Keynote Speech

Planning and Executing the Desert Storm Air Campaign: An Effects-Based Approach

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Introduction

Operation Desert Storm—the military action to eject Iraq's forces from their invasion of Kuwait in 1991—was a turning point the conduct of modern warfare. The key element of Desert Storm's success was the air campaign that was launched in the opening hours of January 17, 1991.

Many books, studies, and articles about Desert Storm address the value of technology, training, teamwork, leadership, flexibility, and the preparation that went into the planning and execution of that operation, and all rightfully so. It was not any one element that led to the overwhelming success of Desert Storm, but the synergy of all these elements combined.

However, there was another key element that was crucial to the success of that air campaign that even today—over 30 years after its occurrence—few people are aware. That element was the fundamental basis for the success of the Operation Desert Storm air campaign. It was the effects-based perspective that was the basis of the planning and execution of the air campaign. It made the critical contribution to its success. By studying and understanding its impact we may be well served in applying that construct in the planning and execution of future military operations in order to achieve similar success in their outcomes.

The basic idea behind this construct—that of causal relationships in conflict—has been around for centuries—a matter of fact, it originated in the teachings of the ancient Chinese philosopher, Sun Tsu. However, it was only in the decade of the 1980s that we began to reach the levels of technology necessary to accelerate an effects-based perspective to its full potential. Ultimately, the mastering of how to achieve desired effects in any military application of force will allow us to move beyond traditional military concepts of annihilation and attrition, with their focus on destruction—as only one means to achieve control over an enemy—rather than the optimal means of doing so.

Before I get into the details of this topic, a summary of why it is important to study the Desert Storm Air Campaign is appropriate. Desert Storm was a turning point in the conduct of warfare as it set the conditions for modern warfare in five major ways:

- First, it set expectations for low casualties—on both sides of a conflict.
- Second, it foretold precision in the application of force for all future conflicts.
- Third it introduced prosecution of a combined/joint air campaign integrating all coalition/service air operations under the functional command of an airman.
- Fourth, it established desired effects as the focus of strategy and in the planning and conduct of operations.
- · Finally, for the first time in history, airpower was used as the key force-or

centerpiece-in the strategy and execution of a war.

Desert Storm was a 43-day war—airpower operated throughout the conflict from start to finish; ground forces acted as a blocking force for almost the entire war as airpower destroyed enemy forces and achieved desired effects against key systems from above. Only in the final days of the conflict were ground forces committed to combat and used to re-occupy Kuwait. In this respect, Desert Storm saw an inversion in the paradigm of traditional force application. Long-time military expert Dr. Ben Lambeth has observed that today, "the classic roles of airpower and land power have changed places in major combat. Fixed-wing air power has, by now, proven itself to be far more effective than ground combat capabilities in creating the necessary conditions for rapid offensive success."

Students of airpower must understand how to exploit the advantages of modern air and space power, for that is the only way in which it can be optimized in meeting a nation's security challenges. Failing to understand how to best optimize airpower will have severe negative consequences. That is why we should study and learn the lessons of the Desert Storm Air Campaign.

Today most have forgotten just how formidable Iraq was in 1991 as a military power. In the summer of 1990, Iraq had the world's fourth largest army with 900,000 troops. It also had the world's sixth largest air force. It had been honed in battle with Iran for the previous eight years.

Desert Storm was a 43-day war—airpower operated as the key force throughout the conflict from start to finish; ground forces acted as a blocking force for almost the entire war as airpower destroyed enemy forces and achieved desired effects against key systems from above. Only in the final four days of the conflict were ground forces committed to combat and used to re-occupy Kuwait.

Iraq—with a fully modernized, trained, and equipped force—was rendered ineffective by airpower, and driven out of Kuwait in disarray—some of its troops trying to surrender to drones—in little more than a month and half. By February 28, 1991, it was over. Iraq had hoped for a long battle of attrition on the ground in which the Coalition's advantages—airpower and technology—would be nullified or minimized. However, we built a strategy specifically designed to avoid that.

The opening air attacks of Desert Storm signaled a radical departure in the conduct of war. Over 150 discrete targets—in addition to regular Iraqi Army forces and surface-to-air missile (SAM) sites—made up the master attack plan for the opening 24 hours. And that does not include the hundreds of tactical targets in Kuwait that were also hit that first 24 hours. Combined, this amounted to over a thousand desired mean points of impact being struck in the first 24 hours of the operation.

The war began with more targets attacked in one day, than the total number of targets hit in the combined bomber offensive in Europe during the *years* 1942 and 1943 combined—that's more separate targets attacked in less time than ever before in history. What enabled us to achieve this level of impact? The short answer is the maturation of aerospace technologies merged with a theory of targeting for effects rather than absolute destruction. Advanced technology—the combination of stealth and precision—in conjunction with a planning

approach based on achieving specific effects rather than absolute destruction enabled a new concept of operations known as parallel warfare or the simultaneous application of force across the breadth and depth of the theater. Combined, it is not too strong to say that these elements became a turning point in the conduct of warfare.

In this paper I will outline each of these elements in some detail. In the interest of space, I will address some highlights on the importance of stealth and precision, and then move on quickly to describe the impact of the effects-based planning approach that was key to its success.

Precision

With respect to precision, we have made enormous advances since World War II (figure 1). In World War II it took 1000 B-17s; 10,000 men; and 9000 bombs to effectively destroy one area target like an oil refinery or electric plant. Why so much effort? Because of the inaccuracy of the targeting. The circular error probable or CEP of the weapons of the day was 1000 meters. That means that half the weapons would fall outside of a kilometer from the target and a half would fall inside a kilometer from the target. Therefore, it is no wonder why it took so much effort.



Figure 1

What took a thousand aircraft and 9000 bombs to accomplish in World War II, we could do during Desert Storm with one aircraft and one bomb—because that CEP went from 1000 meters to 3 meters. In fact, we could double the effects of a thousand plane raid, with just one F-117 fighter-bomber. Today we can do even better, achieving our objectives against multiple targets with one aircraft. We can now target 80 weapons with a single B-2 bomber on 80 separate targets. So, precision has redefined the concept of mass. If we can hit multiple targets from one bomber, we can now start planning attacks across the breadth and depth of a large area. While not to the same degree as we can today, that was what precision allowed us to do in Iraq during Desert Storm.

Stealth

Not as many people are as familiar with the leverage that stealth demonstrated in Desert Storm. The best way to illustrate the impact of stealth is with an actual example (figure 2). This example involves the first non-stealthy attack on one target in the Basrah area of Iraq—Shaiba Airfield to be exact, with three aimpoints—the hangars on that airfield.



Figure 2

The attack force package consisted of four Navy A-6 aircraft dropping bombs, along with four Royal Saudi Tornado attack aircraft dropping bombs; five Marine EA-6B electronic

warfare aircraft jamming acquisition radars; four Air Force F-4G "Wild Weasels" taking out one type of surface to air missile system (SAM); 17 Navy F-18s taking out another type of SAM; four F/A-18s as combat air patrol escorts for the attack package to defend against potential Iraqi air threats; and three BQM-74 drones launched in advance to entice the enemy to activate their radars which would then be attacked by the high-speed anti-radiation missiles carried by the F-4Gs and F-18s. In total, that is 41 aircraft, eight dropping bombs on three aimpoints at one target.

At approximately the same time I have targeted 20 F-117s—all 20 dropping bombs on 38 aimpoints at 28 separate targets. That is less than half the aircraft hitting over 1200 percent the target base. That leverage equates to a stealth multiplier of around 19. Or put another way, it took 19 non-stealth aircraft to accomplish the effect of one stealth aircraft in this circumstance.

Master Attack Plan Design

To understand how precision, stealth, the air campaign objectives, the enemy target sets and other factors were all addressed to build an effective attack plan to achieve our desired effects, I provide an overview schematic in figure 3. This chart identifies all the elements of planning that went into building the air campaign plans daily—what I called the "master attack plans." It provides an overview of how the attack plans were built.



Figure 3

We had a series of weapon systems—stealth aircraft; non-stealth aircraft; cruise missiles; helicopters; and others. We had a series of desired effects we wanted to accomplish—destroy; damage; negate; render ineffective; and so on. We had our air campaign objectives:

- 1. Gain/Maintain Air Supremacy to Permit Unhindered Air Operations
- 2. Isolate and Incapacitate Hussein Regime
- 3. Destroy Iraqi Nuclear, Biological, and Chemical Warfare Capability
- 4. Eliminate Iraq's Offensive Military Capability
- 5. Render the Iraqi Army in Kuwait Ineffective, Causing Its Collapse

Of course, we had the enemy to deal with, and we treated Iraq and the Saddam Hussein regime as a system of systems with an associated set of target categories. Each of these elements was integrated with the other elements for each specific target, and then we had a choice of either attacking the target sets in series or in a parallel attack scheme. I applied a "parallel" approach to the attack design to most rapidly achieve paralysis of Iraq's strategic centers of gravity: leadership; key essential systems; infrastructure; information; and fielded military forces.

The construct of air attack planning employed during the first Gulf War air campaign has become known as *parallel warfare*. The term comes from basic electrical circuit design. In a series circuit with several light bulbs connected to a power source, when the power is turned on, electrons flow from the power source to the five light bulbs sequentially. However, if there is a failure of one light bulb, none of the others get lit because the electricity is inhibited from flowing to the next light.

In a parallel electric circuit, the electricity is routed such that it reaches all the lights at the same time—that defines a parallel flow where electricity reached all the light bulbs simultaneously. Applying the same concept to the application of force in war yields the terms serial or a sequential attack flow, and parallel or a simultaneous attack across all the target sets.

In air campaigns before Desert Storm, force was applied sequentially to roll back enemy defenses before attacking targets of the highest value. The early warning radars had to be destroyed to get to the command and control centers that had to be destroyed to get to the airfields that were protected by surface to air missile sites and so on. Essentially, the fielded military forces were protecting the strategic targets of interest and needed to be negated before one could get to those key targets. In series warfare each target set must be cleared-away in order to hit the next one. This continues until eventually getting to the target of highest value.

Applying a "parallel" approach to targeting is designed to achieve simultaneous attack against multiple high value targets—leadership, key essential systems, and the connections between them. This magnifies surprise, widens enemy paralysis, and inflicts fewer casualties in shorter time, and with greater probability of imposing effective control over the adversary. However, the successful prosecution of parallel war requires more than compressing sequential attacks into one simultaneous attack.

Parallel war exploits three dimensions—time, space, and levels of war. In the opening hours of Desert Storm, all three dimensions were exploited: Time—as mentioned earlier within the first 24 hours, over 150 separate targets were designated for attack. Space—the entire breadth and depth of Iraq was subjected to attack. No system critical to the enemy escaped

targeting because of distance. Levels of war—national leadership facilities (strategic level), Iraqi air defense and Army operation centers (operational level), and Iraqi deployed fighting units—air, land, and sea—(tactical level) all came under attack simultaneously.

Effects-based Planning and Execution

At the time of the Iraq invasion, I was working for Secretary of the Air Force, Dr. Donald B. Rice, on his policy group in the Pentagon. By the summer of 1990 I had spent the previous six months working as the ghost writer for him on the seminal document entitled, *Global Reach—Global Power*. It was an effort to identify the U.S. Air Force role in the post-Cold War era. In 2000 the Air Force added "Global Vigilance," and today, *Global Vigilance—Global Reach—Global Power*, still stand as the six words that define the role of the U.S. Air Force in America's security architecture.

Prior to working for Dr. Rice, I worked for Col John Warden on the Air Staff, and we maintained a close working relationship when I moved on to work for the Secretary of the Air Force. On August 6, 1990, four days after Saddam's invasion of Kuwait, we met together in his office to discuss how we might help in the development of response options. That afternoon the planning effort started in the spaces of one of the divisions that reported to Col Warden. It was called, "Checkmate" and it was originally established in the 1970s as an internal Air Force wargaming center.

On August 8, 1990, the commander of Central Command, Gen Schwarzkopf asked the Vice Chief of Staff of the Air Force to put together an air option for potential use as he and his staff were overwhelmed with moving forces into theater. When the call came in, we had already been working on a plan for two days. The effort resulted in a plan Col Warden named *Instant Thunder*—a concept of operations, a draft operations plan, and an initial cut at a first 24-hour attack plan. While Col Warden and I had discussed the virtues of effects-based planning in my previous assignment working for him, the initial *Instant Thunder* attack plan was developed based on traditional destruction-based planning methodology, and here is how the original plan unfolded.

Early on, intelligence officers told us of two major sector operation centers that controlled all of Iraq's air defenses—there was one in Baghdad, and one at Tallil airbase in southeastern Iraq. These were hardened structures that Saddam Hussein had built to withstand potential nuclear attack from Iran. They consisted of 37 feet of concrete, dirt, rock, and hardened material on top of two bunkers in the basement of each facility to protect them. The intelligence officers, and the F-117 weapon officers determined that we could penetrate all this protection, but that it would take a combination of eight penetrating 2000-pound GBU-27s and GBU-10s per bunker (four-each). Because of the precision of the weapons, the F-117's could place one directly after another accurately enough to dig down to destroy the control centers in the basement. However, that would take 16 weapons per sector operations center to destroy the bunkers in each sector operation center used up all the F-117s in the original attack plan. But if that would shut down the air defenses of Iraq, it would be worth that application of resources.

On the first page of the actual Instant Thunder attack plan that we briefed on August 17, 1990, to General Schwarzkopf—the overall commander of Desert Storm— there are 16 F-117s against the two sector operation centers just as I described; four F-117s targeted with eight weapons on each side of each facility. Sixteen F-117s targeted on two sector operation centers resulted in an eight to one aircraft to target ratio.

Both Col Warden and I thought our presentation to General Schwarzkopf in Tampa would end our involvement in the planning effort. However, at the end of the presentation Schwarzkopf asked us to fly over to Riyadh the next day to brief Gen Chuck Horner who would become the combined force air component commander for Desert Storm. During that briefing I was asked by Gen Horner to remain in Riyadh. Col Warden returned to Washington, D.C. and formed an information fusion cell that was critical in supporting my planning efforts in Saudi Arabia.

Along with Brigadier General Buster Glosson, I worked for General Horner creating and refining the initial attack plans in a small room in the Royal Saudi Air Force headquarters building in Riyadh, Saudi Arabia that became known as the "Black Hole." This was because of the very highly classified nature of our planning effort; we joked that no one who ever came into the planning room could ever leave. During the war, along with help by a small group of others, I created the daily master attack plans.

Jumping ahead two weeks, in late August 1990 in the Black Hole in Riyadh we were furiously working to turn the master attack plan into an executable air tasking order for Gen Horner. On August 30, 1990, General Glosson and I flew to Manama, Bahrain to brief Admiral Mauz, the commander of all the naval forces in the Persian Gulf on the air campaign plan, and the Marine component commander, Maj Gen Royal Moore.

It is interesting to note that the air campaign plan at that time was so classified that we did not want to send it by any electronic means. After we completed the briefing to Adm Mauz and Gen Moore, and as we are taking off out of Bahrain (where the briefing took place), the C-21 we were in had a fire behind the instrument panel and the aircraft filled up with smoke. The pilot declared an emergency and we returned to land back in Bahrain.

As we were waiting for another airplane from Riyadh to come get us, I had time to read a document that I asked intelligence to give me that described the Iraqi air defense system in detail. I wanted to get more familiar with it, because up until that time I was operating only on what the intelligence personnel had briefed me. As I read the report on Iraq's air defense system, I found out that there were not just two sector operation centers in Iraq, there were actually four, and that there were three to five interceptor operations centers associated with each of these sector operation centers that could take over control from them, and that they are all interconnected. It was a fully networked air defense system. As you might expect this dramatically changed the target planning problem if we want to paralyze their air defense system in one blow.

What to do? I wanted to achieve as much impact across the entire target base as possible to achieve a debilitating effect to enable our non-stealth aircraft to ingress successfully. But there were not enough stealth aircraft to do that as the target base continued to expand. The next day in Riyadh, while sitting in our small planning room—the Black Hole—I postulated

that a 2000-pound bomb could go off in the other end of the building, and while we wouldn't be dead, we sure as heck would not hang around to finish our coffee. The realization was that we did not need to destroy each sector operations center the first night, we only needed to render it ineffective, unable to conduct operations.

Now, the F-117 had just come out from being a highly secret program and not many were familiar with its capabilities. This same day, Col Al Whitley, the commander of the deployed F-117s, was visiting Gen Horner trying to get intelligence support. I asked him just how accurate the F-117 was. His response was, "Dave, to date we have made 35 live drops and 34 have been 'shacks'"—otherwise known as direct hits.

With this information, I went back and rewrote the master attack plan not putting eight F-117s on each sector operations center, but rather only one bomb per air defense facility—and two on a couple of particularly critical targets. My idea was that we did not need to destroy the air defense facilities, we just needed to render them unusable—that was the effect we wanted to achieve. When a 2000-pound bomb explodes on the building you are working in you will get out and probably not return. That renders the facility ineffective. By taking this approach it freed up 30 GBU-10s and GBU-27s to use against other targets, namely the interceptor operations centers, biological and chemical weapons facilities, and other critical targets.

By the time the opening attacks started on January 17, 1991, because of this change in approach we had 42 F-117s attacking 76 separate targets—that is almost a one to two aircraft to target ratio. That is just over two and a half times the aircraft from the original plan attacking 38 times the target base. That is the difference between a destruction-based planning methodology and an effects-based planning methodology.

Effect-based Feedback Verses Traditional Battle Damage Assessment

A key element of any military operation is feedback on mission accomplishment. Conventional battle damage assessment or BDA is the practice of assessing damage inflicted on a target from a bomb or missile. It is traditionally performed using many techniques including footage from in-weapon cameras, gun cameras, forces on the ground near the target, satellite imagery and follow-up visits to the target. However, those means of battle damage assessment are destruction based, not effects based. During Desert Storm I did not care if the air defense operation center in Baghdad was physically destroyed or not, I just did not want it operating. Traditional means of battle damage assessment for a precision guided penetrating bomb would only show a small hole in the top of the building and therefore, traditional intelligence assessment would evaluate the facility as 100 percent operational.

Instead of relying on these conventional reports, I had a representative of the Electronic Security Command report to me every day whether or not the air defense facilities were transmitting signals. If they were not, then I would not target them. If they were emitting signals or communicating, then they would get a visit from an F-117 that night.

A traditional intelligence evaluation from the Central Command intelligence division during the war demonstrates how focus on individual target damage rather than accomplishing an effects-based assessment on the system under attack can be misleading. On February 15, 1991, the Iraq target planning cell received a report on the progress of the air campaign in accomplishing its objectives in the electric target set. Because all 26 of the targets in the primary and secondary electric target set were not destroyed or damaged to a specific percentage level, the analysis concluded the overall objective had not been met. In actuality, the electric system was not operating in Baghdad, and the power grid in the rest of the country was not much better off. The *desired functional effect* had already been achieved.

The effect desired in attacking this system was not destruction of each of the electric sites, it was to temporarily stop the production of electricity in certain areas of Iraq. I knew the operating status of the Iraqi electric grid and had already reduced strikes against electric sites to maintenance levels. The determinant of whether to plan a strike on an individual site was whether the electric system was operating in the area of interest, not the level of damage or lack thereof to an individual site. During the war some power plant managers even shut down their electric plants to avoid being targeted—the desired effect achieved without exposing Coalition members to danger and freeing up air resources for another task.

In the absence of theater-based intelligence concerning effects of attack upon target *systems* in addition to the outcome of attacks on individual targets, I would obtain this information daily by secure communications directly from John Warden and his information fusion cell in Washington, D.C. These strategic assessments were very valuable to me in determining when, where, and how much, to change focus in constructing the daily master attack plans.

Key Take-Aways from the Desert Storm Air Campaign

The success of the Desert Storm air campaign was a result of the juxtaposition of technology, planning perspective, organization, leadership, and training—all combined in a way that optimized the contribution of each. While every conflict is unique, the military should retain the flexibility to capture and use these elements in a combination that is most relevant in the execution of today's national security challenges. There are six key "takeaways" from Desert Storm with applicability to the future.

First, Strategic objectives were achieved by aligning ends, ways, and means such that America projected force without projecting undue liability for its forces while making it increasingly difficult to impossible for the enemy to counter.

Next, the effects-based, systems approach applied in the design and execution of the air campaign (i.e., actions taken against enemy systems designed to achieve specific outcomes that contribute directly to desired military and political objectives) worked extraordinarily well and remains relevant to the conflicts of today and tomorrow.

Third, joint operations are best accomplished by using the right forces, in the right places, at the right times. "Jointness" is not homogeneity, and it is not synonymous with interservice cooperation for its own sake. It is not following "Little League" rules of everyone gets to play to equal degrees.

Fourth, wars are won or lost by people—it is crucial that the service educate people to understand how to develop effective options in their respective domains and then allow them to execute them when called to action—people matter: encourage innovation and empower them to win. Fifth, you go to war with the military you have. Preparation and foresight are crucial to future military success.

And finally, the probability of success in future conflicts will rise if our armed services actually study and learn from both their successes and failures and apply corrections to their future plans and actions as a result of those lessons.

Tenets of an Effects-based Approach

In 1991, the confluence of stealth, precision, and an effects-based operational plan allowed the planning and implementation of an air strategy based upon simultaneous attack against the entire array of target sets in a sustained air campaign. Stealth obviated the need for large numbers of suppression and force protection assets to strike a heavily defended individual target—air superiority is inherent to a degree in the nature of stealth itself. Precision reduced the number of assets required to achieve a specific effect against an individual target. And a focus on systemic effects rather than individual target destruction leveraged assets for strikes against other targets.

The key to the success of effects-based operations is a top-down approach where strategy is translated to specific objectives at each level down to specific tactical level tasks. Each tactical level task must be directly related to the highest order objectives of the operation. Failure to do so will result in random attacks of discrete enemy elements unrelated to the ultimate objectives—not unlike what happened in the Vietnam War.

In order to establish and maintain this linkage, a system to delineate the ties between the political objectives and tactical actions was required. During the Desert Storm Air Campaign, the center of gravity model was used to assure that every individual target or target set being engaged was directly associated with achieving the desired political objectives. Centers of gravity were identified at the strategic, operational, and tactical levels that became respectively, the target systems (leadership; key essential systems; infrastructure; population/ information; military forces), the target sets (12) that were key to each of the target systems, and the individual targets themselves that made up each target set (hundreds). For each target set I would identify specific, effects-based objectives. Every new target that came into the planning cell for consideration was then evaluated according to how well it could contribute to accomplishing those objectives. Accordingly, the desired effects drove the planning process, not absolute numbers of targets, nor the degree of their destruction.

Let me take this discussion from the specifics of Desert Storm planning and execution to some key take-aways. The goal of war, simply put, is to get an adversary to act in accordance with our strategic interests. Ultimately, I would like to be able to get an adversary to act in our interests without them even knowing that they have been acted on. Think cyber operations, information operations, and perception management. This would be the logical endgame of an effects-based approach to operations—the securing of national objectives without resorting to destruction. This may not be possible for quite a while, but it is *not* unrealistic, nor should our current inability to accomplish this state, stifle our future aspirations. What *is* possible now are significant improvements in the way we as a military, as a nation, or together a coalition of nations, attempt to affect our adversaries' decisions. If one puts the goal of warfare in

that context, then one begins to see that desired effects should determine our engagement methods—and that force application becomes only one out of a spectrum of options.

Focusing on effects—the end of strategy, rather than force-on-force—the traditional means to achieve it, enables us to consider different, and perhaps more effective ways to accomplish the same goal with fewer resources, and most important, loss of life and casualties.

Conclusion

The significance of the capacity to hit a large number of targets simultaneously in Desert Storm was not simply that many targets could be destroyed, but that vital enemy systems could be brought under effective control. This was made possible through attack of systems in parallel, and at rates high enough that Iraq could not repair, adapt to, or find alternatives to keep critical systems functioning at a level sufficient to continue resistance.

The object of an effects-based approach is to achieve effective control over the set of systems relied on by an adversary for power and influence—leadership, essential systems, infrastructure, population/information, and military forces. Action to induce specific effects rather than simply destruction of strategic systems or 'centers of gravity' is the foundation of the concept of an effects-based approach to war. The crux of parallel war is not its physical elements, but the conceptual ones. As we move further into the twenty-first century the significance of the evolution of change in warfare lies in the way we think about it.

An effects-based approach is not a process, or unique to any one service; it is a methodology...a way of thinking. Accordingly, it has value beyond its military utility. As a means of integrating the pillars of national security, perhaps it stands to achieve its most profound value. In fact, the effects-based approach is a springboard for better linking military, economic, information, and political elements to conduct national security in depth. And perhaps in doing that we can best accomplish our individual, and collective, security objectives.