of this discussion has been to offer several ideas and areas that have not yet developed and implemented a true methodology for implementation of effects-based strategy. Our enemies have gone to school on Desert Storm, and it is essential we anticipate the changes they will make and adapt accordingly.

Notes

[1] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 9.

[2] From a briefing to Air War College on 24 Jan 1997. The briefer is not listed under the school policy of non-attribution.

[3] Richard P. Hallion, Precision Guided Munitions and the New Era of Warfare, *Air Power History*, (Fall 1996): 17.

[4] United States General Accounting Office, *Operation Desert Storm: Evaluation of the Air War*, GAO-PEMD 96-10 Operation Desert Storm Air War, July 1996, 10.

[5] Richard P. Hallion, Precision Guided Munitions and the New Era of Warfare, *Air Power History*, (Fall 1996): 21. Unfortunately, the GAM may be a tradeoff of lower cost

for reduced accuracy. Unfortunately, it is difficult to determine what effect this will have in any given scenario and if it will increase precision munition usage .

[6] United States General Accounting Office, *Operation Desert Storm: Evaluation of the Air War*, GAO-PEMD 96-10 Operation Desert Storm Air War, July 1996, 20.

[7] David Fulghum, "U.S. Black Programs Stress Lean Projects," *Aviation Week and Space Technology*, (Feb 6, 1995): 18.

[8] Ibid., 20.

[9] David Fulghum, "Long-Range Strike Needs Drive Black Programs," *Aviation Week and Space Technology*, (Feb 6, 1995): 20.

[10] Information provided by Maj Pat Shaw, Student at SAAS who participated in the development program and who I worked with at McClellan AFB, CA.

[11] Major Gerald R. Hust, Taking Down Communications, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, AL, September 1994, 31.

[12] David Fulghum, "Long-Range Strike Needs Drive Black Programs," *Aviation Week and Space Technology*, (Feb 6, 1995): 20-21.

[13] Dr. Gene H. McCall, New World VISTAS: Air and Space Power for the 21st Century, Summary Volume, USAF Scientific Advisory Board, 15 Dec 1995, 37-38.

[14] Ibid., 39.

[15] United States General Accounting Office, *Operation Desert Storm: Evaluation of the Air War*, GAO-PEMD 96-10 Operation Desert Storm Air War, July 1996, 20.

[16] Richard P. Hallion, Precision Guided Munitions and the New Era of Warfare, *Air Power History*, (Fall 1996): 15.

[17] Ibid.

[18] Ibid., 17.

[19] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 10.

[20] Ibid.

[21] Ibid.

[22] For an excellent discussion on how the campaign plan was actually developed, see Richard T. Reynolds, "*Heart of the Storm: The Genesis of the Air Campaign Against Iraq*", Air University Press, Maxwell Air Force Base, Alabama, January 1995.

[23] This conclusion is based on discussion with several classmates at Air War College who have recent experience in AOCs.

[24] From the Gulf War Air Power Survey (GWAPS), Command and Control, 6-26, Information extracted is unclassified.

[25] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 10.

[26] Ibid.

[27] Lt. Col. J. Taylor Sink, "Rethinking the Air Operations Center: Air Force Command and Control in Conventional War, School of Advanced Airpower Studies, Air University, Maxwell AFB AL, September 1994, v.

Notes

[28] These comments are based on discussions with several F-117A mission planners who participated in Operation Desert Storm at the squadron level mission planning cell.

[29] My knowledge of the Air Force Mission Support System (AFMSS) comes from experience as the Mission Planning Integrated Product Team Lead at Sacramento Air Logistics Center, McClellan AFB CA for the F-117A. During that time, I had the opportunity to talk with several planners responsible at the wing level for mission planning during Desert Storm and developing the requirements for the F-117A AFMSS system.

[30] Frederick L. Frostic, Deputy Assistant Secretary of Defense (Requirements and Plans), Washington D.C., "The New Calculus: The Future of Airpower in Light of Its Growing Qualitative Edge", *Draft Version*, (December 1996): 21.

[31] For additional information on statistical and assessment tools, see Lt. Col J. Taylor Sink, Rethinking the Air Operations Center, Air Force Command and Control in Conventional War, School of Advanced Airpower Studies, Maxwell AFB AL, September 1994.

[32] Dr Edward N. Luttwak, Air Power in US Military Strategy, from The Future of Airpower in the Aftermath of the Gulf War, edited by Richard H Schultz Jr, Air University Press, Maxwell AFB, AL, July 1992, 24.

[33] Col. Richard Szrafanski, "Parallel War: Promise and Problems," *U.S. Naval Institute Proceedings*, 121 no.8 (August 95): 58.

[34] Ibid.

[35] Major Gerald R. Hust, Taking Down Communications, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, AL, September 1994, v.

[36] Ibid., 13-14.

[37] Ibid., 17-22.

[38] Ibid., 29.

[39] Maj. Steven M. Rinaldi, Beyond the Industrial Web: Economic Synergies and Targeting Methodologies, School of Advanced Airpower Studies, Air University Press, Maxwell AFB, AL, April 1995, v.

[40] Frederick L. Frostic, Former Deputy Assistant Secretary of Defense (Requirements and Plans), Washington D.C., "The New Calculus: The Future of Airpower in Light of Its Growing Qualitative Edge", *Draft Version*, (December 1996): 24.

[41] Col. Richard Szrafanski, "Parallel War: Promise and problems," (*U.S. Naval Institute Proceedings*, 121 no.8 (August 95): 60-61.

[42] Frederick L. Frostic, Former Deputy Assistant Secretary of Defense (Requirements and Plans), Washington D.C., "The New Calculus: The Future of Airpower in Light of Its Growing Qualitative Edge", *Draft Version*, (December 1996): 10.

Chapter 6

Conclusions

The general who makes many calculations in his tent is the one who wins in the field.

—Sun Tzu

For a final time, let us return to the aviator of WWI, who now has at his disposal the capabilities of today's modern weaponry. It is now time to plan how to best utilize them in a real world contingency never contemplated in any previous planning. Assuming the strategy and planning for effects has been accomplished, he might now have a wide variety of options not previously possible. Instead of just being concerned with destruction, he now can begin to think about the ability to disable, negate, threaten or even avoid. In a true effects-based strategy, planners would not only be concerned with the number of targets they could attack in parallel, they would also look to all other means, including ways to actually reduce destruction. The synergistic impact of effects can be the capability to attack more targets at the same time. Merely threatening a target set, or the talk of doing so, is indeed a form of effects if it gains control over the enemy. Consider Figure 6, where a variety of options are presented to achieve a specific effect. Planners may determine that the specific requirements of an attack mean it is only necessary to reduce, jam or even avoid the enemy capabilities. For example, consider a highly defended city where the concentration of defenses makes it difficult to destroy

certain targets without substantial collateral damage and risk of large numbers of civilian casualties. This type of target may be possible to simply jam when necessary and avoid at other times. In some cases, it may not be necessary to fully destroy the target. For example, if the control room can be destroyed, the rest of the facility is rendered

Target A	**Target B**
1 Destroy 0.5	1 Jam
2 Avoid	2 Negate
3 Disable	3 Reduce
4 Stop	4 Threaten

Figure 6. Example of an Effects Campaign Attack Scheme

inoperable for some period of time. This is represented by the term Destruction 0.5. Other aspects of this target may be avoided, disabled or stopped. The second target may be a communication system that was jammed and unable to talk with senior leaders would be rendered ineffective. Other aspects of the target can be negated, reduced or simply threatened. In Desert Storm, some power plant managers shut down their electric plants to avoid targeting, "the desired effect achieved without exposing Coalition members to danger, and freeing up air resources for another task."[1] What about the possibility of dropping leaflets to warn of an attack on the leadership as a way to solicit their surrender? All of these different considerations, and many more not discussed, are possible options that can be matured under a strategy of effects.

Our aviator might next look to the resources he has available to him to conduct his operations. The use of precision guided munitions has only limited utility for effects. The

current concerns over collateral damage and reducing risk of injury has made precision munitions the favored option in many scenarios. "For a nation unwilling to risk military personnel in delivering precision munitions to a target, the somewhat less precise but still highly accurate cruise missile is an acceptable alternative."[2] For example, consider the retaliatory strike against Iraq for its attempted assassination attempt against President Bush. Cruise missiles demonstrated resolve without placing lives in harms way. The new resources available to decision makers may have changed the willingness to use airpower.

> One of the greatest advantages of the precision weapon is the confidence that it can offer a decision-maker confronted with having to contemplate using force in circumstances where so-called "collateral damage" would be either unacceptable or call into question the viability of continued military action.[3]

When air superiority is available, is an A-10 or C-130 weapons of effects? While the current series of resources offer improvement over the days of Vietnam, it will take new capabilities, such as weapons to thicken fuels, polymerize fuel systems or contaminate fuel, for the full capabilities of effects to become a reality. Can you picture a laser weapon or lightweight sticky foam bomb within your available rescues.

Our aviator might then look to who and how the planning can be accomplished to conduct his operations. The earliest theorists looked at effects, but selected alternatives based on destruction. Despite the improvements in precision, only a limited improved planning capability for effects exists today. In a recent series of exercises at Air War College, students wee asked to provide a series of recommendations on airpower options to a given scenario. After multiple hours, not one option considered effects but simply destruction based options. This was especially troubling after several of the participants were experienced planners and participated in recent training on planning for future air

campaigns. We are increasing our training to plan campaigns, but it is unclear how much training on effects is being accomplished. we will have to deal with complex decisions in effects such as the following example. Consider where a town is isolated except by a single, large bridge that provides the only access to and from this large area. This bridge serves not only as a route for the enemy military forces, but also as the only way for the large farming community to bring its crops to market. How do planners assess the effect on destroying this bridge? How do you relate this bridge and the civilian welfare to the overall campaign objectives? Planners also found in Desert Storm that the number of aimpoints exceeded the number of resources available. This means some campaigns will still exceed the ability to strike all targets in parallel and some prioritization must be accomplished. The difference between aimpoints and assets influences the duration of a campaign. In some cases, we were able to effect 40 of 60 desired aimpoints on any given day. "In the developing world, we cannot predict who ones enemies are going to be, but on the basis of exclusion analysis, we can conclude they are likely to be small to midsize powers with high-tech weapons capabilities."[4] In some future conflicts, where the number of aimpoints may be very small, will a success of 40 out of 60 be acceptable? How will we be able to handle targets of lesser value and will we be willing to use expensive precision munitions against them? We must develop processes and planners to develop, test and validate these ideas before we attempt to implement them in any conflicts.

Our aviator might be especially troubled by the complicated nature of targeting. Consider Col. John Warden, who says "control of the enemy command structure, civil and military, must be the ultimate aim of all military operations."[5] Targeting itself still

appears to focus on the success of Desert Storm. "Airpower in this current form (parallel war) seems to have become the power of detached, dispassionate technology."[6] Targeting is not just the weapon employed. Instead, it is the combination of the weapon, intelligence information and other factors such as the ability to find the target in weather. It is not clear the intelligence problems of Desert Storm have been addressed and corrected. Have we only provided more sources of information rather than developed systems and processes to be sure the correct data is available to the appropriate user? Will non-lethal weapons change the kind of data needed by planners to conduct an effects campaign? Precision has become a panacea and may offer some questionable results. Can precision really solve every problem? Some authors contend

> recent examinations of airpower applications against light infantry in typical Third World crisis conditions indicate precision offers high leverage whether one is dealing with a mechanized force, a guerrilla-type army in a wooded or jungle environment, or even an individual sniper a la Sarajevo.[7]

It is unclear if we would be correct if we assume that precision is the domain of the air and airpower alone in future conflicts. As part of future joint operations, it may be better for surface forces to respond in a variety of situations such as described above. As the threat is dispersed or diminished below the strategic level, the utility of air assets may decrease while the risk to aircrews or collateral damage increases.

We return to our iceberg analogy in Figure 7 for a final time to review again the various elements we have discussed. Together, these chapters and discussion answer at a macro level some key aspects of who, what, when, where, why and how related to effects. The block of theories of airpower is added back to the chart to suggest again that these theories are all supportable under the ideas of effects.

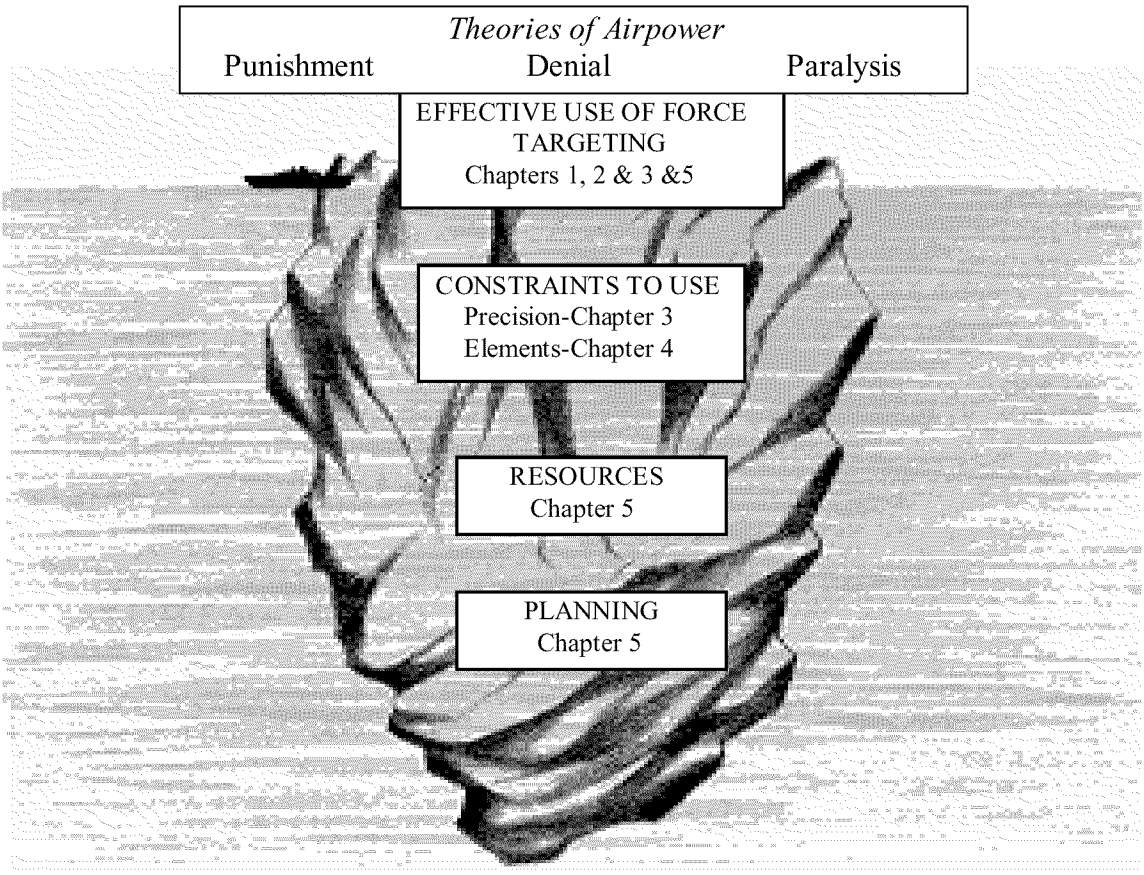


Figure 7. Elements of Effects

Targeting and an effects-based strategy should not be confused. The elements of an effects-based strategy represent the combination of all the areas discussed. "If there is a lesson to be gained from the Desert Storm air campaign, it is that airman should carefully examine their linkages between all target sets and the intended *effect on an enemy*."(emphasis added)[8] Targeting is just one portion, but often represents the most often discussed and studied aspect of any strategy. Both the general ideas and targeting for effects, when considered for precision guided munitions, represent the most well understood areas of effects. The areas below the waterline deserve the greatest attention. The resources, planning and constraint aspects of effects need attention for the many reasons previously highlighted.

The ideas of an effects-based strategy are actually complementary with one of the key Air Force core competencies of Precision Attack. Precision Attack is defined as the "ability to apply *selective* force against specific targets and achieve discrete and discriminate *effects* (emphasis added)."[9] Under this concept, it will be possible to find, fix and track anything that moves on the surface of the earth. With an effects-based strategy, the ability to strike will be dependent upon many factors, including our intelligence of the enemy. How much information do we have, or even know, about the telecommunications systems in Iraq? While technology has been a key to the improvements in precision, it will not be precision alone that will allow us to meet this core competency of precision attack in the future. Selective force is a key.

There are many other areas not covered in this paper that are important to effects that still require much greater thought and discussion. For example, we know very little about other cultures, and sometimes we do not know the importance of a target to the enemy.[10] Consider the great SCUD hunt in Desert Storm and the changes it caused. Also consider the concerns over weapon costs. Who can assess when a target is a viable one for precision munitions based on the weapon cost, the target cost (i.e. a mortar) and sensitivity to deaths. These kind of questions must become part of the discussion of effects.

Planning for effects is not simply the act of preparation. It is the capability to look ahead at the changes and develop and assess a plan without the friction of war to complicate it. Many outstanding references in this paper highlight considerable thought on areas related to effects. What is essential is the plan to put all these pieces together. Whether it is an

organization who needs to do this, or a person, as GWAPS or Sun Tzu suggested in the earlier epigraphs, it needs to be done.

> One point cannot be overemphasized: It is the *combination* of these elements, and not technology alone, that produces the exponential growth in military effectiveness…often the crucial factor in distinguishing those military organizations making a successful transition to the new military regime is no so much a technological advance as it is the vision of how the emerging technologies and military systems can best be applied through new forms of military operation, and adapting to realize that vision (emphasis in original).[11]

This paper concludes with a hope that these contents will stimulate the necessary actions to make an effects-based strategy a part of our future kit bags for conflict.

Notes

[1] Colonel David A. Deptula, *Firing For Effect: Change in the Nature of Warfare*, (Aerospace Education Foundation, Defense and Airpower Series, 1501 Lee Highway, Arlington VA, 22209, August 24, 1995), 9.

[2] Richard P. Hallion, "Precision Guided Munitions and the New Era of Warfare", *Air Power History*, (Fall 1996): 8.

[3] Ibid.

[4] Col. John Warden, "Employing Airpower in the Twenty-first Century", from *The Future of Airpower in the Aftermath of the Gulf War,* (Air University Press, Maxwell AFB, AL, July 1992): 58

[5] Ibid., 63

[6] Col. Richard Szrafanski, "Parallel War: Promise and problems," (*U.S. Naval Institute Proceedings*, 121 no.8 (August 95): 61.

[7] Richard P. Hallion, "Precision Guided Munitions and the New Era of Warfare", *Air Power History*, (Fall 1996): 14.

[8] Mark A. Gunzinger, "Towards Flexible Theater Air Warfare Doctrine," *Air Power History*, (Winter 1996), 57.

[9] Air Force Magazine, (January 97), 24.

[10] Thanks to Dr. Grant Hammond of Air War College, who helped my thinking on the difficult subject of when we might or might not employ precision munitions and how cost of the munition may preclude its use in some scenerios

[11] Andrew F. Krepinevich Jr., Competing for the Future: Searching for Major Ellis, Marine Corps Gazette, Vol. 80, No 11, November 1996, 28.

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