The US Vs USSR in TacAir

Lessons Learned from a Hot Cold War

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THE FUTURE OF POWER PROJECTION

REPORT 5

The US Versus USSR: TacAir Lessons Learned from a Hot Cold War

By Ed Timperlake

Introduction

The complexities of the design of tactical combat aircraft between the US and USSR during the Cold War is a perfect case study of an action/reaction cycle tested in combat between technology savvy and capable reactive enemies.

Tactical aviation in the Cold War consisted of aircraft and crews that could fight and win or die below the threshold of starting a nuclear war. It was an up close and personal fight to the death by fighters and attack aircraft around the globe.[1]

A key element underwriting the validity of President Reagan's famous statement "Mr. Gorbachev, tear down this wall," was President Reagan's undaunted commitment to win the military modernization race against the Russians.

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[1] Before proceeding it must be recognized that Tactical Aviation actually was a second order technology imperative during the height of the Cold War because of the issue of global nuclear war and strategic bombers being an important part of what the US identified as a Triad—bombers, ICBMs and submarines with nuke warhead missiles.

To stop the bombers both the US and USSR built point defense interceptors and an extensive network of ground based radar and command and control centers to vector interceptors toward penetrating strategic bombers. Interceptors would be controlled from a ground based radar center, following a "ground control intercept" (GCI).

As airborne system technology improved many interceptors were designed with airborne radar (F-4 was a success story) so they could independently acquire, lock-on and shoot down a bomber with a missile or cannon/machine guns. The US did tend to favor offensive strike, while USSR designs tend to say point defense. Hence over time some stellar US air-to-air fighters became also multi mission stand outs such as the F-15 becoming an air-o-ground Strike Eagle. This study is only up to the fall of the wall and at that time the USSR was finally also beginning to develop some very capable multi-mission aircraft—the SU-27 family type/model/series progression is an excellent example.

To further complicate the tacair picture strategic bombers were also used tactically, and the most successful example in history was the B-52. The B-52 was successfully modified and employed as a conventional bomber— for example the term "Arc Light" was used in Vietnam when B-52s were used as conventional air-to-ground interdiction bombers.

Both the US and USSR had specific interceptor commands to focus on developing the best technology and tactics to address the strategic bomber threat. This paper will show over time American Air Generals were ultimately much more flexible to change and adapt in the combat employment of all Air Power assets--(bombers, interceptors, GCI sites) from the strategic deterrence mission to the much more deadly mission of actually fighting tactically.

It is important to look beyond the post World War II technological imperative of aircraft and system designs to also note the skill and leadership of both US and USSR combat aviators in shaping the technological competition.

The US and USSR had competing views on fighting the air battle and thus different training and tactics in support of their airborne engagement doctrine. These different approaches to con-ops, in turn, interacted with the technological agendas and approaches.

It must never be overlooked that the complete story of those days must include senior leadership decisions to achieve combat success. Both sides tried to exploit rapidly developing and constantly changing airborne technological capabilities, but the US prevailed and won in this race.

The total mix of technology, airborne flying skills, and the vision of national leadership combined ultimately to make the difference. It is never simply technology alone.

The Great Jet Age Rivalry: The Centrality of Combining Technological Advantage with Effective Employment Strategies

The advent of the revolutionary power of the jet engine as World War II was ending combined with significant improvements in radar meant that tactical combat aircraft had a moment in time in which airborne technology was guaranteed a huge step function in capability.

History has now shown that both countries design bureaus tried for an advantage by enhancing both airframe and system performance in essentially a war-time cycle of designing and testing new combat aircraft. The goal was to always get a war wining edge and the results were often determined by success in combat.

From the MIG Ally fights between the F-86, and Mig-15s during the Korean war, to the IAF sweeping the sky of Arab opponents in both the Six Day War in 1997 and Yum Kippur in 1973, to the US air campaigns during Vietnam, history has provided significant data points of aerial life and death to shape judgments about success in the technological competition. The Cold “hot” War in the air was an unforgiving story of success and failure.

It may have been called a “cold war” but for many combat pilots it became very hot in combat. US and USSR jet-age rivalry was a constant race to fly the best aircraft to kill your opponent.

Along with airborne engagements between fighters, there were many duels to the death by attack aircraft against surface to air missiles, anti-aircraft batteries, and also enemy fight-

ers. Airborne combat was a conflict between deployed offensive and defensive capabilities. It was never merely offense versus offense.

In retrospect, it now looks like the absolute determinant was actually each nation's leadership and vision, not a simple technological one-upmanship. Victory was shaped by many factors: the ability to improve air frame performance with both onboard and externally carried weapons system enhancements *combined with* embracing and instilling proper command and control as well as engaging in realistic training and tactics to exploit the best use of the entire aircraft.

With US and USSR technology leapfrogging in capability it was the evolution of combat doctrine and the commensurate training and tactics to successfully fight the air battle that really tipped the balance.

The lesson for the air power rivalry between the US and USSR is rather straightforward: the technology had to be available but it also had to be successful understood and employed.

A fundamental iron rule of aviation design is that combat aircraft design features is always relative in both airframe and system performance between reactive enemies.

Understanding the design attributes of combat aircraft is simple. A tactical aircraft has basic airframe performance characteristics essentially measured by payload, range (which can be enhanced by vertical and short takeoff and landing basing modes), maneuverability, and speed.

The system performance for an airframe can add quality considerations. For example target acquisition capability and target engagement capability enhances an airframe's payload. Survivability enhances the entire capability of both airframe and systems.

At all times design teams must recognize and adjust system performance because of a reactive enemy, there is an ever-present model obsolescence factor. And the inventory level of fielded aircraft has a quality all its own.

Drivers for Military Modernization

Modernization of a military force can be carried out for any one or combination of three reasons:

1. To gain some new capabilities not previously available;
2. To add new components which provide for enhanced or more reliable operation of existing equipment; or
3. Simply to replace worn-out equipment that is no longer militarily useful.

Of course, modernization also can be viewed as capital investment in facilities for production and modification of existing weapons or support systems. In looking at the modernization of tactical aviation inventory by type/model/series, measurement should be made only in terms of the final output of the fielded inventory

Several inventory caveats must be acknowledged because simple comparisons of total inventories (bean counting) may leave out essential differences of the need for regional deployments. Elemental hardware counts also overlook such intangibles as command and control, training and tactics, and logistical support. Static comparisons thus can often ignore important trends in quality and modernization.

To complicate matters a tactical aircraft can be designed for various missions and roles. TacAir is a very broad and varied category so sub-missions air-to-air (AA) and air-to- ground (AG) become very important in design.

During the Cold War some US aircraft focused on one mission (air-to-air, the F-104, F-106; or air-to-ground, A-4, A-7, and A-10) while others were accomplished in all missions, or "multi-mission" (i.e. the F-4, F-15, F-16, and F-18).

The Soviets had the same design philosophy and some of their very successful MiGs and Sukhois were air-to-air fighters while others ground attack and some multi-mission. The great rivalry between the US and USSR was an action-reaction cycle of design, fly, test, build, fight, and modernize. This cycle lasted for over four decades.

One very telling example of this cycle was the MiG- 21J evolved to be a more capable performance Fighter than the F-4J, because the MiG-21J finally had higher maneuverability and top end speed even though the F-4B started superior over earlier MiG-21 designs. Over five thousand F-4 Phantom II were built for US and allied air forces and the Soviets diligently worked to take away the F-4s advantage in thrust to weight. They were finally successful with the MiG-21J

Essentially, as the F-86 v MiG-15 or F-4 v MiG-21 shows, the US and USSR tactical combat aircraft were in a design race of competing airframe and system trade offs and it was not until the F-15 mastered the skies in a 100+ to zero exchange rate that the US fighter technology finally reigned supreme – for now.

Thus, it is fair and accurate to say that air-to-air benchmarks of success measured during the Cold War were easily expressed in kill ratios. However, the effectiveness of air-to-ground missions is a different order of magnitude and a very difficult issue to this day.

The Human Factor or The Challenge of Shaping Effective Engagement Capabilities

Looking at combat engagements between Russian aircraft in the hands of their surrogate forces and the USAF, Navy, and Marine aviators during hot periods in the Cold War sheds light with regard to the evolution of 21st century aircraft technology.

The US Navy recognized in Vietnam that they were up against air-to–air engagements of well-designed and flown aircraft as well as a significant threat from evolving air defenses. The Navy's visionary response was to create their fighter weapons school, nicknamed "Top Gun." This bold leadership stroke of genius made all the difference.

USAF leaders then created Red Flag to simulate as close as possible an environment capturing the complexities of a multi-plane air battle. It took strong leadership in both the Navy and Air Force to accept training losses, because Top Gun and Red Flag came with a price in higher accident rates.

To use a briefing technique taught at Top Gun, the great combat jet age rivalry between the two super-powers had a lot of "good" and "others," (bad). Understanding that the past is prologue, this jet age rivalry to the death provides insights into the future of air combat in this new century.

It is little noted that below the nuclear threshold the ultimately killing machine in the world is the best fighter. The number one fighter flown competently can kill all opposing weapons – every other weapon is dimensionally limited.

The best fighter can kill everything that flies including a B-2 – if it sees it, it will kill it. The best fighter if modified or designed for multi-mission ground attack can also kill tanks, arterially batteries, infantry, ships, missile silos, and the opponents command and control centers

To be fair, the best fighter may have trouble killing a submarine but if a sub is detected then airborne dropped weapons will kill it.

Finally, fighters combined with onboard missiles can even engage in anti-satellite missions, although not a preferred mission.

The lesson of the great jet age rivalry is that both the US and USSR were capable of producing exceptional tactical aircraft and at times exceptional pilots.

Although to be fair, both sides had their share of design disappointments – the US F-102 and A-5, and USSR MiG-23 and MiG-25, for example.

However, from a purely technology viewpoint the MiG-15 versus F-86 in Korea was not an unfair fight although the F-86 Saber did have a better gunsight.

The next hot period of US verses Soviet designs was in the skies of Vietnam and the MiG-21 engagements against the F-4 in Vietnam matched two very well designed fighters.

Finally, everything came together for America just as the wall was coming down. The air campaign in Desert Storm was a tremendous validation of US air doctrine, and the greatest fighter ever built to date measured by kills-to-losses is the USAF F-15 Eagle. The F-15 has over a 100 to zero loss rate in aerial combat.

Embedded in American success is a strong appreciation about the complexities of success in the air with a strong understanding of the "fog of war." Although this term, coined by Carl von Clausewitz, was used for land campaigns, it is now equally important in the air.

In the air-to-air (AA) mission killing a friendly in the confusion or "fog" is of great concern and tactics and technology evolved with a constant focus to avoid this as much as humanly possible. In the air-to-ground (AG) mission if the focus is close air support (CAS), an air attack called in close to ground troops avoiding friendly causalities is paramount. If beyond CAS and the AG mission is to interdict opposing forces or other targets such as bridges, ammo dumps, factories, or airfields, a US air campaign tries to avoid collateral damage as much as possible. Trying to avoid killing innocent civilian targets is a tactical goal of US air power.

The difficulty is measuring success.

- There is a huge difference in a measure of merit (mom) for AA success and AG success. In AA it is simply the kill ratio between fighters.
- The dilemma in measuring AG effectiveness transcends the cold war and is still a huge problem today. In the air-to-ground mission the measures of merit is usually bomb damage assessment (BDA), sometimes damage is visible with great clarity and other times very opaque and murky. It is much harder to judge the results of TacAir modernization, and tactics and training in the AG mission.

For the AG interdiction mission during the Cold War there was major technology shift to relying upon enhanced weapons. The US attempts to destroy the Paul Doumer Bridge over the Red River in Vietnam captured this dynamic. The Paul Doumer Bridge was essential to the Vietnamese war effort, because it connected Hanoi to the port of Haiphong.

Many courageous attacks were made against the bridge during the Vietnam War. Correspondingly, the determination of the Vietnamese to defend and rebuild was also evident. Many bombs were dropped and planes lost over the course of the war.

Finally, in May 1972 everything changed. USAF F-4s armed with laser guided bombs made an attack with pinpoint accuracy. This was really the first indication that AG performance

had shifted from the aircraft to an integrated marriage of an airframe, internal systems and technology embedded in the weapon itself.

In the CAS mission, the same trend of an airframe, internal systems, and improved externally carried weapons also began to evolve as demonstrated in an interdiction raid in May 1972 over the Red River. This AG trend is ongoing and still one of the most difficult problems in combat aviation well into the 21st century.

Because unlike a kill in AA, AG battle damage can be very difficult to assess and to further complicate the issue a reactive enemy on the ground can be very cleaver at camouflage. Destroying a bridge is visible. The effects of a CAS strike are easy to measure, if the enemy stops firing. They maybe dead, or have run away either way the ground commander has a good sense of effectiveness. Other targets further away from the edge of the battlefield are much more difficult to count as destroyed, assuming even that they are viable military targets – the camouflage issue.

One additional and very important aspect of wining the air battle is the need to concentrate on suppressing enemy air defenses (SEAD). From bombing and strafing WWII "flack" batteries to today's air campaign a lot of technology, training, and tactics have evolved. American lessons learned from Vietnam were acted on because an entire generation of US combat pilots vowed to not be Tom Wolf's famous characterization "Human skeet".

In combat the losses really can mount up.

During the Vietnam War the Air Force lost approximately 2,251 aircraft shot down with an additional 514 lost in operational accidents. The Navy flyers in "the Tokin Gulf Yacht Club" lost 530 planes and an additional 329 in accidents. The Marines operating mostly from land bases lost 193 fixed wing and 270 helos. The Army pilots flying rotary wing really put it on the line and it has been reported they lost 5,086 helicopters (if over 1000 Air America CIA helos are included).

It is a brutally harsh fact of life to this day that high intensity modern combat against even what Secretary Gates has called "non-peer competitors" can chew up and destroy the most advanced aircraft.

Doctrine, Tactics and Training: Fundamental Differences

Since the end of the great Cold War rivalry, it is important to capture a moment in time when there was actually one huge difference between the super powers in their approach to fighting an air battle. The planes were essentially relatively equal and the pilots were trained as well as possible.

But the tactics and command and control philosophy between the US and USSR were totally different and that is the real lesson for a 21st Century air campaign.

The first and most paramount goal of the US Air Force, Navy, and Marines aviators is to establish air dominance. If the aviation units attacking ground targets are free from concern of being shot down by an opposing fighter they will ultimately accomplish their mission.

Current history has shown with aircrew skill, competent leadership, and national will that ensures enough resources, tactical aircraft flying with extremely accurate standoff weapons complemented by cruise missiles can pick apart ground defensives.

A US air campaign might be costly but without an enemy fighter threat a smart air campaign will currently always beat ground defensives and then ultimately destroy the enemies' combat forces on the ground.

The real element of achieving air dominance is the person Tom Wolf in his great book *The Right Stuff*, identified at the top of the aviation pyramid – the fighter pilot. However, measuring the quality (and success) of fighter pilots, especially in aerial combat, is an extensively researched, modestly understood, and fundamentally complex phenomenon. Innumerable psychological and physiological factors – along with opportunity and chance – contribute to the effectiveness of pilots in air warfare.

Combat training for aviators is more than acquiring the skills of flying and delivering weapons. It is tactics and training.

But tactics are much more difficult to assess. Even assuming one can accomplish the difficult task of finding out what tactics a force is actually learning – a challenge made even harder in peacetime – the real difficulty comes when trying to compare one set of tactics with another.

Who can say with confidence that flexibility, a strong American trait, will win out over dogma, or that simple tactics are always better in actual combat than complex tactics.

However, the task is not hopeless because there is an historical difference between the US and USSR prior to the Berlin Wall coming down.

There appears to have been three criteria to judge the effectiveness of the US and USSR air campaign tactics:

1. Level of Authority—the level in the chain of command that has the authority for promulgating tactics. The two extremes are one in which the highest command dictates tactics; the other is a bottoms up case where pilots are totally free in innovate

2. Simplicity/Complexity of applied tactics—This must take in account the Clauswitzian concepts of the "fog of war" and the "friction of battle" which might suggest complex tactics are inherently unstable in actual combat.

3. Flexibility of Leaders/Adaptability of Aircrews—Flexibility refers to the capacity and willingness of leaders to adjust in the face of dynamic war and an adaptive enemy and the skill of aircrews to adapt readily to the required changes. This is what the late Col. John Boyd USAF has described as the capacity to get inside an enemy's "OODA Loop" (the observe, orient, decide, act cycle).

When the level of authority for promulgating tactics lies in the high levels of command hierarchy, tactics usually evolve through a formal process and tend to be rigid. The USSR embraced this top down solution. Their doctrine allowed little deviation from "the school solution." Since the fall of the Berlin Wall all this became obvious.

The USSR was rigid on having a ground control intercept doctrine. Air Marshal's approved tactics were published and were rigorously enforced. The acceptable size and nature of formations, in-flight procedures, attack patterns philosophy of engagement, and weapon firing and communications procedures were all spelled out in detail.

Until the American's caught on in Vietnam, a Soviet surrogate the NVA Air Force had some success with rather rigid ground controlled vectored fighters. But after Top Gun, the ratio of US airborne kills to losses shifted dramatically in favor of the US.

Additionally, the IAF had remarkable and historic success in the Middle East going against their Arab opponents who were utilizing Soviet equipment and tactics.

When authority lies in the lower levels of command down to the pilots themselves, there is a tactical manual, but its contents serve more as guidelines than regulations. Aircrews have both the freedom and responsibility to test the recommended tactics and try and develop better ones. Individual creativity and initiative are encouraged.

Although pure top down or bottom up approaches are extremes. The USSR ground control intercept doctrine was very rigid and their allies were also very top down. While the US and Allies greatly fostered a more bottom-up philosophy.

Air-to-air and air-to-ground combat are inherently complicated and demanding tasks.

- In air combat maneuvering, a pilot must be able to project the paths of several objects moving in three-dimensional space, and do so more quickly than his opponent in a life or death situation.
- No less demanding and dangerous is air-to-ground combat where pilots must meet daunting ingress/egress requirements evade air defense missiles, and "the golden BB" from triple A fire (anti-aircraft artillery), while attacking moving and camouflaged targets.

Under such conditions in actual combat, US combat leaders determined that simple aerial tactics have an inherent advantage over complex ones. Simple tactics are easier to commit to second nature responses and are therefore, less likely to break down in stressful solutions.

A historical take away from the cold/hot war air battles is that in the air-to-air mission a country that equips its fighters with airborne radar and sensors allows more autonomous action and actually favors tactical simplicity and operational autonomy---even though the equipment becomes more complex.

In air-to-ground, airborne simplicity indicators are usually smaller formations and allowance to maneuver independently into weapon launch envelopes primarily in a weapons-free environment. Embedding technology into the weapon itself –bombs and rocket fired weapons-- has also made a revolutionary difference.

Role of Leadership, Technology and the Future

Always assume a reactive enemy can develop the necessary technology to try and mitigate any advantages. With the world wide proliferation of weapons even a second or third world nation might have state-of-the art systems. The air war over the skies of Vietnam was between two peer competitors because of USSR support and constraints by the US national command authority on how the US would fight an air campaign.

The peer fight in the air abruptly ended when President Nixon unleashed the full power of US air in the famous Christmas bombing of 1972. The war ended quickly after that. When the North invaded the South in 1975 US air power was not used like the first invasion in1972, which was a dismal failure.

The lesson on the US-USSR rivalry is that air combat leaders must be able to adjust during the course of an air battle or war by changing strategy and tactics, to achieve exploitation of the enemy's mistakes or weakness. Aircrews must be adaptable enough to follow changing commands from leadership and also, on their own initiative, to change tactics to achieve local surprise and exploitation. Like the quote in Animal House: "knowledge is good." In the cockpit it can be a life saver and aid in mission accomplished.

An air-to-air engagement totally slaved to a ground controlled radar attack, the USSR model was a colossal failure and deadly to a lot of pilots locked into such a system. A bottom-up approach with evolving aircraft system capabilities in a competitive airframe makes for adaptive, creative aircrews that will have a large repertoire of tactical moves and a better chance of getting inside an opponent's OODA loop. This is true for both air-to-air and air-to-ground combat missions.

As the history of war in the air shows it was a constantly evolving process of human factors integrated into technology. The Cold War ended well for humanity and a lot of courageous pilots, bold leaders, and smart technologists deserve a lot of credit for this great victory.

The US would be wise to remember the lessons learned and along the way the loss of very good men in the air who paid in their blood for America today to have the best technology available flown by best Air Force, Navy, and Marine aviators this country can produce. And to shape its concepts of operations to take advantage of the 5th generation aircraft and the associated new tools of combat.

Authors Note

In 1981 as President Reagan was just taking office, a the CIA Theater Forces Division Office of Strategic Research hired me to develop a methodology for estimating Comparative Aircrew Proficiency.

This effort built on previous research sponsored by Andrew Marshall, Director Net Assessment, Office of the Secretary of Defense who had supported research to measure comparative force modernization of US and USSR aircraft trying to balance the "quality" of a country's tactical aviation assets with the "quantity."

Combining both analytical approaches gives a fairly good snapshot of the great rivalry between the US and NATO allies against the Soviet Union and Warsaw Pact. Each side had varied and unique approaches in trying to establish Air Dominance using their own approach to design and development while also focusing on perhaps the greatest "intangible." That intangible is aircrew selection, their training, and tactics employed, the command and control of the force, and finally actual combat engagements.