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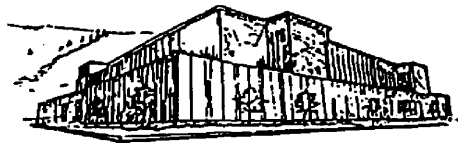
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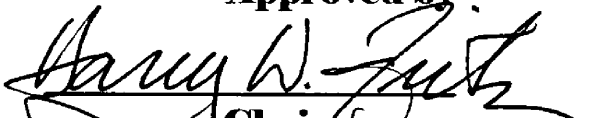
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# **MiG! 6 O'Clock High!**

**A History of the Design Bureau and an Analysis of its  
Aircrafts Combat History**

**By  
Ethan Johnson  
B.A University of Montana 2002  
presented in partial fulfillment for the requirements of  
for the degree of  
Master of Arts  
The University of Montana  
November, 2004**

**Approved by**

  
**Chairperson**

**Dean, Graduate School**

11-10-04

**Date**

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## MiG 6 O'Clock High

### A History of the Design Bureau and an Analysis of its Aircrafts Combat History

Chairperson: Harry Fritz



MiG is known throughout the worldwide lexicon as synonymous with Soviet airpower. Its history is as decorated as the aircraft it has produced, yet the challenges faced by the fall of the Soviet Union may collapse this once proud company. While its future remains unclear, the history of both MiG OKB, and the role its aircraft have played in combat, is clouded in mystery and intrigue.

Among Western military historians, MiG aircraft have been regarded as second-rate, a generation behind their Western counterparts. Since the end of World War II, many MiG's have been downed by the guns of Western aircraft. Many believe this to be proof positive of their inferiority. There is a danger in this assumption, both for historian and strategists alike given that, aside from the air war in Korea, MiG's have never operated in an environment for which they were designed.

Conflicts since Korea have placed MiG's in an environment far removed from their intended role. Had they been utilized in the regimental sized formations against NATO forces in Europe and with the support of a well trained GCI and C3 network, the MiG might perhaps be regarded differently.

This thesis will examine the history and nature of the MiG OKB as well as the environment of Soviet military hardware acquisition. This study will enable an understanding of a military hardware infrastructure far different than existed in the West during the Cold War. Furthermore, four cases studies of conflicts in which MiG's faced Western aircraft will be examined. These case studies will elucidate key issues MiG's have faced as well as the reasons for both their failure and success. Examples of successes include innovative tactics during Vietnam and high pilot proficiency during Korea, while the failures include poor C3 networks over the Bekka Valley and in Gulf War I. However, the overriding theme of the case studies is pilot skill, or the lack thereof.

The goal of this work is not to redeem the view of MiG in the eyes of Western historians, rather too illuminate the key issues responsible for successful air combat.

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## **Introduction**

MiG! The abbreviation of the Mikoyan and Gurevich design bureau has become synonymous with any fighter aircraft built by the Soviet Union during the Cold War. Within Russia and Poland the word has entered gone beyond the spectrum of aircraft and has entered the colloquial lexicon; it is applied to anything that is unusually swift or flashy.<sup>1</sup> This association is not accidental. For over forty years MiG has the premiere fighter bureau of the Soviet Union/Russia. MiG's fame beginning with the MiG-1, designed in a time of seemingly impending doom during the Patriotic War and continuing to this day with the MiG-29, has survived even the founding designers' deaths in the 1970's. Its work has consistently represented the state of the art technology of the Soviet Union, whether it be the nimble MiG-3 over the skies of Eastern Europe or the lightning fast MiG-25 over Siberia and Israel.

Until recently, MiG has enjoyed a level of recognition and prominence realized by no other aircraft design bureau the world over. Only in today's capitalistic Russia has MiG begun to fall from its pillar of grace. A free market economy is doing what NATO never got a chance to by destroying the foremost design bureau of the Soviet Union. But understanding MiG's rapid ascension to prominence is futile without a concise history of the Soviet/Russian Air Force from inception to present day.

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<sup>1</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 5

## Chapter I

### Brief History of the Soviet Air Force<sup>2</sup>

It is claimed that Russia's interest in military aviation began in 1831 when the military governor of Riazon attended the country's first balloon flight. Official acceptance within military circles came with the creation of the creation of a Commission on the Use of Aeronautics for Military Purposes, endorsed by General D.A Muluin in 1869.<sup>3</sup> This commission investigated and eventually accepted the role of balloons as artillery spotting platforms. Throughout the latter half of the 19<sup>th</sup> century, various schools and training facilities were built to achieve this end. The Russo-Japanese War validated the balloon as an effective observation and reconnaissance platform.

Soon after the war, news of the Wright brothers' successful heavier-than-air flight in North Carolina reached Czar Nicholas II and his ministers. Since no indigenous aircraft manufacturers existed in Russia at that time, the Czar ordered aircraft and power plants were purchased from France. In addition, very few Russian pilots were proficient enough to instruct new pilots. To learn and create a cadre able to train future personnel, new Russian pilots and ground crewman were sent to France. This relation with France dictated a reliance on foreign hardware during the first years of World War I.

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<sup>2</sup> The Soviet Navy also has a long and distinguished history of aviation, including long range bomber assets and since the latter part of the 1970's a small carrier based fleet. However, for the purpose of this paper the focus will be on the VVS because it is the main recipient of MiG aircraft. It should be noted that recently MiG has made its first foray into naval aviation with the carrier based MiG-29K for the Indian Navy's ex-Soviet Kiev class aircraft carrier.

<sup>3</sup> *ibid* pg 11

Russian aircraft performed poorly in the first years of the Great War. In part this was due to Russia's lack of domestically produced aircraft. Sourcing spare parts for Russia's fleet of 250 aircraft in the early part of WWI was nearly impossible. Domestically developed replacement were often far inferior to foreign components. This led to nearly half of Russia fleet of 250 aircraft being unserviceable at the outbreak of hostilities.<sup>4</sup> Most of these aircraft were used for observation rather than combat, as were most planes in either side's inventory.

The birth of Russian fighter aviation can be traced to a July 4, 1916. In response to German fighter effectiveness on the Western Front, the Soviet Union began arming planes as fighters. The shining light of Russian aviation during this period was the success of Sikorsy's *Ilia Muromet* bomber. These bombers flew an impressive 442 missions, delivered 2,000 bombs, took 7,000 photographs and lost only three out of a fleet of forty to hostile fire, an impressive deed.<sup>5</sup> However the fledgling Russian Air Force could not overcome its reliance on foreign made aircraft or its poor maintenance record. By the Revolution of 1917, it was hardly an effective fighting force.

After the Revolution of 1917, the Soviets immediately began to overhaul the air force. They renamed it the Red Army *Aviadarm* (Air Fleet) and placed it under the control of the army, a precedent that continues to this day. Newly cleaned of counter-revolutionaries, the Soviets used the new Soviet Air Fleet to great effect during the Civil War. During the War with the Whites over 19,000 sorties were flown, 208,000lbs of bombs were dropped as well as 19,000lbs of

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<sup>4</sup> ibid pg 12

<sup>5</sup> ibid pg 14

propaganda leaflets. The Air Fleet was employed on all fronts during the war and its success secured its continued funding and interest.

The Soviets sought to end their reliance on foreign built aircraft during the 1920's. They invited German companies such as Junkers to build, and partially man, factories inside the Soviet Union. In return the Germans found a way to get around the restrictive Versailles treaty by secretly developing and testing aircraft in Lipetsk, 250 miles southwest of Moscow. The deal proved fruitful for both parties. The newly formed Soviet Air Force (VVS) gained experience and hardware and the Germans, an opportunity to rebuild the Luftwaffe.

During this time relations on the Chinese border were souring, and skirmishes broke out among border units. In 1929, thirty four VVS aircraft participated in skirmishes along the border soundly defeating the Chinese in the air and on the ground. This was one of the first uses of Soviet air power outside of the borders of the Soviet Union and its success would bode well for the VVS.<sup>6</sup> However the Soviet Union's success against the Chinese convinced the Japanese to invade Manchuria to protect her northern flank, a move that would result in a clash between Tokyo and Moscow.

War was also raged on the Iberian Peninsula. Franco and his Nationalist forces threatened the Republicans, backed by the monarchy and in 1936 Stalin delivered aid to the beleaguered Republican forces. Aid came in the form of volunteer troops, tanks, munitions and aircraft. The Soviet aircraft industry had been hard at work during the 1930's producing such aircraft as the SB-2, I-15 and

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<sup>6</sup> Soviet airpower had also been employed during the punitive skirmishes with Poland in 1920.

I-16. All of these aircraft were improvements over previous designs, but were rapidly becoming obsolete.

Hitler's decision to send the famed Condor Legion of Me-109s, He-111's and Ju-87's to Spain in 1937 turned the tables rapidly. Losses soon became prohibitively heavy. Stalin used this as an excuse to withdraw his support from the International Brigade. During the same time, the Japanese invasion of China threatened Siberia. This forced Stalin to give material aid in the form of munitions and mercenaries to the Chinese, including aircraft and pilots who suffered heavily under the guns of Japanese Zeroes.

In the midst of the war in Spain and the threat of Japanese invasion, Stalin ignited ludicrous military purges. The VVS was not immune, such high ranking officers as the Chief of the VVS Yakov Alksnis and Leningrad Air Commissar Lopatin were executed. By the time Germany and the Soviet Union invaded Poland, nearly 75% of the VVS senior officers had been shot.<sup>7</sup> Not only was this disastrous for the VVS, but it decimated the Soviet aircraft design bureaus, their supporting government agencies and the factories.

With the signing of the Molotov-Ribbentrop treaty on August 23 1939, the Soviet Union was obligated to become a participant in the next war. When German troops moved across the Polish frontier on 1 September 1939, the Soviet Union was unable to follow suit. It was not until September 18<sup>th</sup> that Soviet forces moved into their sector of Poland. The Luftwaffe had already decimated the small Polish Air Force and the VVS did little during the invasion. However, the next

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<sup>7</sup> ibid pg 15

stage of the war would find the VVS at the forefront. 3,000 aircraft were deployed in support of the Soviet invasion of Finland.

However the purges and lack of progressive thinking in its ranks, coupled with increasingly outdated aircraft proved disastrous for the VVS. Nearly one third of the deployed aircraft were destroyed, with the remaining two thirds unable to operate effectively due to weather and enemy action. This poor showing led to a re-organization of the VVS into five new commands: the Long-Range Bomber Aviation (*Dal'nebombardirovchnaia Aviatsiia* or *DBA*), Air Reserve Component (*Aviatsiia osbogo naznacheniiia* or *AON*), Frontal Aviation (*VVS Fronta*), Army Aviation (*VVS Armii*) and Corps Aviation (*Korpusnye aviaieskadrii*). The Soviet Air Force was still in the midst of these reforms when Hitler initiated *Operation Barbarossa* and invaded the Soviet Union on June 22, 1941.

Though Stalin had been warned of the impending invasion through his spy, Richard Sorge in Tokyo, as well as several Western intelligence agencies, he refused to accept the news. As a result Soviet aircraft were still lined up neatly on the taxiways of the western approaches to the Soviet Union, making easy targets for Luftwaffe Stuka dive bombers. During the first day alone 1,489 Soviet aircraft were destroyed on the ground and within a week, 4,000 VVS aircraft had been lost.<sup>8</sup> The only good news was that pilot losses were relatively light, since most of the aircraft had been on the ground when they were destroyed.

The Soviets did have new aircraft such as the high altitude MiG-3 and IL-2 Shturmovik ground attack bombers. They were on par, technologically, with the

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<sup>8</sup> [www.centennialofflight.gov/essays/Air\\_Power/Russia/AP21.htm](http://www.centennialofflight.gov/essays/Air_Power/Russia/AP21.htm)

Luftwaffe's aircraft. The crews of these aircraft were trained in the regimented fashion of the purges, however and failed to capitalize on their advantages, They were easily picked off by the superior Luftwaffe pilots It was on the Eastern Front that the highest kill tallies realized were achieved. Werner Molders flying an Me-109 became the first pilot ever to surpass the 100 kill mark and Erich Hartmann became the highest ranking ace ever with over 352 kills, all against Soviet aircraft. It was not until the Battle of Moscow that the VVS received any kind of reprieve from the slaughter it was receiving from the guns of Georings Luftwaffe.

The harshness of the Russian winter eventually stopped the Wehrmacht drive to Moscow in December of 1940. The Luftwaffe too was paralyzed. Engines would not start, hands froze to tools and oil became thick. The VVS, invigorated with reinforcements sent from the Far East Military District and Lend Lease aircraft, began to seize the initiative and wrest control of the skies from the Luftwaffe. The Battle for Moscow was the turning point in the air war over the Eastern Front. Never again would the Luftwaffe to operate with such impunity. Hitler, realizing he could not take Moscow, diverted his troops south into Ukraine and towards the oil rich Caucuses.

Stalingrad became the epicenter of the war. During the offensive to encircle and trap the German Sixth Army, the Soviets massed 24 air divisions and 99 regiments in support of the pincher movement. The VVS conducted air support for the army and fighter patrols over the city to hinder German re-supply efforts. During the winter of 1942-43 the VVS claimed over 1,100 Luftwaffe aircraft

destroyed.<sup>9</sup> The VVS succeeded in cutting off the encircled German Army from the air forcing General von Paulus to surrender on February 3, 1943. After Stalingrad, the VVS never again lost control of the skies over the front and maintained nearly complete air superiority through mass numbers. More importantly, the army had learned the lesson of air support and fully half of the missions flown by the VVS were in direct support of ground troops. By late 1944, German aircraft on the Eastern Front numbered 1,850, of which less than 400 were fighters. In comparison the VVS had a strength of nearly 17,000 aircraft. During Battle for Berlin, the finale of the war in Europe, the VVS flew over 91,000 sorties, destroying over 1,100 Luftwaffe aircraft with the claimed loss of only 527.<sup>10</sup>

With the fall of Berlin and the end of war with Germany, Stalin honored the Yalta conference and on August 8 1945 he declared war on Japan. Soviet forces decimated the Japanese in Manchuria and North Korea, making landings in the Kuril and Shikotan islands as well. Japanese aircraft were no match for the VVS and suffered heavily. Japan surrendered on September 2, 1945 and the greatest war the world had ever known came to an end. The statistics for the VVS during the war were phenomenal. 3.8 million sorties were flown, nearly 700,000 tons of bombs were dropped and 1.7 million tons of fuel and lubricants expended while building over 8,000 airfields. The Soviet Union also claimed more than

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<sup>9</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 18

<sup>10</sup> *ibid*



77,000 Luftwaffe destroyed, 44,000 to the guns of the VVS. Costs were also great, more than 80,000 VVS aircraft fell to Luftwaffe guns.<sup>11</sup>

The nuclear age brought about yet another re-organization of the VVS. Stalin sought to develop an extensive air defense network and an indigenous nuclear capability. In response to the threat posed by American intercontinental bombers, Stalin created the Air Defense Command (*Protivovozdushnaya oborona* or *PVO*) responsible for the defense of Soviet airspace. Stalin's re-organization of the VVS received a major windfall in 1947, the British government offered to sell the Soviet Union twenty five Roll Royce Nene and thirty Rolls Royce Derwent turbojet engines. This offer allowed the Soviets to hurdle past the problems associated with domestic jet engine development. These engines were put to good use, and soon aircraft capable of intercepting the newest generation of American bombers were developed, the most significant was the MiG-15 (NATO codename FAGOT).

North Korea burst across the border with South Korea on June 25<sup>th</sup> 1950, beginning the Korean War. The North Korean Air Force (NKAF) did very well against the inferior South Koreans, but with the arrival of the American Far Eastern Air Force the NKAF was nearly annihilated. As the UN forces advanced towards the Yalu River, China began to feel pressured from the south and asked the Soviet Union for help to modernize her armed forces. Not wanting to become directly involved in the war, Stalin gave China a large number of MiG-15's to augment its small air force. The MiG-15 was far superior to anything the UN had in Korea at the time. By November however, the Americans began to introduce

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<sup>11</sup> *ibid*

the F-86A Sabre to the Peninsula. The F-86 was more than a match for the Chinese piloted MiG-15's with the Americans achieving a kill ratio of 15 to 1. Soviet/Warsaw Pact pilots did take part in dogfights with the Americans. They were far more proficient and deadly than their Chinese and North Korean counterparts. The lessons learned by these pilots benefited future generations of Soviet fighters.

After Stalin's death in 1953, the VVS focus shifted towards strategic nuclear warfare. Long-range TU-95 (NATO codename BEAR) and TU-16 (NATO codename BADGER) bombers were developed and high speed interceptor aircraft such as the MiG-21 (NATO codename FISHBED) were introduced. The VVS also received control of many newly developed IRBM and ICBM missile systems. Invasion of Soviet airspace by U-2 aircraft in the late 1950's prompted a build-up of surface to air missile sites throughout the country. In the 1960's with the development of the XB-70 Valkyrie, the Soviet created such aircraft as the Mach 3+ capable MiG-25 (NATO codename FOXBAT) to intercept them.

Aid to friendly nations in the Middle East such as Egypt and Syria stepped up in the early 1960's. The Middle East and Vietnam became the laboratories for Soviet aircraft and weapons designers. As American-made Israeli aircraft and Soviet-made Arab aircraft dueled in the skies over the Sinai, the vast Soviet-built air defense network of North Vietnam tested American strike aircraft. The Middle East was of great interest to the VVS. Since the end of the Great Patriotic War, the focus had been on defensive fighters and offensive missile and bomber forces.

The Six Day War, however, taught the VVS the importance of tactical aircraft, capable of supporting troops and striking defended targets close to the lines. This led to the development of aircraft such as the MiG-23/27 (NATO codename FLOGGER), SU-24 (NATO codename FENCER) and SU-25 (NATO codename FROGFOOT) as tactical support aircraft.

Focus began to shift from a global war to regional conflicts. The Soviet Union became embroiled in the war in Afghanistan. The war against the mujahedin was a new type of war for the Soviet Union. Much like the US in Vietnam, the Soviet Union was unable to bring firepower to bear on an elusive enemy. Consequently, the only large role the VVS took part was rotary winged. The MI-24 (NATO codename HIND) and MI-8 (NATO codename HIP) helicopters bore the brunt of the combat and transport roles in Afghanistan, moving troops and attacking rebel positions. They suffered considerably. The only fixed wing combat involvement of the VVS was with Su-25's and ground attack versions of the MiG-21 attacking mujahadien positions.<sup>12</sup> The VVS learned much from its role in Afghanistan and its successor, the Russian Air Force is applying these lessons in Chechnya.

In anticipation of the nuclear war with NATO, the Soviets deployed their best units to Eastern Europe during the 1970's and 1980's. Frontal Aviation units were on call twenty four hours day to repel an invasion of Warsaw Pact airspace and strike tactical targets in Western Europe. In addition, Soviet nuclear armed

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<sup>12</sup> Combat did occur on a number occasions when Soviet/Afghan MiG-21 and -23 aircraft strayed into Pakistani airspace and were engaged by the PAF. Long Range Aviation also did participate in a few strategic bombing operations within Afghanistan from bases near Dushanbe. Source [www.acig.org](http://www.acig.org)

bombers were constantly on alert to strike targets in the continental US. The PVO was to intercept incoming American bombers and fighters. This constant state of readiness was taxing on the VVS and by the late 1980's, it could no longer maintain this state of readiness. It was in this situation that the Soviet Union broke apart and the VVS's aircraft were divided up among the new republics, with Russia and Ukraine getting the lion's share of hardware.

The future of Russian air power is unknown, Gulf War I proved the fallacy of a Soviet air defense system. With little money and dwindling export markets for its aircraft, the Russian Air Force has little room to re-equip and re-organize itself. This is where MiG and all other design bureaus in Russia are today, separated from the system they were founded and prospered under.

## Chapter II

### Soviet Bureau System of Aircraft Development

Soviet era design OKB bureaus (*Opytno Konsrutorskoe byuro or Experimental Design Bureaus*) whether designing missiles or nuclear submarines, operated in an environment foreign to Western designers. The first Soviet aviation design bureaus were founded during the first Five Year Plan in 1928 by Andrei Tupolev and Nikolai Polikarpov respectively. These design two firms, headed both by TsAGI (*Tsentral'ni aerogirdrodinamicheskii institut or Central Air and Hydrodynamics Institute*) graduates, formed the nucleus for the all large aircraft design bureaus to come. After the pitiful performance of Polikarpov designs in Spain against the German Me-109, the newly formed Commissariat of Aviation decided to take the best talent from each to form new firms. It was hoped this action would bypass the stagnation these two firms were experiencing. The new firms, headed by Aleksander Yakolev (Yak), Artyom Mikoyan and Mikhail Gurevich (MiG), Syemyen Lavochkin (LaGG), Pavel Sukhoi (Sukhoi) and Sergei Ilyushin (Ilyushin) created new advanced aircraft such as the MiG-1 and -3, LaGG-3, Yak-3 and Il-2 Shturmovik. It was these aircraft that served as the backbone of the VVS throughout the Great Patriotic War.

The Second World War saw the beginning of another trend in Soviet aircraft design, reverse engineering. Aleksander Yakolev in his memoirs, *Notes of an Aircraft Designer*, admitted that “copying foreign models was a necessary

evil”<sup>13</sup>. Thanks to the Lend-Lease act the flood of American and British aircraft numbered more than 17,000<sup>14</sup> giving Soviet designers the chance to reverse engineer many features, such as superchargers, engine control systems and lead computing sights. Perhaps the most infamous case of Soviet reverse engineering was the Tupolev TU-4 (NATO codename BULL), a rivet by rivet copy of the American B-29 Superfortresses. The Soviet Union had “interned” many B-29’s in Vladivostok after the Superfortresses had made emergency landings following raids on Japan.<sup>15</sup> This reverse engineering feat gave the Soviet Union intercontinental bombing capability well ahead of a domestically designed aircraft. Perhaps the most important gift to Soviet aircraft designers was windfall of fifty Rolls-Royce jet engines from Britain in 1947. These reversed engineered jet engines powered the first two generations of Soviet jet powered fighter aircraft and allowed the Soviets to hurdle past the problems of developing an indigenously designed jet engine program. This windfall is perhaps the most important event in Soviet fighter aircraft design. Reverse engineering continued until the early 1980’s when Soviet designers came up with aircraft such as the SU-25 (NATO codename FROGFOOT), MiG-29 (NATO codename FULCRUM) and SU-27 (NATO codename FLANKER). These aircraft, though highly advanced and utilizing some notably Soviet designs, are still reliant on reverse engineered Western designs.

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<sup>13</sup> Yakolev, Aleksander Notes on an Aircraft Designer pg 228

<sup>14</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 28

<sup>15</sup> Other prominent examples of reverse engineering include the AA-2 missile (NATO codename ATOLL), essentially a copy of a AIM-9B Sidewinder reverse engineered when a Chinese MiG pilot was hit by a Sidewinder from a Taiwanese F-86. Luckily for the MiG pilot, the missile failed to explode and the missile was recovered in good condition. For the sake of brevity only the most blatant examples have been discussed.

Soviet design bureaus operated in an environment devoid of financial concerns. Feasibility was dictated by resource availability. In comparison to Western design firms, there were no foreign or domestic costs associated with marketing or production. In addition, there was one singular customer, the MoD (Ministry of Defense), responsible for all military hardware procurement of the armed services in the Soviet Union. Even commercial aircraft design was managed through the MoD, as all Aeroflot aircraft were under the control of the VVS in time of war. With only one customer, however, creative designs did not fare well and a clear evolution of aircraft developed. This led to Soviet aircraft design stagnation and a lack of proactive research.

Designers in the Soviet Union were driven by what is called a “requirement pull”, a design was created in order to counter an existing threat. Western designers on the other hand were driven by a “technology push”, the uses for the newest developed technology were researched extensively. A classic example of this divergence in motivation can be found in the development of Look-Down-Shoot-Down-Radar<sup>16</sup> (LSDS) systems by each country. The US developed this technology in the early 1960’s, well before the Soviets had aircraft capable of low altitude, high speed penetrations. The LSDS system was ordered into production as the AWG-9 Phoenix system, even though no threat yet existed. The Soviets chose not to implement LSDS systems until Western powers had aircraft capable of low altitude, high speed penetration in the mid 1970’s, even

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<sup>16</sup> LSDS systems can detect an aircraft at a low (sub 1,000ft) altitude, distinguish it from surrounding ground radar clutter and launch a missile at it, all while the launch aircraft maintains a higher altitude. It is particularly useful in engaging all weather, terrain following aircraft such as the F-111, B-1B, SU-24 or terrain masking helicopters.

though the Soviet were capable of deploying a system a decade earlier. Other examples include the MiG-25 (designed to counter the XB-70 Valkyrie and later the A-12 Oxcart and SR-71) and the MiG-27 (designed as a tactical fighter bomber after lessons learned in Arab-Israeli and Vietnam Wars). It was not until the late 1970's and early 80's that the Soviet design environment allowed for a measure of proactive research.<sup>17</sup> It is perhaps no coincidence that as Soviet designers began to break away from the pattern of reverse engineering and create a generation of Soviet fighters that included advanced indigenous technology, the "technology push" was finally realized. Aside from why technology is implemented in new design, the Soviets had a system not surprisingly, very different from the west. A central committee known as MAP (*Ministerstvo aviatsionnoi promyshlennosti or Ministry for Aircraft Production*) coordinated all requirements originating from the MoD for aircraft development.

MAP was responsible for all aspects of Soviet aircraft design under which the Soviet design bureaus fall. It created manuals based on aspects such as propulsion, airframe, avionics and fire-control. These manuals were given to the respective bureaus as guidelines for design. This is why many Soviet aircraft share such similarities such as air inlet design, undercarriage position and cockpits.<sup>18</sup> Another aspect of MAP is advanced flight research. In this capacity it is roughly equivalent to NASA, but has a much more active role in input in new designs then does its American counterpart. MAP takes the financial burden of

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<sup>17</sup> Examples of this change to proactive design include the helmeted mounted IR sights on the MiG-29, the phenomenal maneuverability of the SU-27 due to thrust vectoring nozzles and a break from GCI (Ground Control Intercept) dependence.

<sup>18</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 31



flight testing and research off the bureaus, but in return limits their autonomy.

Under MAP there is an organization that has no equivalent in the Western world, the TsKB (*Tsentral'noe konstruktorskoe byuro or Central Construction Bureau*).

The TsKB was the main conduit through which all requests for new hardware flowed. When a request was made from the MoD, the TsKB made a feasibility study to decide whether the project is worth pursuing with reference to available resources, i.e. engines, avionics, airframe, raw material and labor. After the feasibility study had been completed by TsKB, a check with both the customer (MoD) and MAP occurred and the design was approved, the outline was then given to the actual design bureaus. The role of the TsKB in the world of Soviet aircraft design is essential. It injected the entire process with a sense of competition. It created the incentive to make a better aircraft in a Soviet industrial world dominated by quantity over quality. What is unique in the Soviet system is that the TsKB headed a group of organizations that were in direct competition with each other for resources and contracts.

Design bureaus not only design the aircraft, but after approval from the TsKB built a small number of prototypes. These prototypes were, with the help of MAP, tested rigorously before final approval from the MoD, TsKB and MAP.<sup>19</sup> The bureaus themselves did not, in the fashion of western manufacturers, build their own production aircraft. The workshop at MiG's Zhukovsky testing facility is typical of most OKB's in that space allowing the construction of only two aircraft simultaneously. After the flight testing and finalization of plans for the

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<sup>19</sup> Please refer to appendix for a flow chart of Soviet Military Aircraft Acquisition. Courtesy of General Dynamics via Butowski, Piotr and Miller, Jay [OKB MiG: A History of the Design Bureau and Its Aircraft](#)

production aircraft, plans, tooling and expert technicians are sent to one of the many GAZ's (*Gosudarstvenny aviatsionny zavod or State Aircraft Factory*). MiG's assigned GAZ is, and continues to be, number 30<sup>20</sup> at Khodinkna in Moscow. It employed over 30,000 people directly involved with aircraft manufacture and 3,000 others manufacturing such items as kitchen appliances and furniture. The factory covers 618 acres and contains 26,909,675 sq ft of floor space!<sup>21</sup>

Flight testing and delivery to either VVS or foreign forces occurred at adjacent Lukhovsky airfield. Flight testing was done in three stages, the first being plant flight testing, flown by factory pilots, the second, design testing, flown by a combination of military and factory pilots and finally state acceptance testing, flown exclusively by military pilots. The aircraft OKB system of awarding contracts and designs began to change again during the *perestroika* period of Gorbachev, but little information exists before the collapse of the Soviet Union. Today, OKB's in Russia are struggling to cope with a new free market economy. MiG has not sold an aircraft to the VVS in many years and this problem will be discussed at the conclusion of this work. The history of the company is somewhat akin to the story of the Phoenix, as it rose to take flight from the ashes of the great OKB, Polikarpov, during the Second World War.

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<sup>20</sup> Interesting to note is that Lenin's glass covered casket was built at the same factory after his death in 1924.

<sup>21</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 33

### Chapter III

#### The Creation and History of MiG OKB

During the 1920's and 30's the design firm headed by Nikolai Nikolayevich Polikarpov was the undisputed design champion of Soviet fighter planes. Having been arrested in 1929 and sent to the gulags, Polikarpov was freed in 1933 to help modernize and expand the VVS. His firm designed the I-15 biplane and I-16 monoplane, which would form the backbone of the VVS until after the opening stages of the invasion of the Soviet Union. The first combat test for these aircraft came in 1936-37 during the Spanish Civil War. Achieving early supremacy over the underpowered early Me-109's and Fiat CR.32's, Polikarpov was congratulated for his design. Unfortunately for the Soviets, the Me-109 was a new aircraft and still engaged in teething problems. The Messerschmitt Company, designers of the Me-109, soon overcame these by equipping new 109's with an upgraded Daimler Benz engine and a 20mm spinner firing cannon.<sup>22</sup> Polikarpov aircraft were very quickly unable to compete and were withdrawn from combat by late 1937.

Eager to overcome the problems his aircraft had experienced over Spain, Polikarpov designed and built a replacement, the I-153. The I-153, while incorporating state of the art technologies such as a retractable undercarriage, was still a biplane and suffered accordingly. Notwithstanding their excellent turn rate and stability, biplanes are inherently slower than their monoplane counterparts. This problem was obvious in combat with early Japanese Zeroes over Mongolia.

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<sup>22</sup> ibid pg 39

The I-153's suffered greatly at the hands of the superior Japanese aircraft, infuriating Stalin.<sup>23</sup>

After meeting with Stalin, Polikarpov began designing a high speed monoplane to equip the VVS. He produced a prototype of the I-180 high speed monoplane quickly and tests of the new aircraft commenced. The testing was to become the doom of Polikarpov. The first test flight by Soviet national hero Valeriy Chaklov, ended in disaster when the aircraft crashed and killed him. Although the problem had nothing to do with the design (the aircraft was left uncovered all night in -24C weather and the engine seized soon after takeoff), Polikarpov took the loss hard. When the following two prototypes crashed due to unrelated problems, Polikarpov became convinced of his inferiority. As these incidents took place during Stalin purges, allegations of sabotage naturally arose. Many people in the firm and factory that produced the I-180 were never heard from again. It is a mystery how Polikarpov avoided implication, as many people including the chief designer, Tomashyevich, were executed.<sup>24</sup> The firm never recovered from this disaster. Polikarpov was then sent to Germany as part of a Soviet delegation to gather German aircraft technology. It was during his absence that the team that would become MiG OKB was formed.

For some time the Polikarpov OKB had been working on a project simply called "Project X" (Kh in Russian), a high speed, maneuverable well armed monoplane somewhat along the lines of the German ME-109. The NKAP (*Narodni kommissariat aviatsionnoii promyshlennost or Peoples Commissariat*

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<sup>23</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 8

<sup>24</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 7

*for the Aircraft Industry*) learned of this project and decided to hasten its completion, by forming an OKO (experimental design department) within the Polikarpov OKB. On December 8, 1939 the new OKO was established, headed by the bright young Artyom Mikoyan and his deputy Mikhail Gurevich, both employees of Polikarpov OKB. The Yakolev bureau had also been at work on a similar project. Upon its completion in 1939 it was expected to go into production. Yet the OKO headed by Mikoyan promised a higher top speed than the Yakolev. After much wrangling with the NKAP, Stalin was convinced to wait for the completion of aircraft X. After all, Stalin was convinced speed in aircraft was everything.

Anushavan (Artyom) Ivanoich Mikoyan was born in the village of Sanain near the Turkish border with Armenia on August 5<sup>th</sup> 1905. When war broke out with Turkey in 1914, Mikoyan's family, along with most other Armenians in the area, were convinced the Turks would invade and slaughter ethnic Armenians. These fears led to a mass movement of Armenians away from the border. Mikoyan would never return, instead settling with his family in Tbilisi in nearby Georgia. His brother, Anastas became very involved with the Bolshevik party during the war and in 1915 joined the party. He soon met and befriended a young Joseph Dzhughashvili. This friendship would bear fruit for both Mikoyan's brothers later in life.<sup>25</sup>

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<sup>25</sup> Artyom's brother by 1946 was the deputy premier of the Soviet Union and the vice chairman of the Council of Ministers. He retained this role through Khrushchev's reign, even being awarded the position of Trade Minister. His position close to Stalin was perhaps the reason Artyom was not implicated in the purges and his firm escaped Stalin's rule with little damage. Anastas's position as trade minister in the 1950's and 60's undoubtedly helped MiG's foreign sales and allowed it first choice of imported resources.

Arytom was accepted into a Tbilisi high school in 1918 and upon completion of school, joined the Communist party. He moved to Moscow to work as a lathe operator in a factory, contracted tuberculosis and nearly died. Through a miracle of sorts, he was able to fight off the disease and make a recovery. While working in the “dynamo” factories of Moscow, Arytom became passionate about Communist ideals and was called upon to serve a secretarial function for the Party. Soon after he began the position, however, he was called to serve in the Red Army. He served in the infantry until he received a commission at the Frunze Academy. After his release from the Army, young Mikoyan was asked to enter the VVA (Soviet Air Force Academy), where he studied at the Zhukovsky Aeronautics Institute, pursuing a degree in aircraft design. During his time at the Academy, Arytom became an accomplished parachutist, no small feat in the late 1930’s, and pilot. Part of his studies at Zhukovsky required an internship at an OKB and Arytom was sent to Kharkov and the design bureau of D.P Grigovich.<sup>26</sup>

In Kharkov, Arytom, along with some friends, built an ultra light aircraft, the *Oktyabrenok* (named for the organization of young children preparing to join Young Pioneers) powered by a 25hp American engine and its flight characteristics were wonderful. The instructors at the OKB looked very favorably on Mikoyan for its low cost (under 12,000 rubles), and that it was foldable for storage.<sup>27</sup> Soon after Artyom’s graduation, his aircraft flew a series of four testing flights, each better than the last until, when on the fourth flight, the old engine gave out and a forced landing was necessary. The damage was minimal, but it was

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<sup>26</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 37

<sup>27</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft 37

the death blow to the students' small program Artyom moved onto bigger and brighter things. Artyom was assigned to Polikarpov fighter OKB in Moscow as a VVS inspector.

Mikoyan rapidly advanced through the ranks of the OKB, gaining the trust of designers and engineers alike. Soon he was given his first independent project, overcoming heat issues of the I-153 with regard to gun firing. Within weeks Artyom fixed the problem and became a protégé of Polikarpov. It was from this position he would emerge when his own OKO was formed in Polikarpov's absence. It was also here that he met his future partner, deputy bureau chief Mikhail Gurevich.

Mikhail Iosifovich Gurevich was born on January 12, 1893 near Kursk in Ukraine.<sup>28</sup> The son of a well-to-do distiller, Mikhail excelled at mathematics from a young age. During his time at Kharkov University, young Gurevich became involved in student movement of which the czar disapproved and in 1911 Mikhail was exiled to France. He continued his studies of aeronautics at *L'Academie I'Aeronautique* in Paris. After graduation and the October Revolution, Gurevich returned to Kharkov University where he earned a post-graduate degree. In 1928 went to work for the TsKB. He was given a position working with Frenchman, Paul Richard who was heading a project designing flying boats. The project was completed and successful but was never ordered into production, Richard returned home to France and Mikhail found work with the TsAGI.

In part because of his command of English Mikhail was asked to accompany a delegation visiting the Douglas factories in the US in 1936. The

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<sup>28</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 10

committee was to research and pursue a production license for the DC-3 in the USSR, which they eventually accomplished. Upon return to the Soviet Union, Gurevich was appointed Deputy Chief of the Polikarpov bureau, then to head a new OKB with Mikoyan. The two men already had a blossoming friendship due to their mutual ties to Kharkov University and they soon found they worked and complimented each other very well. Mikoyan had stated that he would head the company “provided Gurevich can be my deputy”.<sup>29</sup> Mikoyan became the energy while Gurevich, thirteen years his senior, played the devils’ advocate. On December 8, 1939 MiG was born.

As MiG was a break off of the Polikarpov bureau, employees were given the option of going with the new design team or staying with Polikarpov. Nearly 40% of Polikarpovs employees went with MiG to refine Project X into a viable fighter. Polikarpov, away in Germany during the break-up was understandably distraught. On his death bed in 1944, said the events of 1939 hastened his downfall.<sup>30</sup>

Refinement of the I-200 (former Project X) was quick. It was the first fighter aircraft to exceed 400 mph in level flight, and though it had proved to be a quirky aircraft to fly and master, it was rushed into production in early 1940 as the MiG-1. The first examples were seen in the annual May Day Parade fly-over in Red Square in 1940. The initial version was very quickly updated and renamed the MiG-3. When Germany invaded the Soviet Union in June of 1941, fully one

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<sup>29</sup> Ibid

<sup>30</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft 40



third of VVS fighters were MiG's, the only non-obsolete aircraft in the Soviet inventory.

MiG received an order for the design of a ground attack aircraft in 1941, but the success of the Ilyushin Il-2 in the early stages of Operation Barbarossa convinced Stalin to put all production capacity behind the Il-2 and the order was cancelled.<sup>31</sup> Throughout the war MiG's performed decently, although not to their fullest capabilities. The early MiG-1's never reached full scale production and frontline numbers were limited. On the other hand, over 3,000 MiG-3 were accepted by the VVS.<sup>32</sup> The MiG-3 excelled at high altitude intercepts and once this was discovered by the Germans<sup>33</sup>, the Luftwaffe engaged the MiG's at lower altitudes where their aircraft held the advantage. Stalin believed aircraft were to support ground troops and therefore was keen on the success of the IL-2 Shturmovik. He halted production of the MiG-3 in the beginning of the 1942 to in order to concentrate on Shturmovik production.

The rapid advance of the Wehrmacht into Soviet territory spawned a mass migration of Soviet industry eastward. Soviet industry that had not yet succumbed or was west of Urals moved east. Part of this mass exodus of man and machine was MiG, starting east in August 1941. The move was incredible, set-up to produce aircraft until the last possible second GAZ 1, was disassembled and rushed eastward to get the lines rolling once again. An airfield, factory and very

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<sup>31</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 41

<sup>32</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 22

<sup>33</sup> The Germans, prior to Operation Barbarossa had sent numerous JU-86P aircraft over Russia on reconnaissance missions. The aircraft cruised at such a high altitude the Germans believed it to be impervious. Only after the failure of two aircraft to return, did the Germans discover the potential and existence of the MiG-3. source Butowski pg 43

modest facilities were quickly built and by October, the factory was up and running. As the Nazi push towards Moscow fizzled, the threat subsided and by March of 1942 MiG and GAZ-1 returned to Moscow. The OKB was reorganized, the GAZ renumbered 155 and MiGs new home became *Leningradskoye Shosse* (Leningrad Highway). MiG continued producing designs for new fighter aircraft throughout the war, but for various reasons, never again won a piston engine contract. MiG seemed destined for obscurity, especially in light of the conservatism of the Stalinist era. Jet engine design and technology, however, would prove the saving grace of MiG.

In late 1944 Stalin issued an order for jet fighter aircraft just as the German Me-262 was gaining notoriety. The Allies, in a program headed by Frank Whittle, also announced they were flying jet aircraft, albeit not yet in combat. This naturally infuriated the General Secretary and Soviet OKB's were pushed to catch up. Soviet jet design was nearly non-existent; the only semi-viable option was a strange piston powered jet engine that was severely lacking. It was not until the end of the war and the capture of German BMW jet engines that design of such aircraft became viable. Using information gathered from German scientists and designers, MiG created the MiG-9, the first Soviet jet powered fighter, in August 1946. An interesting side note that through a flip of a coin, it was also the first jet powered Soviet aircraft to take flight.<sup>34</sup> Though its performance was average and its maintainability poor (the average life of the engines was only 75 hours) it launched MiG to the forefront of Soviet OKB's. A gift far greater than this was in store for MiG in the near future.

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<sup>34</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 10

A short sighted gift from Great Britain allowed MiG to develop the MiG-15. Great Britain sent the Soviets twenty five Rolls-Royce Nene jet engines and thirty Derwent jet engines at their request.<sup>35</sup> This gift, coupled with captured German data on swept wing design, allowed MiG to create this new aircraft. The MiG-15 (NATO codename FAGOT) would soon gain infamy in the skies over Korea, and secure MiGs place in the hierarchy of the Soviet defense establishment. MiG soon became the premier fighter OKB, quickly overshadowing such famous names as Ilyushin, Lavochkin and Tupolev. For the next forty years the VVS ordered almost exclusively MiG aircraft to equip its fighter regiments.

Arytom Mikoyan reached the rank of General Constructor of the MiG design bureau on December 20, 1956. He continued in this capacity even after a serious stroke, which in 1969, left his deputy Rostislav Belyakov, as head constructor. He died on December 9, 1970. Gurevich outlived his partner but was plagued by illness from 1957 onward, retiring in 1964 and passing away in 1976. The company continued in their tradition of excellence. Since 1960, more than 20,000 MiG's have been produced (excluding license built copies), more than any other modern aircraft manufacturer.<sup>36</sup> The company later helped design the *Buran* Space Shuttle in the 1980's. In the early 1990's MiG merged with MAPO (Moscow Aircraft Production Organization) to become MiG-MAPO and today it is simply know as RAC (Russian Air Company) MiG. Importantly RAC MiG was granted the right of independent foreign economic activity by President Boris

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<sup>35</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 60

<sup>36</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 12

Yelstin on January 25, 1996.<sup>37</sup> Today, the company faces financial hardships that were never anticipated under the Soviet system. The future of MiG is still uncertain.

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<sup>37</sup> [www.migavia.ru/eng/corporation/?tid=4](http://www.migavia.ru/eng/corporation/?tid=4)

## Chapter IV

### Synopsis of MiG Aircraft Since 1950<sup>38</sup>

MiG enjoyed moderate success during the Great Patriotic War, with the MiG-1 and -3 and immediately afterwards with the MiG-9, yet it was the Cold War era that would propel MiG into the everyday world lexicon. The MiG-15 was the first aircraft from the Mikoyan Gurevich OKB to receive worldwide fame. It was designed to complete an order from the MoD for a fighter capable of “up to Mach .9 and altitude not less than 11km (36,089ft), with an endurance of at least one hour, the ability to operate from unpaved airstrips, heavy big gun armament and easy maintenance”<sup>39</sup>. Work began on the MiG-15 in 1946. Wartime engines captured from the Germans were not able to meet the thrust demand, but with the acquisition of Rolls-Royce jet engines from Great Britain work proceeded. A reverse engineered version of the Rolls-Royce Nene engine, the RD-45, was chosen to power the MiG-15. A radical design for the day, the MiG-15 incorporated a swept wing design, a design learned from captured German scientists and documents. The first flight of the MiG-15 took place in mid-1948, around same time as the first flight of the American F-86 Sabre. It was ordered into production soon after, with the first rolling of the production line of GAZ 1 in December. The VVS accepted the aircraft in early 1950 for front line service, just

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<sup>38</sup> For a flow chart and visual representation of each aircraft see appendix

<sup>39</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 52

as war on the Korean Peninsula erupted. Korea became the proving ground for the first generation of swept wing jet fighters.

Stalin, unwilling to become directly involved in the Korean War, instead gave the Chinese a number of MiG-15's to offset the air superiority of UN forces over Korea.<sup>40</sup> When the first MiGs appeared over the Yalu River in November of 1950, the UN forces had nothing to counter. A US Air Force F-80 Shooting Star became the first victim of an all jet dogfight, falling to the guns of a Chinese MiG on November 8.<sup>41</sup> The US was quick to respond with the deployment of advanced F-86 Sabres to Korea. The first MiG to fall to the Sabres was shot down over the Yalu in early December. By the end of the conflict, US Sabres had destroyed nearly 800 MiG-15's while losing only 78 F-86's, ending with a kill ratio of 10 to 1. This did not mean the MiG was an inferior aircraft, it most certainly was not. It enjoyed a better climb and dive rate and was considerably more robust than its American counterpart, but the skill of the average MiG pilot was inferior to US pilots. When flown by a competent pilot the MiG-15 was deadly as almost 80 American pilots discovered.<sup>42</sup>

Though the MiG-15 did not dominate the skies over Korea, many countries chose to equip their air forces with them. Poland, China and Czechoslovakia all produced domestic, license-built versions. Overall nearly over 16,000 MiG-15 in numerous variants were built with some still serving as training

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<sup>40</sup> Soviet pilots were flying combat missions over Korea albeit in Chinese marked MiG's. Please see Chapter 6.

<sup>41</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 218

<sup>42</sup> The more competent MiG-15 pilots are believed to be either Soviet or Eastern Bloc mercenaries flying for the Chinese. Not all Chinese pilots were bad, with a few becoming proficient fighter pilots.

aircraft today. Improvement on a design such as this is natural. From the lessons learned in the MiG-15 the MiG-17 (NATO codename FRESCO) was designed.

In response to a call from the MoD for an all-weather, radar equipped interceptor, MiG began design on the MiG-17. With Soviet jet engine design still lagging behind the West MiG decided to improve upon the aerodynamics of the -15. The wings were swept back further, reducing the thickness of the wing and the tail was re-engineered. The design was a success and entered production in 1953. A later variant, the MiG-17F was equipped with a KV-1 afterburning engine thereby increasing the Fresco's speed and power drastically. Production numbers eventually reached nearly 11,000 aircraft with license-built versions in nations such as Czechoslovakia, Poland and China <sup>43</sup>

The Fresco saw combat in places such as Vietnam, the Sinai Peninsula, Africa and the Indian sub-continent and did well. During the Vietnam War, American pilots, in far more advanced aircraft, found themselves at disadvantage to the small, maneuverable MiG-17. This was especially true due the restrictions placed on BVR (Beyond Visual Range) engagements for American pilots. General Robin Olds, one of the top American aces of the war, said "Unlike the chair-borne strategists in the Pentagon and their computer analysis, I can say that the MiG-17 is a very dangerous little animal. Its maneuverability is phenomenal! It is very difficult to outmaneuver it with an F-4 Phantom."<sup>44</sup> MiG-17s also served in the Indo-Pakistani wars and the Arab-Israeli wars although they did not perform as well as they had in Vietnam due to the nature of the combat.

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<sup>43</sup> Gunston, Bill and Gordon, Yefim MiG Aircraft Since 1937 pg 82

<sup>44</sup> *ibid* pg 82

The Korean War was studied diligently by both the Soviet MoD and the OKB's. The MoD issued a call in 1953 for "a frontal fighter (i.e. not a radar equipped interceptor) capable of Mach 2 in level flight at an altitude of 20km (65,617ft) while carrying guns and a radar-ranging sight."<sup>45</sup> Later this requirement included integration of a GCI (Ground Control Intercept) network and the ability to fire guided missiles. MiG came up with perhaps the most famous Soviet fighter design ever, the MiG-21 (NATO codename FISHBED).

Incorporating such features as large delta wings, an afterburning engine and the ability to fire K-13 (NATO codename ATOLL) infrared air-to-air missiles, the MiG-21F was an advanced design. When it entered production in late 1959, the MiG-21MF was one of the most advanced aircraft in the world. Used by more than 40 countries worldwide, it became one of the most prolific jet fighters in the world, numbering more than 14,000 aircraft, many still in service today. In combat the MiG-21 was the victor and the vanquished many times over. First seeing combat in Vietnam and the Middle East, its record was mixed. In Vietnam the MiG-21 did fairly well, downing a number of American aircraft, including a B-52. The Arab-Israeli Wars were a different story, with Fishbeds suffering greatly at the hands of the more proficient Israeli pilots. The MiG-21 also served in the war on the Indian sub-continent, where it did quite well against American F-104 Starfighters. This war also was the first in which MiG on MiG combat occurred. A Pakistani F-6 (Chinese version of the MiG-19<sup>46</sup> (NATO

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<sup>45</sup> ibid pg 141

<sup>46</sup> The MiG-19 was an attempt to further the design of the MiG-17 by adding missiles and a more powerful engine to create an interceptor. As the aircraft is not as widespread, and for the sake of brevity, it has not been included in this analysis.



codename FARMER)) destroyed an Indian MiG-21. MiG-21's also participated in the Iran-Iraq War, and suffered greatly to the American supplied F-4 Phantoms, F-5 Freedom Fighters and F-14 Tomcats.<sup>47</sup> The MiG-21 continues to serve to this day having recently participated in the wars of the break-up of Yugoslavia. With modifications done to the fire control and avionics by MiG and such companies as IAI in Israel, the MiG-21 will continue to serve well into the 21<sup>st</sup> century.

In the mid-1960s, the need for a fighter-bomber capable of STOL (short takeoff and landing) was realized by the VVS. The MoD issued a call for design and MiG created the first production variable geometry aircraft in the Soviet Union, the MiG-23/27<sup>48</sup> (NATO codename FLOGGER). The MiG-23 was designed at a time when the high speed performance of aircraft was exceeding the capabilities of pilot and structure. Due to the small wing surface of aircraft such as the MiG-21 and F-104 Starfighter, landing speeds were becoming intolerably high. In addition, the aircraft were not proficient in air-to-ground munitions. They could not carry the load required and the speeds at which they operated precluded successful engagement of ground targets. MiGs designers, taking the lead of American programs such as the F-111 and even captured German documents, worked to solve this problem by using a "swing wing" design whereby the aircrafts wing surface would extend for low speed-high maneuver operations, and sweep to a near delta configuration for high speed-low maneuver situations. The

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<sup>47</sup> These aircraft were supplied to the Shah prior to the Islamic Revolution on 1979. Their story is fascinating as the Iranians managed to maintain and keep them combat ready despite embargoes. Amazingly some are still flying to this day.

<sup>48</sup> The MiG-27 is a further incarnation of the MiG-23. Designed to be a tactical support aircraft, it was optimized for ground attack with slightly different intakes, advanced nav-attack system and the ability to sweep the wings with stores on pylons.

swing wing also lowered landing and takeoff speeds allowing the MiG-23/27 to operate from shorter, unprepared landing strips. The first production MiG-23 rolled off the production line in mid 1969.<sup>49</sup> The MiG-23 was faster than the MiG-21, could carry a heavier, more varied payload and could operate from dispersed airfields. The VVS hoped the MiG-23 to be the answer to what was needed; a reliable, fast maneuverable, versatile fighter-bomber.

The MiG-23 was a large success as hoped, it was a very complicated aircraft to build and maintain. In addition, transition to the aircraft was not as smooth other aircraft had been and a two-seat trainer version was hurriedly put into production. The MiG-23 was also difficult to maintain. There were structural integrity problems with aircraft produced at certain factories. The aircraft was exported and license built by many countries with nearly 3,000 examples being produced worldwide. Its combat record is also less than stellar. The Flogger saw widespread service during the Iran-Iraq War with the Iraqi Air Force, but could not operate very effectively over hostile territory and fell prey to the more advanced Iranian Air Force. During the Israeli "Peace for Galilee" Operation it also saw service with Syria, where it again suffered significantly to Israeli aircraft.<sup>50</sup> The MiG-23 was phased out of service with the VVS in the mid-1980's in favor of the new MiG-29. It remains one of the more disappointing aircraft MiG produced. An air show at Domodedovo in July of 1967 was the first showing of not only the MiG-23 but its stable mate, the MiG-25 (NATO codename FOXBAT).

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<sup>49</sup> Belyakov, R.A and Marmain, J. MiG: Fifty Years of Secret Designs pg 362

<sup>50</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 220

During the 1960's the CIA and the USAF deployed the A-12 and the SR-71 reconnaissance platforms, both capable of Mach 3+. The US also developed a high speed high altitude bomber capable of Mach 3+. The XB-70 Valkyrie was to penetrate Soviet airspace at high altitude and at high speed to deliver its nuclear payload. In addition, the US Navy fielded the A-5 Vigilante; a carrier based nuclear capable attack aircraft capable of speeds nearing Mach 2.5. The Soviets saw the need to counter this threat and the call for a Mach 3+, high altitude interceptor with a powerful radar was issued. The MiG-25 was born out of this order. With testing beginning in the mid-1960's and the first public showing in 1967, production of the first Foxbat commenced in 1970. The XB-70, one of the aircraft the MiG-25 was designed to counter, never reached production, but SR-71 Blackbird reconnaissance aircraft were harassing Soviet Air Defenses in the Far East on a regular basis. Many of the new MiGs were sent to intercept them, a feat they never accomplished. The high speed high altitude capability of the MiG-25 made it, ironically enough, the perfect reconnaissance aircraft. It was in this form that the MiG-25 first found itself in a combat situation.

The Soviets deployed a number of reconnaissance versions of the MiG-25 to Egypt in 1971 to over-fly and photograph the Sinai Peninsula and Israel itself. These MiG-25's, stationed in Cairo and flown by Soviet pilots, flew with impunity over the Israeli air defense network. According to Israeli sources, the MiGs were tracked flying at Mach 3.2 and altitudes approaching 72,000ft.<sup>51</sup> It was not until 1981 that a MiG-25 was lost to hostile fire; in this case a Syrian

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<sup>51</sup> Butowski, Piotr and Miller, Jay OKB MiG: A History of the Design Bureau and Its Aircraft pg 110

MiG-25 was ambushed by two Israeli F-15 Eagles. The most notorious case of the MiG-25 is that of the defection of Lt. Viktor Belenko to Hokkaido Japan in 1976. This answered many questions concerning the Mach 3 interceptor. Air to air combat with the MiG-25 occurred during the Iran-Iraq War, with the MiG-25 scoring a number of kills, although they suffered heavily to the Iranian F-14's. Lt. Belenko also warned that a new MiG-25 version, optimized for low altitude high speed intercepts, was being developed to counter the threat posed by the American B-1B. Satellite photographs during the early 1980's confirmed the existence of this aircraft which came to be known as the MiG-31 (NATO codename FOXHOUND).

Optimized for high speed, low altitude intercepts, the Foxhound used the latest in Soviet LDS (look down shoot down) radar systems, carried the new AA-9 (NATO codename AMOS) long-range missile and was operated by a crew of two. The Foxhound was a near total redesign of the MiG-25, with new lightweight, efficient Solyukov engines replacing the thirsty Tumansky engines of the Foxbat. The fuselage was lengthened to accommodate a WSO (weapons system officer) and the airframe was strengthened for a higher g rating. This new MiG-31 was photographed for the first time by a Royal Norwegian Air Force F-16A off the coast of Finnmark in 1985.<sup>52</sup> Still posing a threat today, it is in service with the Russian and Chinese Air Force.

In 1972, the VVS issued an order for a lightweight fighter to replace the MiG-21 and -23. It was to combat such as aircraft as the American F-15, -14, -16, French Mirage 2000 and Panavia Tornado, all coming online in the West. It was

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<sup>52</sup> Butowski pg 110

to operate over friendly territory as an interceptor under the close supervision of GCI controllers; in addition it was to have limited air-to-ground capabilities using precision guided munitions. Out of the VVS order came the MiG-29 (NATO codename FULCRUM). The MiG-29 is a single seat, twin engine design bearing resemblance to the American F-15, though it is not a copy of it. The first production MiG-29 rolled off the assembly line in 1982, at a plant in Moscow. Initially deployed to the 16<sup>th</sup> Air Army in East Germany, all production aircraft were earmarked for the VVS. In 1986, the first export versions, with downgraded avionics and radars, were delivered to India. Sales followed shortly to Warsaw Pact countries and Middle Eastern nations. More than 1500 have been built to date, with MiG still producing Fulcrums for the Indian Navy.<sup>53</sup> It is also the only Russian-built aircraft to serve in a NATO air force.

Prior to the fall of the Soviet Union, the MiG-29 demonstrated its phenomenal maneuverability during airshows in the West, performing tail slides and other previously unheard of maneuvers. Today the MiG-29 is employed the world over, with more than 21 nations.<sup>54</sup> However, the MiG-29 has not been promising in combat. In Gulf War I the only aircraft it shot down was another Iraqi fighter, just prior to its own crash into the ground. In addition, four more MiG-29's were downed by American F-15's during the conflict. Losses also occurred during the Eritrean-Ethiopian War in which more than five Fulcrums were shot down by Ethiopian SU-27's (NATO codename FLANKER).<sup>55</sup> Two

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<sup>53</sup> <http://www.acig.org/>

<sup>54</sup> Tartar, Easy. "MiG-29 in Study" Fighter Tactics Academy. December 2003  
<http://www.sci.fi/~fta/MiG-29.htm>

<sup>55</sup> Tartar

MiG-29's of the Yugoslavian Air Force were downed during the NATO bombing campaign by American F-15's. In 2001 two Syrian MiG-29's were downed by Israeli F-15's.<sup>56</sup> Very few victories exist for the MiG-29 in combat.<sup>57</sup> The aircraft, however is selling, with Malaysia being the latest customer. This aircraft is related directly to the future of MiG as a company, as the call for new designs by the MoD looks dim. How MiG reacts to the present and future will decide its fate.

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<sup>56</sup> *ibid*

<sup>57</sup> A Cuban MiG-29 did succeed in downing a civilian Cessna 337 in 1996. [www.acig.org](http://www.acig.org)

## Part II

### Case Studies of Four Generations of MiG Aircraft in Combat

#### Introduction

Fighter aircraft development in the post war era can be divided into several distinct generations. The development of post-Second World War jet-propelled straight winged aircraft such as the German Me-262, the American P/F-80 Shooting Star, the British Gloster Meteor and the Soviet MiG-9 constituted the first jet-turbine driven fighter aircraft. These aircraft were not much faster than their propeller-driven counterparts and were less maneuverable. Additionally, they were considerably more expensive to build and maintain than the fighters of World War Two. Although an improvement over previous prop-driven aircraft, jet turbine-driven aircraft left much to be desired as viable weapons platforms. Hence, they are usually not included as a separate generation.

The first generation designated by aviation experts included the first aircraft to make use of captured German technologies such as swept wing design.<sup>58</sup> They were also the first generation able to break the sound barrier, albeit only in a dive. Aircraft in this generation include the American F-86 Sabre, the Soviet MiG-15 and the British Hawker Hunter. These aircraft, along with some first generation jets, participated in many conflicts such as Korea, the Suez crisis, the Indo Pakistani wars and the Six Day War, and numerous other skirmishes.

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<sup>58</sup> Aviation Weeks Show News Online September 10, 1998 "On the record with Maj Gen Steffan Nastrohm Chief of Swedish Air Force Material Command"  
<http://www.aviationweek.com/shownews/today/newsmk14.htm>  
Defining first generation aircraft in manner consistent with international aviation experts dismisses aircraft that were developed during the Second World War. Only aircraft developed post-War are included such as the MiG-15 and F-86.

Some of these aircraft are still in service today as training aircraft, ground attack aircraft or in reserve roles in many of today's third world nations.

Second generation aircraft were the first to be able to fly at supersonic speeds in level flight. The American F-100 Super Sabre was the first of these. Improvements in avionics, engine and weapons design, along with a shift in policy towards bomber interception created missile-carrying aircraft capable of engaging and destroying intruding enemy bombers. Aircraft in this generation include the American F-4 Phantom and F-105 Thunderchief, the Soviet MiG-19 and MiG-21 and the British Lightning. These aircraft are still in service with many air forces around the world, including NATO and former Warsaw pact nations. The proving grounds for these second generation aircraft include, Vietnam the Arab-Israeli wars and the Iran-Iraq war. These aircraft are still being refitted and improved upon.

The third generation includes most modern front line fighters. These include the American F-15 and -16, the Soviet/Russian MiG-23 and -29 and SU-27, the European<sup>59</sup> Tornado and the French Mirage. These aircraft are currently in the middle of their service life and most likely will continue to fly well into the 21<sup>st</sup> century. The third generation is typified by fly-by-wire systems<sup>60</sup>, advanced radar and fire control systems and increased maneuverability. Equipped with much more efficient engines, these aircraft are allowed more flight time at higher

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<sup>59</sup> The Tornado was built and designed by an international consortium from Britain, Germany and Italy.

<sup>60</sup> Fly-by-wire is a system in which pilot input is not directly linked with control surfaces, instead the control surfaces are controlled via a computer system. This allows highly unstable aircraft designs to be controllable as the computer makes thousands of corrections to the flight surfaces a second. It also allows the computer to evaluate the pilot's input and then decide how best to perform the maneuver, thus allowing unparalleled maneuverability.



speeds. Most have also adopted multi-role positions, optimized for air-to-ground and air-to-air engagements, often within the same sortie. These aircraft have seen conflict in the Middle East during the 1982 Israeli invasion of Lebanon, both Gulf Wars, the skies of Bosnia/Kosovo and in many other small skirmishes during the last twenty years around the world.

The fourth generation of aircraft takes the multi-role aspect even further. Among their advantages are digital avionics and fire control, supersonic cruise and incredible maneuverability. Militaries around the world hope the flexibility offered by these new aircraft engender a one type air force, thus simplifying training, maintenance and supply problems. The cockpits of these aircraft will also replace all but the most essential gauges with MFD's<sup>61</sup>. Although flight testing of fourth generation aircraft is at a very advanced stage, the only nation that has fielded such an aircraft in front line service is Sweden, with the SAAB Gripen. Expected to enter service in late 2005 the United States is developing the F-22 Raptor, while the Eurofighter Typhoon is expected to enter service with the countries of Germany, Italy, Britain and Spain soon. Russia has lagged behind in this field, although some argue that the SU-27 Flanker and the aircraft evolving from it are truly the first fourth generation aircraft. However, the initial SU-27 lacked the sophistication of aircraft such as the Raptor, Typhoon or Gripen. Due

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<sup>61</sup> MFD's or Multi-function displays are display screens much like a computer, that with a touch of a button, can control and monitor any number of systems within the aircraft such as navigation, fire control, engine management or communications. These monitors both save space and provide the pilot with much more information at a glance than previous gauged type cockpits. Some later third generation aircraft have MFD's but the fourth generation is the first to have them included at the initial design level.

to fiscal constraints MiG in particular has stalled the development of its fourth generation aircraft, the MiG 1.44.

This is the first generation of aircraft in which MiG has not been at the forefront of aircraft development. Its designs have played a major role in nearly every air-to-air engagement of the post-war era, beginning with Korea and continuing to this day in places such as the Middle East, the Balkans and Asia. A short history and evaluation of MiG aircraft within each generation from Korea to present day, including lessons learned from previous conflicts, is the key to understanding the design bureau and its designs.

## Chapter V

### The Korean War

#### The MiG-15 and the First Generation of Soviet Jet-Powered Fighters

When North Korea careened across the 38<sup>th</sup> parallel on June 25<sup>th</sup> 1950, there was little in the way of airpower to stop them. South Korea possessed no armed aircraft and very few transports. Most of these were caught by surprise and destroyed on the ground in the early hours of the invasion. At the outbreak of hostilities the North Koreans had mostly surplus World War Two Soviet aircraft such as Yak-9's and Il-10's. Although obsolete, they were extremely effective as they were no counter threats. The North Korean Air Force reigned supreme over the skies of Korea for a short time, until the US Far Eastern Air Force (FEAF) began to launch sortie against them from both Japan and the Korean Peninsula.

FEAF wrested control of the air from the North Korean Air Force (NKAF) Very quickly. American F-82 Twin Mustangs and early jet aircraft such as the F-80 Shooting Star, decimated the poorly trained and equipped NKAF. By the time of the Inchon landing in September of 1950, the NKAF has nearly ceased to exist. The UN now dominated the skies and pounded relentlessly the beleaguered North Korean soldiers trapped between Seoul and Pusan. A rapid retreat ensued and by October UN forces had crossed the 38<sup>th</sup> parallel into North Korea. Air operations during this time were in tactical direct support of ground forces, strafing and bombing enemy locations, and strategic bombing of North Korea by B-29's operated from Japan. Little air opposition was met by either. The B-29 raids

became known as “milk runs” by the aircrews as not even enemy



<sup>62</sup> [http://www.maxwell.af.mil/au/afhra/wwwroot/korean\\_war/kwd\\_images/ks05\\_crop.jpg](http://www.maxwell.af.mil/au/afhra/wwwroot/korean_war/kwd_images/ks05_crop.jpg)  
Map from Air War College at Maxwell Air Force Base. Some detail and text added by author.

anti-air artillery was encountered. Without outside help the NKAF was in no position to defend its airspace from the UN forces. Mistakes made by American pilots and planners, however may have served to reinforce plans in Beijing and Moscow to intervene in the war.

On September 22, a flight of US B-29 Superfortresses accidentally bombed the rail marshalling yard at Antung, north of the Yalu River and inside of China. After making a navigational error on October 8, four US F-80 Shooting Stars attacked a Soviet airfield near Vladivostok.<sup>63</sup> Some speculate these errors may have convinced China and the USSR that UN forces had intentions extending outside the boundaries of North Korea. These two actions may have been the catalyst for the Soviets to deploy MiG-15's (NATO codename FAGOT) and pilots to China to counter the dominate UN air forces. The USSR also began training Chinese and North Korean pilots to fly the MiG-15.

On November 1 1950, six previously unidentified swept wing jet fighters made a firing pass on a flight of US F-51 Mustangs.<sup>64</sup> The swept wing fighters came in from north of the Yalu and fled back across after the unsuccessful attack. The US fighters were unable to pursue as anything north of the Yalu was, and would continue to be throughout the war, off-limits. Even when the commander of the 25<sup>th</sup> FS/51<sup>st</sup> FW, Lieutenant Colonel Clure Smith, flying an F-80C, brought back gun camera footage clearly showing a MiG-15 he had engaged, the intelligence and command communities did little to counter the threat. However,

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<sup>63</sup> Knez, Saso and Joe Brenan. "Honchos" Air Combat Information Group Journal. October 2003 [http://www.acig.org/artman/publish/article\\_315.shtml](http://www.acig.org/artman/publish/article_315.shtml)

<sup>64</sup> Dorr, Robert. Lake, Jon and Thompson, Warren Korean War Aces (Osprey. London, 1995) pg 15

on November 8 the first jet-vs-jet aerial victory occurred, Lieutenant Russell Brown was credited with downing a MiG-15, though the Soviets disputed this fact and claimed an F-80 was downed.<sup>65</sup> The first MiG kill confirmed by the Soviets occurred the next day when Lieutenant Commander William Amen of VF-111 scored one of the few Navy kills in his F9F Panther. Very quickly, the MiG-15 proved its worth over the skies of Korea, proving far superior to anything in the UN inventory. Able to out-turn and out-climb all jet fighters in the theatre, the MiG-15 was faster than all prop driven aircraft and could attack with near impunity the now vulnerable B-29 Superfortresses. It soon began to wrestle control back from the UN forces.

### MiG-15 Development: The Soviet Union Enters the Jet Age

Soviet designers in the immediate post-war era faced a huge dilemma. Stalin had ordered the development of an aircraft that drastically exceeded the performance of early straight-winged MiG-9. The design called for the aircraft to be effectively airborne for over an hour, able to operate at high transonic speeds

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<sup>65</sup> Dorr pg 16 This kill is highly debated, as the Soviets (the only nation with MiG-15s flying in Korea at the time) does not acknowledge losing any aircraft that day. In fact the kill ratio traditionally accepted by UN sources is now , with access to Soviet archives, highly suspicious. Both sides claim far more kills than the other admits to losing. For example the US claim of a 15:1 kill ratio is not corroborated by Soviet, Korean and Chinese sources. Soviets claim nearly a 1:1 ratio. Causes of this are multiple but include the problem that the airspace where MiG-UN engagements occurred over Communist controlled territory; therefore wreckage of claims could not be found. Also many engagements ended with a MiG spinning and apparently out of control, yet out of sight the aircraft recovered and returned to its bases north of the Yalu. The issue of kill ratios will unlikely ever be resolved and for the purpose of this work not be used as a measure of aircraft success.

and able to achieve altitudes of over 40,000 feet.<sup>66</sup> This criterion presented difficult problems for Soviet designers. First, domestic jet engine development was no where near the level needed for the speeds required. Soviet designs had a very poor service record most engines needed full rebuilds after only 25 hours of operation.<sup>67</sup> Another hurdle was the fact that at speeds over 500mph, straight winged aircraft experienced stability problems, due to fluctuations in airflow over control surfaces. The result of exceeding this speed (called critical Mach number) would often result in uncontrollable fluttering of the tail and wings, often separating these from the aircraft. Swept wing aircraft could raise the critical Mach number to a much higher level, but Soviet designers possessed little knowledge of this design. Extensive research had been done by the German Luftwaffe during the Second World War, but the nature of advancing Soviet troops convinced nearly all research engineers and pilots to flee westward towards US and British lines to surrender. Thus, the Soviet Air force did gather a wealth of data and material such as airframes and importantly Jumo engines as they advanced, but they did not capture many Luftwaffe test pilots or researchers. The US had an edge after the war, with its vast knowledge of Luftwaffe experiments both through captured pilots and aircraft designers. As Luftwaffe Lieutenant General Adolf Galland told his US intelligence officer during his debriefing, “I am of the opinion that Germany has lost the war but the future of all Europe lies

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<sup>66</sup> Butowski pg 59

<sup>67</sup> Saso Knez , Diego Fernando Zampini & Joe L. Brenan, [Korea, 1950-1953: Honchos.](http://www.acig.org/artman/publish/article_315.shtml)  
[http://www.acig.org/artman/publish/article\\_315.shtml](http://www.acig.org/artman/publish/article_315.shtml):

in the hands of the allies (i.e. US and Britain). I have no place to go and no desire to go anywhere. I will be at your wishes at all times.”<sup>68</sup>

The Soviets captured few pilots and engineers. Unfortunately for the VVS, the few who were captured were tried for bogus war crimes such as killing civilians with stray machine gun rounds. Once sentenced to hard labor in Siberia, these pilots and engineers were of little use to the VVS. This would later harm the tactical evolution of the VVS as the Americans learned much from their captured Luftwaffe personnel concerning new tactics being perfected towards the end of the war. The VVS did benefit from captured Luftwaffe documents. It began to incorporate these designs, along with captured German engines into its first post-war jet aircraft.

After experimentation with the swept wing designs, the MiG OKB used both indigenous and captured Luftwaffe documentation, to develop an airframe capable of exceeding the performance of the MiG-9 FARGO. Two areas of airframe design allowed MiG to advance past the MiG-9. First, engine placement was changed from the nose of the aircraft (called the Redan design) to the rear of the aircraft. This allowed more room in the forward fuselage, allowed placement of the wings further forward and put the exhaust of the jet engine at the complete rear of the aircraft, improving aerodynamics. Of equal importance was the creation of the swept wing. This wing design, now swept at an angle back from

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<sup>68</sup> Knez, [http://www.acig.org/artman/publish/article\\_315.shtml](http://www.acig.org/artman/publish/article_315.shtml)



the fuselage, allowed both a higher speed and better economy and stability.<sup>69</sup>

These two designs formed the basis of the MiG-15 (NATO codename FAGOT).

Airframe now ready, the Soviets still lacked a sufficient engine to propel the new fighter to speeds of which it was aerodynamically capable. This problem was overcome in a most unusual manner. In fall of 1946, Artyom Mikoyan and his deputy, Mikhail Gurevich, were invited by the British government to visit the Rolls-Royce jet engine plant as part of a trade agreement. This seemed too good to be true at the time; the British possessed the world's finest turbojet engines. During the visit, Mikoyan acquired twenty five complete Rolls-Royce Nene engines as well as rights to manufacture, over a game of snooker.<sup>70</sup> One of the greatest windfalls for Soviet aviation was won by pool hall skill. Additionally, during the visit one of the Soviet delegates wearing very soft soled boots, stamped around the milling machines that made the turbine blades and was able to secure small pieces to analyze in Moscow. This helped the Soviets overcome a major hurdle in jet engine production, mainly what materials would allow a turbine blade to be able to withstand the extreme pressures and force encountered within a turbine. Having discovered this composition, the Soviets manufactured the alloy prior to the arrival of the British engines at the Klimov design bureau. Coupled with its new airframe, the newly designated RD-45 engine allowed performance pleasantly beyond Stalin's expectations.

Flight testing of the I-310, (as the prototype MiG-15 was called) commenced at the end of December, 1947. This was quite a surprise to MiG

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<sup>69</sup> Gordon, Yefim, and Vladimir Rigmant. MiG-15: Design, Development, and Korean War Combat History. (Motorbooks International. Osceola, WI. 1993). pg 8

<sup>70</sup> Gordon pg 23

and the TsKB. Test pilot Yuganov was selected to carry out the first flight, to take place in early January of 1949. At the time, Soviet test pilots were given ten thousand rubles as a bonus for first flights. Being short on money, Yuganov decided the first flight must take place before the New Year. Though his requests were denied, Yuganov took off during a high speed taxi trial on December 30<sup>th</sup>, retracted the landing gear and flew two circles around the airfield. Thus the first flight of a MiG-15 was unauthorized.<sup>71</sup>

At the same time that the MiG-15 was being designed and tested a similar fighter, the La-15 was being tested by rival OKB, Lavockhin. Despite its acceptance into service for the VVS by Marshal Veshinin, the MiG-15 was ordered to fly against the La-15 in a series of tests to determine which design was superior. Pilots decided upon the MiG-15 for a number of reasons. It boasted ease of maintenance, simpler manufacture, superior handling and take-off behavior, better armament, greater range, superior rate of climb and last but not least, better reliability.<sup>72</sup> Despite these the La-15 possessed a higher top speed and more stability at the transonic speed envelope. No clear winner was decided and both designs were ordered into production.<sup>73</sup> Exactly one year after Yungaoov's first unauthorized flight, he flew the first production MiG-15.

As with any new aircraft, the MiG-15 was not without problems. Foremost it had an unsettling habit of becoming unrecoverable during a spin. This phenomenon was never rectified, instead pilots were instructed to avoid spins at

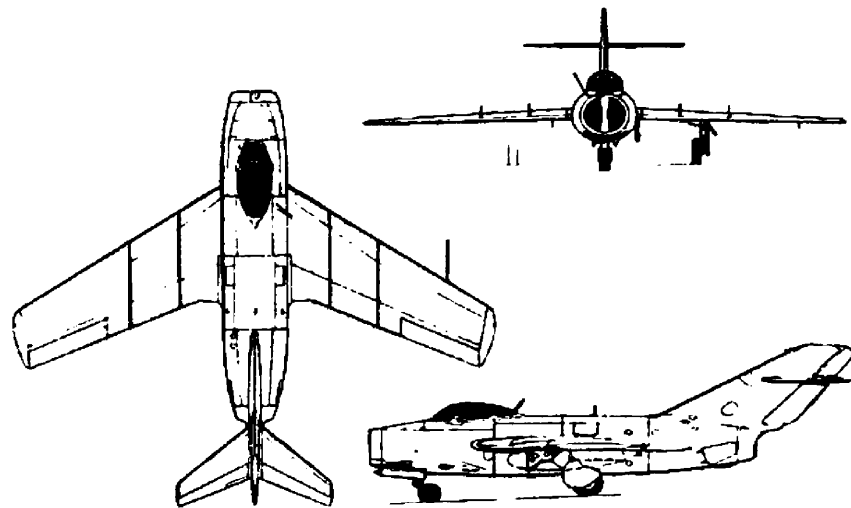
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<sup>71</sup> Gordon pg 17

<sup>72</sup> Butowski pg 62

<sup>73</sup> The La-15 was a failure within the VVS with only 500 being made. It was withdrawn from service in the early 1950's in favor of the MiG-15.

all costs and an automatic airbrake at Mach .88 was incorporated. A weakness in the materials used to make the tail was also discovered. During high speed dive recoveries and combat maneuvers a small percent would deform leading to occasional separation. better quality materials being retrofitted to all MiG-15's fixed this problem. Most importantly was the continuing redesign of the RD-45 powerplant.



Sketch of MiG-15<sup>74</sup>

The RD-45 did not live up to the expectations of the VVS, though based on a good design, the Rolls-Royce Nene. It gulped fuel at an excessive rate, had a poorer than expected thrust output and a higher than expected maintenance schedule. Klimov, the manufacturer of the RD-45, designed a new engine, the VK-1. This produced twenty percent more power, had significantly lower fuel consumption and required less time between engine overhauls. These improvements were incorporated into the MiG-15bis, an upgraded version of the

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<sup>74</sup> [http://www.fiddlersgreen.net/AC/aircraft/MIG-15/mig15\\_info/mig15\\_info.htm](http://www.fiddlersgreen.net/AC/aircraft/MIG-15/mig15_info/mig15_info.htm)

original. The MiG-15bis version would see the most use over the cold skies of the Korean peninsula.

### Duels at 1,000 MPH: The Jet Comes of Age

#### Korea

The air war in Korea began as the Second World War ended, with prop-driven surplus aircraft used by both sides. In three short years the conflict ushered in an era of aerial combat shaped aerial warfare for the next twenty years. The MiG-15 raised alarm bells inside Far Eastern Air Force (FEAF) command when it was reported. The aircraft was vastly superior to anything fielded by the UN forces in Korea at the time. More importantly the MiG-15 could disrupt with impunity, the B-29 Superfortress bomber streams attacking tactical and strategic targets within North Korea. The balance in the air began to swing towards the Communist side for the first time in the war.

When the first MiG-15's were sighted by American F-51 Mustang pilots in November 1950, there was no North Korean or Chinese air force to speak of. China had relied upon Soviet pilots and aircraft for air defense since the signing of the Sino-Soviet alliance treaty in February of 1950.<sup>75</sup> Soviet MiG-15 pilots claimed kills against Kuomintang aircraft in April of that year and may have been in Shanghai for quite some time previous.<sup>76</sup> The Soviet Unions involvement in the

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<sup>75</sup> Zhang, Xiamong. "China and the Air War in Korea, 1950-1953" The Journal of Military History Vol 62, No.2 (April, 1998) pg 344

<sup>76</sup> Knez, Saso and Joe Brenan. "Honchos" Air Combat Information Group Journal. October 2003 [http://www.acig.org/artman/publish/article\\_315.shtml](http://www.acig.org/artman/publish/article_315.shtml)

Korean War, though widely speculated during the war, has become public knowledge since the fall of the Soviet Communism and the opening of Soviet archives. It was Soviet pilots that gave the American and UN forces the greatest challenge earning them the respectful name “Honcho’s”, by allied pilots. This is not to say that North Korean and Chinese pilots were not skilled, but the vast majority were ill prepared for the high speed aerial fighting that occurred over the Yalu River. Yevgeni Pepelyeav, a former Soviet MiG-15 pilot is quoted, “If it was a hard fight for the us, then what about the Chinese? Our Chinese allies were inadequately trained for combat and suffered heavy losses. They were actually aerial targets for the Americans.”<sup>77</sup> The Chinese and North Korean pilots also suffered heavily due to the lack of an anti-g suit<sup>78</sup> coupled with a poor diet and health. Many simply passed out during high G maneuvers or avoided them all together. Indeed, it was the Soviet pilots who flew the MiG-15 to its greatest potential.

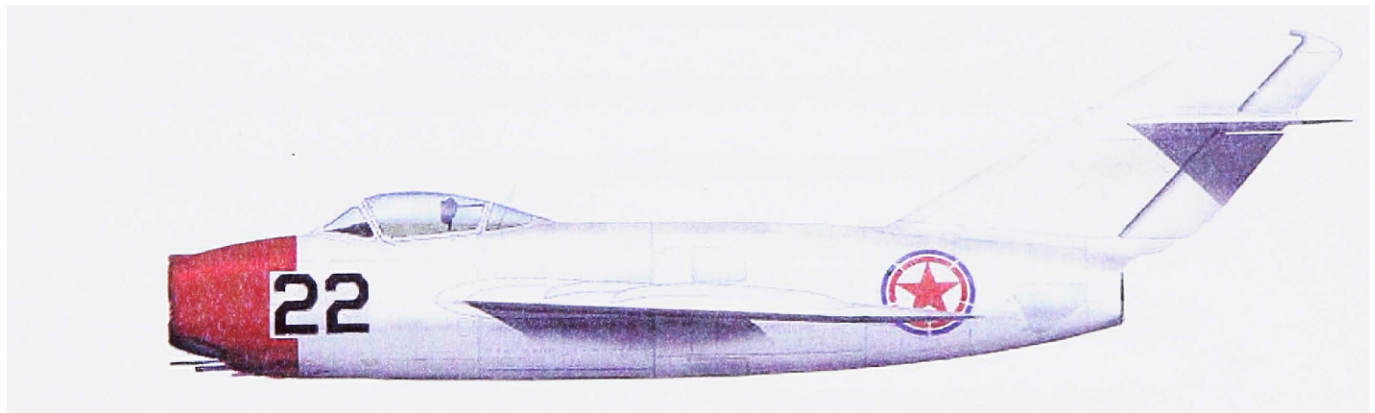
Although it was flying fighter aircraft in Korea, the Soviet Union was unwilling to publicly admit its involvement. Stalin was concerned that it could lead to a broadening of the war and could very quickly introduce nuclear weapons to the conflict. Due to Stalin’s reluctance to further Soviet involvement restrictions were imposed on Soviet pilots. All pilots were ostensibly volunteers, though in truth entire units were rotated through. Pilots wore Chinese uniforms and were instructed to only speak Chinese over the radio despite the fact they

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<sup>77</sup> Gordon pg 137

<sup>78</sup> An Anti-G suit is worn over the top of a pilots flight suit. Using a system of pressurized air, it inflates and deflates to keep blood from rushing to or from the brain and causing loss of consciousness.

knew were not fluent. Not surprisingly, Russian pilots speaking Chinese lasted only until first contact. Soviet pilots were tasked with the protection of the Yalu River Valley from bomber raids. Their primary mission was interception of B-29's, not tangling with American fighter aircraft. As the Americans were eager to get a hold of a MiG-15 to study, all MiG pilots were forbidden to fly over the sea for fear of being shot down and the aircraft recovered. Soviet pilots were restricted to flying over friendly territory. The capture of a Soviet pilot by the UN would have been a publicity coup. Thus, most operations were limited to the area known as MiG Alley, the target of most B-29 raids. Soviet pilots were not to engage in offensive operations in the theater, thus Soviet MiG-15's did not carry bombs, napalm or rockets with which to attack UN ground forces.<sup>79</sup> Stalin hoped that by keeping his posture defensive, a broader war could be avoided.



Early Soviet MiG-15 in Korea<sup>80</sup>

Responding to the threat posed by the MiG-15, the USAF introduced the F-86A Sabre to the Peninsula. On December 17<sup>th</sup>, 1950 the first patrol by Sabres

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<sup>79</sup> Gordon pg 139

<sup>80</sup> Artwork courtesy of Tom Cooper, editor of ACIG.org. Used with permission

was flown over MiG Alley. Soviet pilots (thought to be Chinese) intercepted the flight and in the ensuing battle Lt Col. Bruce Hinton became the first F-86 pilot to down a MiG.<sup>81</sup> The duels for the next three years that ensued between the Sabres and MiG's over the Yalu River would become legend, in part due to the similar design nature of the aircraft involved.

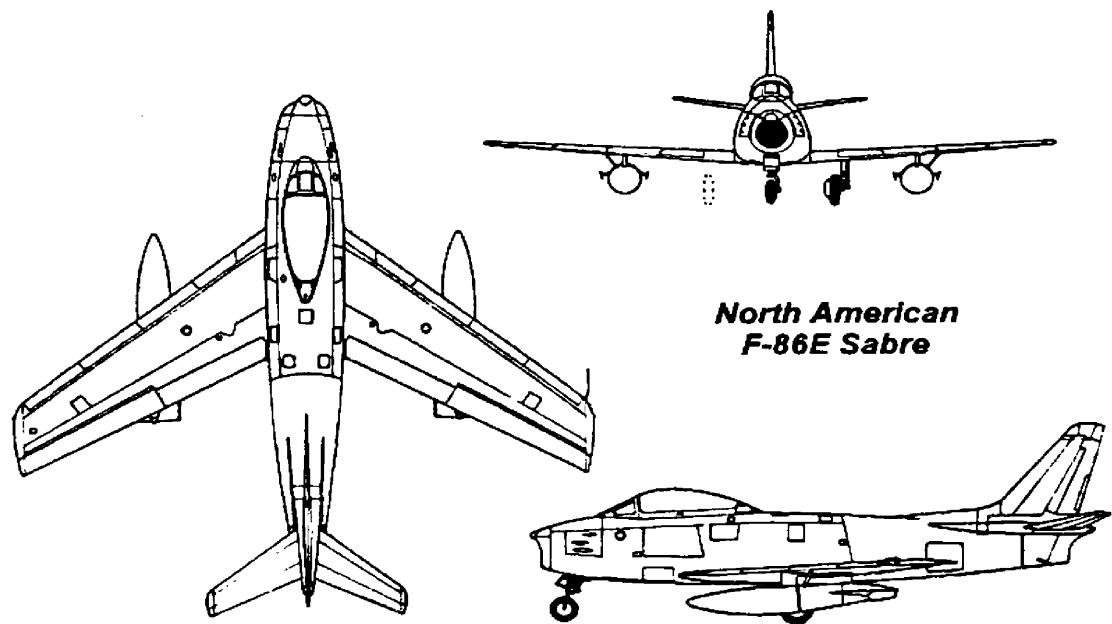
The F-86 was a very similar aircraft to the MiG-15; in fact both were based upon captured Luftwaffe research. The wing design on the F-86 had come directly from captured Me-262's. Both aircraft were similar sized and performed comparably, however there were design elements that affected the manner in which both types of aircraft were flown in combat.

The MiG-15, with the RD-45 engine, could operate at altitudes up to 50,000ft. This was nearly 10,000ft higher than the original F-86A. It also climbed much faster, had a better thrust to weight ratio and was more maneuverable at higher altitudes than the Sabre. The Sabre gained speed in a dive faster than the MiG-15 and was more maneuverable at lower both lower altitudes and higher speeds. Importantly the armament also differed. The MiG-15 featured two NR-23 23mm cannons and a single N-37 37mm cannon, while the F-86 had six rapidly firing .50 caliber machine guns. Both set of guns presented problems for the respective pilots. The MiG's cannons, designed to destroy bombers, were very lethal but fired slowly making deflection shooting difficult. The weight of the round also made long range shooting more of an art than a skill, as the drop incurred on these massive rounds was immense. Despite these problems, if a MiG-15 pilot scored hits on an F-86, the aircraft would most likely be destroyed.

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<sup>81</sup> Dorr pg 18

The six Browning .50 caliber machine guns fitted on the Sabre were accurate to a much greater range, but suffered because of their small size. During the first engagement of MiG's and Sabres, Lt Col Bruce Hinton fired more than 1802 rounds at the MiG before it was killed. As Evgeny Pepalyeav states, "The American .50cal guns acted like peas on our MiG-15's. Our aircraft would return to the airfields with 40 to 50 bullet holes. The Americans would claim them as killed, while pilots landed them safe and sound. The MiG-15 was more survivable than the Sabre; our pilot was protected from astern and the VK-1 and RD-45 engine itself was more survivable than the J47 found on the Sabre"<sup>82</sup> The F-86 also had a much better radar-ranging, lead-computing sight than the MiG-15, and according to MiG pilots, theirs was not even used in the computing mode.<sup>83</sup>



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Three Dimensional sketch of F-86E

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<sup>82</sup> Gordon pg 136

<sup>83</sup> Gordon pg 136

<sup>84</sup> <http://home.att.net/~Historyworld/F-86.html>



Later versions of the Sabre, the –E and –F models, had an improved engine that decreased the MiG advantage of ceiling and rate of climb, but the upgraded MiG-15bis suffered the same problems as the MiG-15 during dives and at lower altitudes. Later models of the Sabre had a different wing design and powered flight controls, both increasing maneuverability while decreasing pilot fatigue.<sup>85</sup> Interestingly, neither side addressed shortcomings dealing with armament during the war.

### Soviet Tactics, Successes and Problems

Tactics have traditionally evolved out of ones strength while exploiting the enemy's weaknesses. Soviet pilots in Korea displayed this and used the advantages of their MiG-15's to their greatest potential. The MiG-15, especially against the earlier F-86 Sabres, held a distinct advantage in both rate of climb and operational ceiling. The F-86 could dive faster and was more maneuverable than the MiG at lower altitudes. Thus, as Major General Sergey Kramarenko, commander of the 176<sup>th</sup> FAR, commented, "The F-86 and the MiG-15 rarely went into protracted fighting. The fight, as a rule, was decided in the first attack. It did not matter whether it was successful, after the first attack, MiG-15's reached for altitude, while Sabres raced for the ground. Each tried to get to the altitude where it held the distinct advantage and thus the air battle, scarcely having begun, faded

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<sup>85</sup> Fleck, Michael USAF Lt. Col. "Continuities in Four Disparate Air Battles" MA Thesis, Air University (Maxwell Air Force Base, AL. June 2003) pg 54

at once.”<sup>86</sup> The battle often turned into a game of baiting, each side trying to lure the other to the altitude that offered the greatest chance of downing the enemy.

Soviet tactics reflected this doctrine. MiG’s usually operated in a six aircraft flight, loitering near the target they were to protect. There were usually three flights of six aircraft called, respectively, “attack, cover and reserve”.<sup>87</sup> The attack flight’s main goal was disrupting of the bombers or fighter bombers from hitting the target; they left the escorting fighter aircraft to be dealt with by the cover flight.<sup>88</sup> The reserve flight was to assist either flight if the need arose and was not to engage unless needed.

During the entire course of a sortie, MiG’s were controlled by GCI (Ground Control Intercept) officers who manned radar stations inside of China. MiG’s usually remained on the ground until GCI stations detected an incoming threat; they then scrambled the MiG’s into the air and vectored them into the target area. The system varied little from the proven system developed by the Soviets during the Great Patriotic War.

After being vectored into position by the GCI, Soviet pilots would initiate a head-on approach to the target, usually as high above the target as possible. When the MiG flight was in proper range, they would divide up into three pairs and dive on the target. The first pair would attempt to break up and scatter the bombers, while the subsequent two pair would attack the most vulnerable targets after they fled. As soon they finished attacking a target, the MiG’s would use their

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<sup>86</sup> Gordon pg 127

<sup>87</sup> Gordon pg 115

<sup>88</sup> In this sense, the cover flight acted much as the American CAP (Combat Air Patrol) continues today, protecting a flight of fighter-bombers or interception aircraft.

superior climb rate to zoom back to a perch greater than the escorting fighter could reach. Then the original tactic was repeated. This tactic made it very hard for the escorting Sabres to engage the MiG's. They did not possess the thrust to reach the altitudes from which the MiG's began and by the time the MiG's came screaming toward the bombers, they were going much faster than the Sabres.

Another variation of this tactic was called "hump the sun". In this variation, MiG pilots would dive out of the sun towards a target, perform a half roll whilst attacking and egress back upwards towards the sun. This tactic allowed the MiG not only to escape to a higher altitude but also to escape visual detection at the beginning and end of its dive.

Using these tactics, Soviet pilots fought very well against their UN counterparts. They scored a claimed 1,300 aircraft downed while losing 345 MiG-15's.<sup>89</sup> Though these numbers do not match claims made by the Americans, they nonetheless show that Soviet pilots were skilled. Nevertheless, Soviet pilots had their fair share of problems.

Soviet squadrons were rotated through Korea as a whole unit. In contrast, the Americans rotated pilots through individually. This enabled new American pilots to learn about combat firsthand from pilots who had been in-country for some time. This resulted in a lower loss rate for new American pilots. Incoming Soviet pilots, on the other hand, could learn only by word-of-mouth from experienced pilots. Even this was difficult, as the Soviet leadership was unwilling to admit even to members of its own military, that Soviet pilots were flying in

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<sup>89</sup> As mentioned previously, claims made by either side, both likely inflated, are not the focus of this work, but do show the skill of both sides.

Korea. Consequently, Soviet pilots “stepped on the same rake” as their predecessors, making the learning curve very steep. After each rotation American pilots were facing rookie Soviets. This disservice done by Soviet high command to its pilots is best illustrated with the example of the 97<sup>th</sup> IAD, who rotated into Antung in early 1952. Within four months of their arrival in Korea, the squadron was nearly decimated. This prompted calls from Soviet field commanders for better training or a pilot-based rotation. Nothing was ever done. It was far easier for a huge military like the Soviet Union to rotate whole units rather than single pilots.<sup>90</sup> Lt General Lobov, head of the 64<sup>th</sup> IAK (Fighter Air Corp) in Korea expressed his dismay.

People were replaced in the 64<sup>th</sup> IAK by relieving an entire division at a time. Arriving replacements had only a vague idea of combat tactics. This caused newly arrived units to lose many rookie pilots. Besides, participation by the VVS in the war was secret and was concealed from our own citizens. Experience gained at the expense of our pilots lives was studied by the VVS and PVO officers, but was kept strictly confidential

In addition, in many air units, flight safety, rather than combat training, enjoyed high priority. Air commanders of all ranks were forced to simplify training. For example, training flights were made in close combat formations, and, as a rule, with external tanks that limited maneuverability. Mock air battles during training were waged against targets that were not maneuvering or mounting any opposition. We addressed higher authorities’ criticizing this faulty system of training and replacing pilots. But all remained as it was. It was simpler to move entire divisions with a stroke of a pen, rather than to train every regiment, every pilot, for coming battles.<sup>91</sup>

Despite the highly centralized Soviet military model, the Soviet Union declined to coordinate with either the Chinese or the North Koreans air forces, regardless of the fact the two former countries maintained a joint air command

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<sup>90</sup> Zhang, Xiamong *Red Wings Over the Yalu: China, the Soviet Union, and the Air War in Korea.* (Texas A&M Press, College Station, TX, 2002) pg 140

<sup>91</sup> Gordon pg 120-121

infrastructure. For political cooperation never materialized reasons, though pushed for by Soviet field commanders. Stalin believed this would expose the Soviet Union's participation in the conflict.<sup>92</sup> This lack of cooperation created problems on a number of occasions, such as Chinese or North Korean anti-aircraft artillery firing on Soviet MiG's or Soviet MiG's firing upon Chinese or North Korean aircraft. Many Soviet leaders believe this lack of cooperation, coupled with Stalin's reluctance to participate in offensive air operations, the reason for the dismal performance by their Communist allies.

Soviet pilots operated from Chinese bases just across the Yalu River from North Korea, this in part to keep them safe from American bombers who were not to cross the river. American accounts say this gave the Soviets an advantage in combat. Communist pilots, they claim, could climb to high altitude within China and make diving firing passes on American aircraft across the border, and then execute a climb to the north back to their sanctuary. Conversely, Soviet pilots believed American pilots to hold the advantage. "When they [Americans] found themselves at a disadvantage, they quickly went toward the sea and from there, after choosing a convenient moment and taking advantageous position they could engage without hindrance. Our adversary was restricted by the Chinese border. In spite of this, our pilots went deep into the south, and the Americans crossed the Yalu, attacking our aircraft during takeoff and landings."<sup>93</sup> Some historians have

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<sup>92</sup> Zhang 141

<sup>93</sup> Gordon pg 120

claimed that this attacking of Soviet MiG's on take off and landings "puts the Soviet-American kill ratio in air to air combat in a somewhat different light"<sup>94</sup>

The MiG-15 was by most reports, roughly the equal of the F-86. It was clearly superior to aircraft such as the Australian Meteor or the straight winged F-80's of the USAF. Designed along the same lines, it was usually the better pilot who prevailed in combat between the MiG-15 and the F-86. Each had distinct advantages that their respective pilots attempted to exploit, while the other attempted to take advantage of their foes weakness. Korea was perhaps the last true traditional dog fighting war.

Soviet participation in the Korean War, exclusively flying the MiG-15, was impressive. Though kill claims are highly disputed, the Soviets do admit losing 345 MiG's to all causes, while USAF records show 971 total aircraft lost, with 103 F-86's being lost in aerial combat.<sup>95</sup> Taking into account the inflation of kills and reduction of aerial losses, Soviet and American pilots were well matched in both skill and technology. Most pilots on both sides were veterans of the Second World War, some Soviet pilots scoring over 60 kills against the Germans. Clearly skill, not technology was the deciding factor in these first aerial battles of the jet age. This was also perhaps the last war in which jet propelled aircraft would duel with guns against each other in a traditional sense. After Korea, development of air-to-air missiles would forever change the nature of aerial warfare.

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<sup>94</sup> Zhang pg 141

<sup>95</sup> Dorr pg 82

## Chapter VI

### The MiG-21 and the Air War in Southeast Asia

When, in retaliation for the Gulf of Tonkin incident, American Navy and Air Force aircraft began flying strikes against North Vietnam, it was noted that up to thirty Chinese supplied MiG-17's<sup>96</sup> (NATO codename Fresco) were parked at airfields throughout North Vietnam. American pilots were warned to be on the look out for the small MiG's. On April 4<sup>th</sup>, 1965, US pilots were attacked for the first time by North Vietnamese MiG-17's with inconclusive results. Each side claims to have shot the other down, but American pilots are credited with three kills that day.<sup>97</sup> The first undisputed kill of the conflict came nearly two months later when USN F-4B Phantom from VF-21 destroyed a MiG-17 with an AIM-7.

North Vietnamese MiG pilots became increasingly aggressive during the ensuing months. Using their small nimble MiG-17's the North Vietnamese pilots turned inside of the larger American aircraft and then attacked them with cannon fire. During the summer of 1965 no less than five North Vietnamese MiG's were downed by American fighters. However, the Vietnamese also succeeded in shooting down at least one American fighter during the summer of 1965 and another in November of the same year. These losses were too high for the North

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<sup>96</sup> The MiG-17 is a small aircraft resembling the MiG-15, of which it was a further refinement. It has a more powerful engine, a larger, more swept tail and larger more swept wings. It was not capable of supersonic flight, nor did it carry air-to-air missiles.

<sup>97</sup> ACIG.org Korean war database

Vietnamese Air Force (NVAF); and the MiG pilots entered a training period, making mock attacks on strike packages before escaping into sanctuary zones. It was not until the spring of 1966 that the VNAF began to aggressively target American aircraft again. Also in the spring of 1966, the VNAF received their first MiG-21 (NATO codename FISHBED) interceptors from China and the Soviet Union. Though initially they experienced high losses, the MiG-21 would be the plane of choice for thirteen of the VNAF sixteen aces. One pilot, Nguyen Van Coc, would be credited with at least nine kills, perhaps more, until his death in 1972.<sup>98</sup> The MiG-21, in the hands of the few experienced Vietnamese pilots, was a formidable threat for American aircrews over North Vietnam.

The air war over North Vietnam provided both belligerents, American and Communist, a laboratory in which to test new weapons of the Cold War. It was the first time American pilots were threatened with surface to air missiles, missile equipped interceptors and a highly developed modern air defense network. It was the first use of US missile equipped fighters, B-52 Stratofortresses, precision guided weapons and high altitude reconnaissance aircraft. Each country used the on and off nature of the war over Vietnam to learn lessons, analyze them, and quickly devise a new tactic.

The Americans, in particular, struggled with the MiG threat. During the early years of the war the kill ratio was 2:1 in favor of the Americans, a long cry from the claimed 10:1 in Korea. By effectively using down time offered by the peace negotiations, the US Navy raised this ratio to 8:1 by 1972. This was in large

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<sup>98</sup> Peebles, Curtis. *Dark Eagles: A History of Top Secret US Aircraft Programs*. (Presidio. Novata, CA. 1995) pg 232



part due to its intense, hands-on study of the MiG's capability. In large part, the low kill rate was due to US air power tacticians miscalculating the evolving nature of aerial warfare. American pilots were no longer proficient in ACM (Air Combat Maneuvering) i.e. dogfighting. Instead they relied on weapons ill-suited to the conflict over North Vietnam. In contrast, the North Vietnamese had the appropriate weapons; they struggled with training and deploying effective pilots in a war zone. Both sides would struggle throughout the war to achieve victory in the air, and while the final outcome can be debated, both sides were valiant in attaining their goals.

Later to serve in air forces the world over the MiG-21, gained its initial combat experience over the jungles of North Vietnam. It performed admirably in the face of overwhelming American numerical and qualitative superiority. While suffering heavily under the guns of the Americans, MiG-21's are credited with a minimum of 45 kills.<sup>99</sup> The development and design of the MiG-21 is a key aspect in understanding the successes and drawbacks of the aircraft in the war over North Vietnam.

### MiG Enters Mach Two

Aviation grew in leaps and bounds in the twenty years preceding the late 1950's. Soviet military theorists as well as aircraft designers learned much about the correct implementation of airpower from the conflict in Korea. However, the

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<sup>99</sup> American and Vietnamese kill claims do not come close to matching and, as stated before, for the purpose of this work will only be used sparingly. If one is to believe Vietnamese claims, over 120 American aircraft were downed by MiG-21's. MiG-21 units pg 89-90

Soviet Union was not as technologically advanced as the West which was beginning to plan fighters and bombers beyond the capabilities of the Soviets. In particular, the American development and deployment of the B-47 Stratojet put fear into the Soviet military. The B-47, capable of flying around the world, could cruise at Mach 0.9 rendering the MiG-15, its close cousin the MiG-17 (NATO codename FRESCO), and the newly developed MiG-19 (NATO codename FARMER) all but obsolete.<sup>100</sup> Even more worrisome was the nearly complete B-52 Stratofortress. Its cruising altitude would preclude any defense the Soviets could mount. This, coupled with the growing nuclear tensions between the newly formed NATO and Warsaw Pact alliances, led the Soviet Air Force and the TsAGI (Central Air and Hydrodynamics Research Institute, assigned to work with MiG on the project) to scramble for a new fighter.

The MiG-15 proved to be a formidable opponent from experience from Korea, especially in the hands of an experienced pilot. It also proved that tactical air warfare could still be fought in a close-in battle of maneuver. Turning, acceleration, rate of climb and situational awareness were still assets to be valued. On top of this, the new threat from American intercontinental bombers had to be addressed. Therefore, in March of 1953, an order was put forth by the Ministry for Aircraft Production (MAP) for an aircraft capable of reaching speeds in excess of 2,000km/h and at altitudes of 20,000 meters while carrying range-only radar, air-to-air missiles and heavy cannons.<sup>101</sup> As if this was not difficult, the aircraft had to be small, lightweight, have conventional flying characteristics, be

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<sup>100</sup> Spick, Mike ed. The Great Book of Modern Warplanes. (Salamander. London. 2002) pg 450

<sup>101</sup> Butowski pg 81

maneuverable and operate from unprepared surfaces. This created a large problem for MiG and the TsAGI. Primarily, no engine yet existed in the Soviet Union that could propel an aircraft to such speeds. The small size of the aircraft was also a problem as it restricted both the size of engine and fuel capacity. MiG had just finished designing the MiG-19, an aircraft meant to intercept high flying bombers. However, at the conclusion of the design and acceptance by the VVS, the MiG-19 was deemed only a marginal success. It had become too heavy to fly fast and be an effective dogfighting platform.<sup>102</sup> It was also far too complex for the conscript mechanics to maintain.

Design of the airframe came first, after which an appropriate sized engine was to be developed. It was during the late 1950's that the TsAGI reached the height of its influence and, as a result, much of the research to design the airframe was done in conjunction with MiG and TsAGI. During high speed wind tunnel tests, the Institute had discovered two approaches to high speed wing platforms. First, the traditional MiG swept back wing, similar to the wings found on the MiG-15, -17, and -19. If swept to the appropriate angle, the wing would provide stability needed to operate in the subsonic, transonic and supersonic regions. The benefits of this design included ease of manufacture and decreased research effort. Another design explored by MiG and TsAGI was the delta wing.

Delta wing research within the Soviet Union was virtually nonexistent. During the late 1930's, some of research was conducted, but dealt with slow, prop-driven aircraft. Luftwaffe research documents captured at the end of the war had led the TsAGI to test the feasibility of the design. It was not known if the

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<sup>102</sup> Butowski pg 81

wing would offer enough stability at supersonic speeds yet offered little drag. The delta wing was shown to be much more agile than the swept wing. The TsAGI proved it to be stable in the trans- and -supersonic region, but it suffered from high landing and fast takeoff speed and bad stall characteristics. Research soon proved the addition of conventional horizontal tail surfaces remedied these problems without adverse effects.<sup>103</sup> While not a true delta wing design (it had conventional elevators), it offered the versatility needed by the VVS.

To test both designs in real world conditions, aircraft with both wing designs were built as flying testbeds. The swept wing Ye-2 rolled out of GAZ-155 in February 1955 for its first test flight and in late May, the delta wing Ye-4 flew for the first time.<sup>104</sup> Performance of the Ye-4 verified the conclusions drawn by both MiG and the TsAGI. The delta configuration was superior in all aspects, except for flat out speed. This was not deemed a huge obstacle. The engine that powered both prototypes, the VK-7, was highly underpowered. Coupled with the correct engine, MiG was convinced its design could exceed the 2,000km/h mark.

Engine design was assigned to the newly founded Tumansky Bureau. The bureau built on existing data from the defunct Mikulin bureau to create the RD-11, an engine that was exceptional for the time. The RD-11 created a thrust to weight ratio of nearly 6:1, an outstanding number for the day. It was a simple design, with only 3,500 parts and very importantly for MAP, was highly reliable.

Reliability and durability are two very different assets when dealing with jet engines. Reliability is what keeps the aircraft in the air and in combat.

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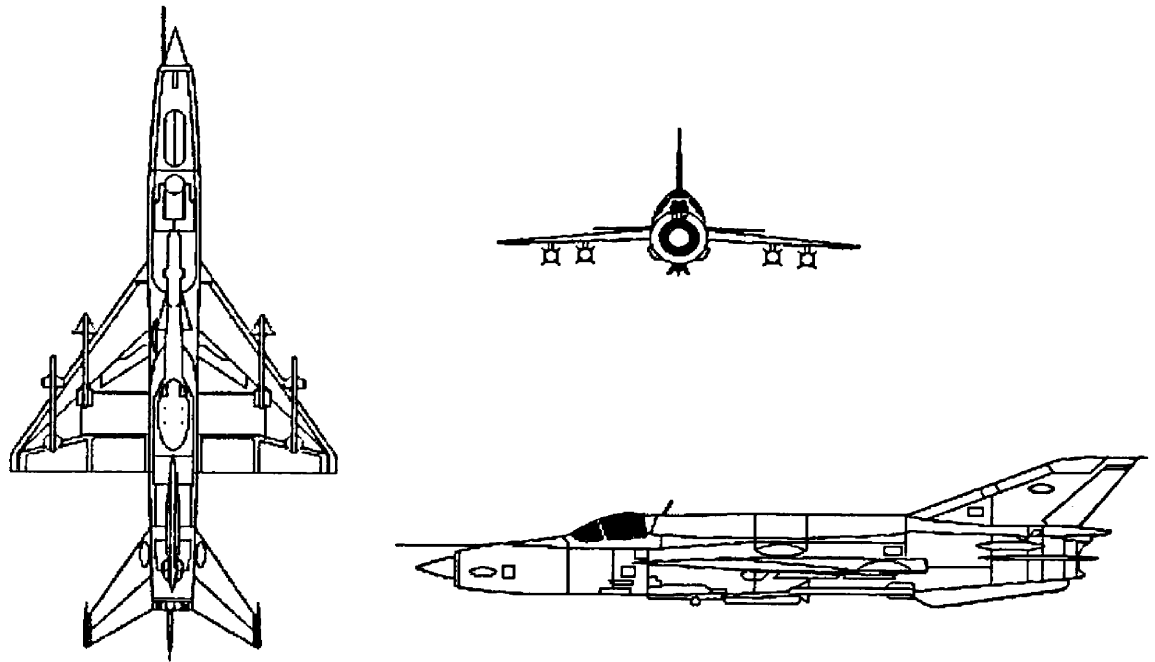
<sup>103</sup> Spick pg 454

<sup>104</sup> Spick pg 454

Durability determines how long a particular engine can operate. In the Soviet system, reliability was stressed above durability. An aircraft engine in the Soviet system had a very short time between overhauls, usually around 300 hours. In comparison, American aircraft engines required a complete overhaul after 1500 hours. This meant the engine was removed from the airframe for a thorough rebuild. However, the nature of the Soviet supply and maintenance system dictated a low turn overhaul time. Combat units were not afforded the level of maintenance support as their Western counterparts, in part due to the limited education of the average Soviet conscript. Instead of overhauling equipment such as engines within the unit, the Soviet system prescribed a unit to draw new equipment from storage depots. The Soviets expected that any offensive operations would require only half of the hours before a major overhaul. If replaced when nearing the half way mark, all engines would be fresh enough to complete the assigned objectives in case of war. Thus, a Soviet engine was rebuilt on a much higher level than at individual unit level. Consequently, the quality of rebuild is better, but more importantly, allows the engine to be worked much harder, though for a shorter time, than its Western counterpart. Thus, though the Soviet engines were less sophisticated, they performed roughly the same as Western powerplants.<sup>105</sup> The RD-11 fit the needs of the Soviet system perfectly. Though it needed a major overhaul quite often, it produced good thrust and good reliability.

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<sup>105</sup> Spick pg 455



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Sketch of the MiG-21

The West received its first look at the new MiG designs during the Tushino Airshow in May of 1956 when a Ye-2 and Ye-4 passed over the crowd. Interesting to note, the West believed the Ye-2, the swept wing version, to have already entered mass production over the delta winged Ye-4. In fact, NATO had a new codename for the Ye-2, Faceplate.<sup>107</sup>

Tests continued with small airframe and engine changes until the first true pre-production MiG-21, the Ye-6, took flight in May of 1958. It was powered by an improved version of the Tumansky engine, the R-11F300. Catastrophe struck on Ye-6's seventh test flight when, upon reaching 18,000 meters, the compressor blades within the engine exploded, destroying the aircraft's hydraulic systems on

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<sup>106</sup> [www.inetres.com/gp/military/ar/fb/Mig-21.html](http://www.inetres.com/gp/military/ar/fb/Mig-21.html)

<sup>107</sup> Spick pg 455

the aircraft. Test pilot Nefydov attempted a dead-stick landing but failed and died of his burns a short time later.<sup>108</sup>

Crash investigation attributed the cause of the accident to poor design in the nose cone/intake. When an aircraft flies at supersonic speeds shock waves are created by the air. The engine cannot use air moving at supersonic speed as the shock waves will tear the engine apart. Therefore, the air must be slowed to an appropriate speed and volume. As supersonic intake design was in its infancy in the Soviet Union, little was known about the cure to this problem. Eventually it was decided that the intake spike would be variable to adjust to the appropriate needs of the engine. After this issue was resolved the aircraft was ordered into production as the MiG-21F in December of 1958.

The MiG-21F was armed with two 30mm NR-30 cannons carrying 60 rounds apiece and was linked to a radar ranging sight. Interestingly, the MiG-21F could not fire guided air-to-air missiles, despite MAP's requirement to do so. It was rudimentary in both avionics and capability and unsurprisingly only 40 were produced. The next version, the MiG-21F-13 was the first truly successful MiG-21.<sup>109</sup>

Able to fire the new reverse-engineered AA-2 Atoll missiles, the MiG-21F-13 was the first MiG-21 to be exported outside of the Soviet Union. To reduce weight, one cannon was removed and magazine capacity was halved. It apparently handled well, and was benign in flight, though it was only capable of a 7g turn. The aircraft also featured an autopilot, threat warning receiver and a

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<sup>108</sup> Butowski pg 84

<sup>109</sup> Spick pg 458

seventeen percent increase in fuel capacity. It offered a highly reliable, simple Mach 2 capable, missile carrying fighter to foreign countries. The MiG-21F-13 was produced in large quantities and license produced in India, Czechoslovakia and reverse engineered in China.<sup>110</sup>

The next generation MiG-21, the -P, -PF and -PFM versions were the most successful. This was the generation most widely in service with the North Vietnamese Air Force. All of these versions did away with the cannon completely, much as the US had done with its F-4 Phantom II. A larger radar was installed in the cannons place<sup>111</sup>. Structural improvements allowed these MiG-21s to stress the airframe to 8.5g's. A more powerful version of the Tumansky RD-11 engine was also installed. Later, a two seat training variant, the MiG-21US, capable of firing AA-2 Atoll infra-red missiles was designed. It was assigned the NATO codename MONGOL. In the end, over 12,000 MiG-21's have been built, with construction continuing in China.

Further versions of MiG-21's were designed, but were too late to serve in Vietnam. However, the MiG-21 still flies with many countries. Some countries, such as Romania, have opted to discontinue flying their more expensive aircraft, such as the MiG-29 or -23, in favor of the cheaper, more easily maintained MiG-21. Companies such as Israeli Aircraft Industries upgrade MiG-21's with modern avionics and fire control systems at a fraction of the price of buying new aircraft. IAI coupled with Romania to produce the Lancer, the most advanced version of

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<sup>110</sup> Butowski pg 88

<sup>111</sup> The radar varied from version to version. For example the MiG-21PF had the Sapphire radar, while the while the -P had less capable TD-03T.



the MiG-21 to date.<sup>112</sup> MIG-MAPO (the company MiG is under presently) is offering an upgrade that it hopes can help pull MiG out of its current economic woes. These upgrades include new high power Doppler radar systems, glass cockpits and the ability to fire guided air-to ground munitions. The MIG-MAPO upgrade also includes the RD-33 engine, the same engine that powers the MiG-29. For both companies upgrades includes reinforcement of the airframe to withstand more flight hours. The interest in these upgrade options is, in part, due to the versatility and reliability of the original airframe, but is also because the MiG-21 is a forgiving and easy aircraft to fly. This is evidenced by the large number of MiG-21's flown by civilians in the US.

### The MiG-21 in Vietnam

Appearing to intercept a flight of F-4's in April, 1966, the MiG-21's changed the threat environment over North Vietnam. Since 1965 North Vietnamese pilots of the 921<sup>st</sup> Fighter Regiment had been training in the Soviet Union to fly the MiG-21. Initially the NVAF received the gun-less MiG-21F-13 from the Soviets; however they were augmented by cannon carrying MiG-21PF's, arriving in the spring of 1966. At first the NVAF command was reluctant to allow its new high speed interceptor to engage manned American aircraft. The MiG-21 pilots became acquainted with their new mounts by intercepting and destroying unmanned American Firebee reconnaissance drones. The first Firebee was

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<sup>112</sup> Vlad, Danut. "Whatever happened to...Romania's *Floggers*?" Air Forces Monthly. (June 2004. pg 80-86) pg 85

downed in March of 1966. The North Vietnamese used the experience to gain knowledge as to the use of their radar and missile systems. These skills would prove valuable when engaging manned aircraft. By April, the NVAF command structure felt confident enough to allow its pilots to attempt intercepts on American manned aircraft.

During April and May of that year, MiG-21s participated in numerous interceptions, firing over 14 Atoll missiles. However, they achieved no hits and suffered numerous losses due to enemy fire and fuel starvation.<sup>113</sup> It was proving difficult for the inexperienced NVAF pilots to manage the radar and fire control systems at the same time. The system in the MiG-21 required the MiG pilot to keep the target in his radar sights, while firing an Atoll, a skill that took much practice. MiG-21 pilots did not score their first kill until June, when they downed a solitary F-105D Thunderchief.

Soon new tactics were implemented. Having transitioned from the highly maneuverable but slower MiG-17, most NVAF MiG-21 pilots had failed to exploit their new aircrafts potential. They were also using tactics that had been developed for the MiG-17, tactics that did not work in the MiG-21. It was decided that the MiG-17's and -21's should operate in concert, exploiting each others strength. Therefore, the MiG-17's would patrol at low altitudes, under 1,500 meters, while the MiG-21's would patrol at higher altitudes, up to 3,000 meters. The MiG-17's would engage and disperse the American formations with cannon fire, while the high flying MiG-21 would dive from above and engage stragglers

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<sup>113</sup> Toperczer, Istvan. MiG-21 Units of the Vietnam War. Osprey Publishing. (Oxford Publishing, 2001) pg 8

that had broken away.<sup>114</sup> This tactic was very reminiscent of Soviet MiG-15 tactics during the Korean War.

MiG pilots over Vietnam enjoyed distinct advantages over their American rivals. They were intimately familiar with the country's terrain, particularly the mountain ranges, and exploited this at every advantage. They were also flying over their own air defense network and thus they could drag pursuing enemy aircraft over SAM and AAA sites. This tactic was not without peril for the MiG, as the NVAF pilot ran a risk of being shot down by the anti-aircraft installation himself. Of utmost importance was the vast network of radar and ground control sites throughout North Vietnam. These allowed the MiG pilot to receive up-to-date, comprehensive information, and allowed the GCI to vector the MiG into optimum firing position without the MiG pilots having to turn on his own radar. During Operation Rolling Thunder (1965 to 1968), as the air offensive over North Vietnam strikes against airfields were prohibited. There was also a 30 mile buffer zone between China and Vietnam in which US aircraft were not permitted to fly. NVAF MiG pilots took full advantage of these "safe zones" when planning and launching attacks.

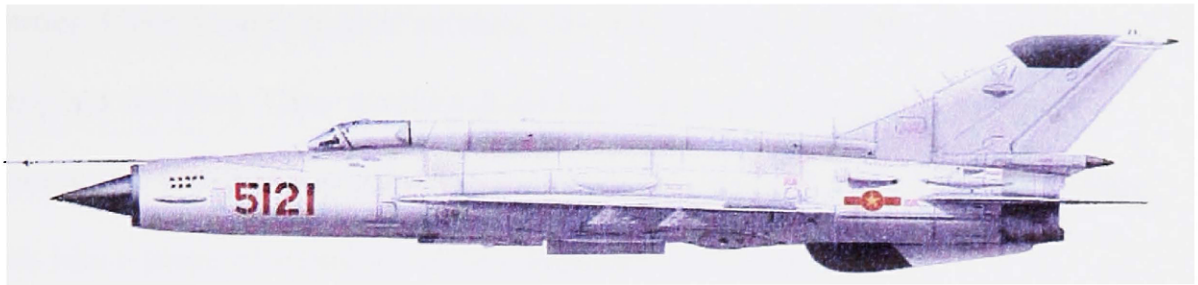
Though the MiG-21's succeeded in downing only 10 American aircraft in 1966, they intercepted 192 flights, causing 107 of them to jettison their bombs before reaching their target.<sup>115</sup> These numbers show that despite the Fishbeds poor performance in combat, it was causing disruption. Frustrated that the MiG's could

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<sup>114</sup> Toperczer pg

<sup>115</sup> Summers, Harry G. Historical Atlas of the Vietnam War. (Houghton Mifflin, Boston and New York. 1995) pg 114

not be attacked on the ground, the USAF developed a plan to ambush and destroy the MiG-21's in the air.



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### A North Vietnamese MiG-21

Operation Bolo was conceived by Col. Robin Old, commander of the 8<sup>th</sup> Tactical Fighter Wing in Udon, Thailand. His plan was to ambush NVAF MiG-21's by mimicking F-105 ingress routes, call signs and formations in F-4 Phantoms. When the MiG's intercepted what they believed were F-105 fighter-bombers, the F-4's would engage and destroy the MiG's. The plan required a large number of American fighters including 14 flights of F-4's, 6 flights of F-105D for SEAD (Suppression of Enemy Air Defenses), 4 flights of F-104 Starfighters and numerous flights of support tankers and AWACS.<sup>117</sup> The key to surprising the MiG's was twofold. First, the MiG's needed to be tricked into engaging the group. This was accomplished by imitating F-105 characteristics, such as speed, altitude and call signs. Once this was accomplished, the escape route back to their airfields and into the protected airspace near the Chinese

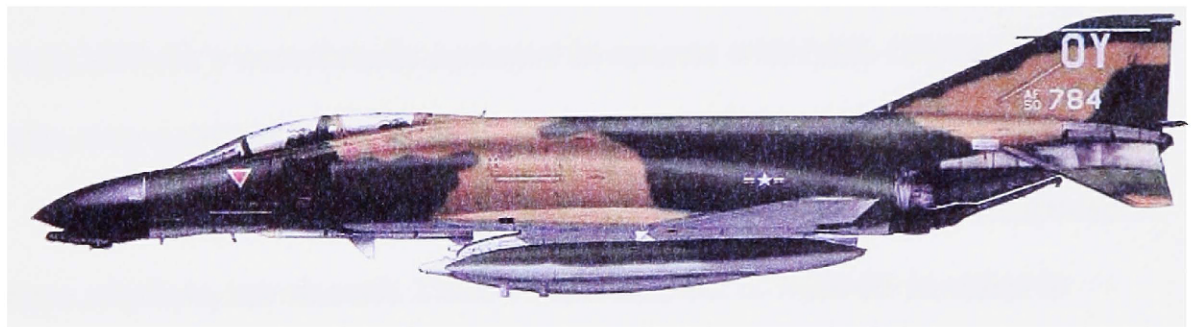
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<sup>116</sup> Artwork courtesy of Tom Cooper, editor of ACIG.org

<sup>117</sup> Aces and Aerial Victories: The United States Air Force in Southeast Asia, 1965-1973. (The Albert Simpson Historical Research Center Air University and Office of Air Force History. 1976.) Pg 35-37

border must be cut off by another flight of F-4's. This is a variation of the hammer and anvil infantry tactic. One group, mimicking the F-105 would be the hammer. Upon realizing their mistake, the MiG's would rapidly attempt to disengage and flee. They would run into the other group of F-4's, the anvil. Between these two groups, the MiG's would be under pressure from both sides, much like a piece of metal between a hammer and anvil.

Having learned the lessons of 1966, F-4 crews were briefed to not attempt to engage in turning dogfights with the MiG's but rather use their superior acceleration and radar to achieve a firing solution. This operation required a large degree of cooperation between the flights of fighters. The mission was set for January 2, 1967.



USAF F-4 Phantom II<sup>118</sup>

The weather on the 2 January proved less than favorable. Though a one hour delay was instituted, it was decided to go ahead with the mission. Col. Robin Olds led the first flight near Phuc Yen airfield, hoping to entice the MiG's into battle. However, the MiG's did not respond until the second flight of F-4's,

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<sup>118</sup> artwork courtesy of Tom Cooper, editor of ACIG.org

mimicking F-105's appeared. The weather was bad enough that part of the covering force could not cover their assigned sector and did not see any MiG's. Regardless, a large air battle developed with a fifteen mile radius of Phuc Yen airfield resulting in seven MiG-21's downed with no losses to the USAF F-4's. According to Col Olds, "We outflew, outshot and outfought them."<sup>119</sup> The loss was considerable for the VNAF, as they lost nearly half of their sixteen MiG-21's. For the next few days the USAF continued its deception operations and destroyed an additional two MiG-21's.

After a terrible mauling at the hands of the USAF, the 921<sup>st</sup> Fighter Regiment was given a reprieve by the NVAF high command. Operation of the MiG-21 virtually ceased. Attacks by its stable mate, the MiG-17, continued unabated despite suffering great losses; seven losses in one day on April 13, 1967. Though MiG-21's occasionally operated in concert with MiG-17's in the next few months, they were not as prominent as their brethren.

During Operation Bolo the losses suffered by the VNAF were expensive in terms of pilots, not aircraft. There were a number of MiG-21 in crates in Haiphong awaiting transport and assembly to replace aircraft losses. Both the Soviet Union and China continued to provide North Vietnam with a nearly endless supply of weapons, including MiG's. At times, the number of aircraft exceeded the number of pilots.<sup>120</sup> Pilots, however, took more time to replace and train. Though MiG-21's did not participate much in aerial combat in 1967 or

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<sup>119</sup> Aces and Aerial Victories Pg 41

<sup>120</sup> Topceczek pg 79 Sometimes though, they did not arrive as ordered. Soviet technicians, upon opening crates of Soviet sent MiG-21PF were shocked to discover that, as the MiG's passed through China by rail, their sophisticated radars were stripped and replaced by inferior Chinese copies.

1968, a number were shot down by US Navy picket ships as they attempted to either bomb or fly reconnaissance near the naval picket line. On November 1, 1968, President Johnson called a halt to the bombing of North Vietnam and thus ended the first chapter in aerial combat over Vietnam. Engagements between MiG's and US aircraft would not renew until May 8<sup>th</sup>, 1972, when President Nixon initiated Operation Linebacker I and II. During this four year lull in hostilities, both sides vigorously trained and prepared their forces.

The US was eager to reverse the dismal kill ratio it had experienced from 1966 to 1968. The key to reverse this trend was to learn was learning to fight the MiG-17 and -21 effectively with a fighter (F-4) and missiles (AIM-7 Sparrow) meant to destroy Soviet bombers. The Navy's Ault report was issued outlining steps needed to rectify this situation. Part of the Ault report called to re-introduce ACM (air combat maneuvering) to fleet pilots. Meanwhile, in 1967 the CIA obtained a singular MiG-21 from secret sources.

An initial comparison between the F-4 and the MiG-21 showed the two aircraft to have comparable turn rates at high speed. While at slower speed the MiG-21 was slightly superior. A joint team of Navy and Air Force pilots put the two aircraft through tests in ACM. The MiG-21 won some, while the F-4 won others. The test however, were far from inconclusive, they showed the deficiency was not in the aircraft but in the pilots. American pilots had lost the skill necessary to compete in ACM, relying too heavily on their long range missiles and radar systems.

After more comprehensive testing, the large delta wing of the MiG-21 was shown to bleed energy more quickly than the F-4. This, coupled with the fact that the turn radius of MiG-21 and F-4 was similar at high speed, led to a tactic to defeat the MiG-21. When closing with a MiG-21, an F-4 pilot would initiate a high g, high-speed turn which the MiG would try to follow and rapidly lose energy. At a certain point, the F-4 would climb vertically, which the MiG-21 lacked the energy to do, thus the F-4 could roll over and dive into a six o'clock position on the MiG.<sup>121</sup> Now that the joint team had discovered the weakness of the MiG-21, it set out to teach Navy pilots how to kill them.

During the initial testing of the MiG-21, the US had only one example and desperately needed more aircraft in order to train its pilots. During the Six Day War, Israel had acquired a number of MiG-21's and -17's through defections, deceit and capture. Eager to rebuild its air force after the war and unable to secure its traditional French examples due to sanctions, Israel approached the US with a deal. The Israelis wanted A-4 and F-4E fighters, as well as tanks and small arms. In turn, they offered the US not only an ally in the Middle East, but recently captured MiG's, SA-2 SAMs and Soviet tanks. Soon the US acquired a number of MiG's with which to train its pilots.<sup>122</sup>

The US Navy moved to establish "Top Gun", an advanced ACM school at NAS Miramar in California to train its pilots to fight the MiG's. The pilots were given the opportunity to fly against the MiG and many were allowed to fly the MiG's. Very quickly, Navy pilots obtained the level of proficiency to counter the

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<sup>121</sup> Peebles pg 220

<sup>122</sup> Peebles pg 223



NVAF threat. The Navy also improved teamwork between the pilot and his backseat RIO (radar intercept officer). By implementing these changes the Navy was able to reverse the dismal trend of its 1966-1968 kill ratio, ending the war with a respectable 8:1 ratio.

The Air Force did not institute a similar program until 1975 with its creation of Red Flag. The only major change the USAF instituted during the lull in fighting was the specialized training of the backseater in an F-4. Previously, the Air Force had simply put pilots in the back. This could cause communication problems between the pilot and the backseater tended to second guess the pilot. Soon the Air Force began training specialized WSO (Weapons System Officers, similar to Navy RIO's) to operate the radar and fire control systems. This did little to change the USAF's dismal record marginally improving to 2.83:1 by the wars end.<sup>123</sup>

The North Vietnamese also took advantage of the four year respite in fighting. They bolstered both their air defense structure and MiG force. By March of 1972, US reconnaissance showed that the NVAF had nearly 100 MiG-21's, that were now divided into two regiments, the 921<sup>st</sup> and 927<sup>th</sup>. Additionally the NVAF had 150 MiG-17 and -19's. By now North Vietnam, boasted the world's most sophisticated defense network in the world. Many more SA-2 SAM missile batteries were constructed since 1968. The NVAF had superb radar coverage throughout the whole country that in theory, allowed precise guiding of both MiG and SAMs. It also allowed the North Vietnamese to detect American aircraft long before they entered North Vietnamese airspace, thereby allowing MiG's to be

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<sup>123</sup> Peebles pg 231

positioned. Inherent in this system was the value of operating over friendly and familiar territory.

In 1972, despite the ban on bombing North Vietnam, interdiction missions were flown over Laos. Increasingly, MiG scrambled to thwart these missions, finally resulting in three MiG kills over Laos. During May of 1972, the North formally invaded the South and President Nixon authorized Operation Linebacker, an attempt to attack the supply centers of North Vietnam. This included for the first time, the mining of Haiphong harbor.

The resumption of hostilities brought about the fiercest air battles seen in the Vietnam War. During the month of May alone, US aircrews were credited with downing nearly thirty MiG's, including nine MiG-21's, while the NVAF shot down at least ten US aircraft.<sup>124</sup> Linebacker strikes also included raids against the MiG bases, that disrupted the organization of the NVAF greatly. Accordingly, the leadership in Hanoi called the NVAF leadership to formulate a plan.

The NVAF decided to adopt a Western style after-action report after each mission. Information would be shared between the two regiments, something that had not been done effectively. After each action, successful or not, the pilots would debrief and share lessons with each other in an organized format. Though this format is familiar within the US armed forces, it was new to the North Vietnamese. Cocky pilots were frowned upon, and in some cases removed, from flight status for lack of respect towards the enemy's fighting ability.<sup>125</sup>

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<sup>124</sup> acig.org database of kills

<sup>125</sup> Topceczer Pg 61

Aside from the inexperience of many of its young pilots, the NVAF suffered from a host of other problems. These included a poor command structure. Command decisions were often slow and ambiguous and the information that flowed to the commanders was often outdated, resulting in orders that made little sense. Additionally, though the radar net was extensive, it was not the latest equipment. Often operators could not understand the evolving situation and could not issue correct orders. In a system that frowns upon individual action, inaction by ground controllers led to the death of many pilots. All of these issues had to be overcome if the NVAF was to reverse the downward trend of 1972.

In late 1972, the NVAF became increasingly obsessed with shooting down the high flying B-52 Stratofortresses with a MiG-21. When Operation Linebacker II began in December of 1972, the NVAF believed itself prepared to down one of the bombers with their new MiG-21MF's. As B-52's flew at night and at high altitudes, a select cadre had to be trained for these highly dangerous night interceptions. Thirteen pilots were selected and trained to attempt to down a B-52.

The plan was riddled with problems; MiG bases were now under daily attack by American F-111's. Numerous times the MiG's scrambled numerous times to intercept the B-52's, though none were reported shot down.

Embarrassingly, one MiG-21 was shot down by the tail gunner of a B-52 on the 18 December and another on 24 December. Their tactics failing, the NVAF told their pilots to ram the B-52's.<sup>126</sup> Finally, on the 27 December a number of MiG-21's were scrambled to intercept an incoming B-52 flight. Pilot Pham Tuan describes the incident:

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<sup>126</sup> Topeczer pg 65

When I saw a yellow light in front of me, I increased my speed to 1200 km/h and climbed to 10,000 meters, where the B-52's were cruising. I radioed to the command, "I have the target in sight, request order for attack", the response came "You have permission to fire twice, then escape quickly".

"The Americans were holding formation, keeping separation of approximately two to three kilometers. I made last minute checks to my missiles, and when I reached the level of the third B-52, I pushed the fire button on the control stick, launching two heat seeking missiles from a distance of two kilometers. Huge flames were visible around the second B-52 as I broke sharply to the left and descended to 2000 meters before landing at Yen Bai. The attacked formation immediately dropped their loads and returned to base. The crew of the hit B-52 was killed<sup>127</sup>

This loss, however, was attributed by the USAF to a SAM, rather than a MiG-21.

As the year progressed, the NVAF began to stem its losses. But by the years end lost forty-three aircraft, including at least thirty-eight MiG-21's. The rapid expansion of the NVAF from the bombing halt of 1968 to Operation Linebacker brought a vast influx of new pilots. Led by a cadre of very experienced older pilots, these pilots did not fair well in combat, especially as many of the US aircrews had flown and gained experience during the strikes of 1966-1968. The last US aircraft lost to MiG's was recorded December 28, 1972, when a MiG-21 downed a US Navy RA-5C Vigilante.

The poor quality of the majority of the North Vietnamese pilots was obvious. They were unable to adapt to the changing tactics and aggressive nature of US aircrews during Operation Linebacker I and II. Records kept by the top Soviet advisor to the NVAF show that only half of the pilots had more than 450 hours logged. These records showed that the NVAF had been all but destroyed by

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<sup>127</sup> Topeczer pg 66

the air strikes, with only forty-seven of the remaining 187 aircraft operationally fit for combat.<sup>128</sup> This is only half the story.

North Vietnam produced thirteen aces during the war with top scoring Nguyen Van Coc scoring at least nine. They also proved that the MiG-21 was a formidable foe in combat with the right pilot in the cockpit. The US admitted to 43 losses to North Vietnamese MiG-21's, most from 1972 and later. The North Vietnamese claimed to have downed at least double that number with their MiG-21's. The conflict was bitter and not the one-sided ordeal the Bekka Valley would become ten years later. The air war over Vietnam was a hard fought battle by both sides and it was the superior pilot, not the aircraft, who won every engagement.

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<sup>128</sup> Topcezer pg 67

## Chapter VII

### The MiG-23 and the Air War over the Bekka Valley

Israeli Air Force (IAF) operations during the 1982 Operation Peace for Galilee against the Syrian Air Force (SyAF) are representative of third generation fighter aircraft and tactics.<sup>129</sup> The Israeli invasion of southern Lebanon was in response to increased activity by the Palestinian Liberation Organization (PLO). In May of 1982 an assassination attempt was carried out in London by elements of the PLO on the Israeli ambassador to the UK. In turn, Israel reacted with punitive strikes against PLO targets inside of Lebanon. At the time, the PLO was embroiled not only with a quasi-war against Israel, but involved in a civil war within Lebanon. The PLO was supported by Syria in the Lebanese Civil War against the Christian militias, who in turn were, supported by Israel.

After the assassination attempt by the PLO hostilities escalated. Punitive strikes into southern Lebanon prompted Syria to massively reinforce its SA-6 SAM batteries in Lebanon; eventually 19 such sites were established.<sup>130</sup> The gesture was not meant as an offensive threat by the Syrians, as they did not want direct action against the Israelis. Rather it was probably meant as a deterrent to

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<sup>129</sup> It should be noted that both the IAF and SyAF employed second generation aircraft such as the F-4 Phantom II by the Israelis and the MiG-21 Fishbed by the Syrians. However for the purpose of this work, effort will be made to concentrate upon combat with only third generation aircraft.

<sup>130</sup> Hurley, Matthew C1C USAFA, "The Bekka Valley Air Battle, June 1982: Lessons Mislearned?" (Aerospace Power Journal, Winter 1989) URL <<http://www.airpower.maxwell.af.mil/airchronicles/apj/apj89/hurley.html>>

further punitive strikes. Arab nations had learned well the lessons of a compressive and stout SAM<sup>131</sup> umbrella as a deterrent to IAF aircraft strikes.

During the “War of Attrition” (1967-1970) between Israel and the Arab nations, particularly Egypt the IAF, suffered heavily from SAM’s. Indeed according to notoriously conservative IAF records twenty-two Israeli aircraft were downed by SAMs. This was a great loss to the IAF, but the Yom Kippur War of 1973 would show the IAF the true potential of a well built missile umbrella; as forty IAF aircraft (or fourteen percent of the total IAF inventory) was lost to both AAA and SAMs within the first forty-eight hours of the conflict.<sup>132</sup> Thus, the build-up of Syrian SA-6 SAM sites in southern Lebanon was unacceptable to the IAF, regardless of Syrian intentions. This, coupled with increased cross border activity by the PLO, led to the June 6, 1982 invasion of Lebanon.

After the serious losses to enemy air defenses during the Yom Kippur War, the IAF took seriously the threat of Syrian SA-6’s. In preparation for the invasion Israel trained heavily against mock SAM sites it built in the Negev desert. Israel was determined not repeat the dismal performance of nine years earlier. On June 9 the IAF attacked the SAM sites located in the strategic Bekka Valley, destroying within ten minutes 17 of the 19 SA-6 sites and many more SA-3 and SA-2 sites, while suffering no losses. The remaining two SA-6 sites were destroyed in follow-up strikes the next morning. With the Israeli attack on Syrian SAM sites and their subsequent destruction, Syria had no choice but to engage the

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<sup>131</sup> SAM- Surface to Air missile

<sup>132</sup> Hurley

IAF in the air. Thus the stage was set for the largest air battles since the end of the Second World War. This battle was also to be the baptism of fire for both American and Soviet third generation aircraft, among them the Soviet MiG-23 (NATO codename FLOGGER).

### Baptism of Fire for the Flogger

Soviet aircraft designers during the late 1960's and early 1970's strove to achieve equilibrium with new American fighter aircraft such as the F-14 Tomcat, F-111 Aardvark (or as the Australians refer to it, "the Pig") and eventually the F-15 Eagle and F-16 Fighting Falcon. Though a successful design, the MiG-21 FISHBED would be outclassed by the newest generation of Western aircraft both in speed and weapons systems. To create an aircraft capable of engaging the newest generation of Western aircraft, Soviet Frontal Aviation, through the TsKB, issued an order for a new fighter in 1964.<sup>133</sup> The aircraft was to be faster than the Fishbed and able to carry a greater load. Additionally it would have a BVR (Beyond Visual Range) capability similar to the American F-4 Phantom. Within the established tradition of Frontal Aviation, it was also required to operate from improvised runways.

Two new technologies were explored to allow both high speed flight, and low takeoff and landing speeds needed to operate from improvised fields. The first technology was variable thrust engines capable of directing thrust downward

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<sup>133</sup> Spick pg 467



to help lift the aircraft.<sup>134</sup> The second was a variable geometry winged aircraft capable of “swinging” its wings as the aerodynamic situation demanded. These requirements led the MiG design team to create a fighter technically more advanced than anything the Soviet Union had fielded.

The Soviet Union had been aware of the developments made at the NASA/NACA research facilities in Langley, Virginia, through both secret and open sources, towards variable sweep winged aircraft. Variable angle wings allowed aircraft to “swing” their wings to the demands needed for both high lift situations, such as takeoff and also low drag situations, such as supersonic flight, within the same sortie. This was exactly what was needed for the new fighter aircraft. Concurrently, a project was underway to use variable thrust engines to meet the same demand. Both designs eventually resulted in prototype aircraft and, in much the same fashion used by Western designers, a competition was initiated. On July 9, 1967 both aircraft displayed their technology for the public at a military air show in Domodedovo. The variable geometry (vg) aircraft was designated Flogger by NATO while the variable thrust engine prototype was labeled Faithless.<sup>135</sup>

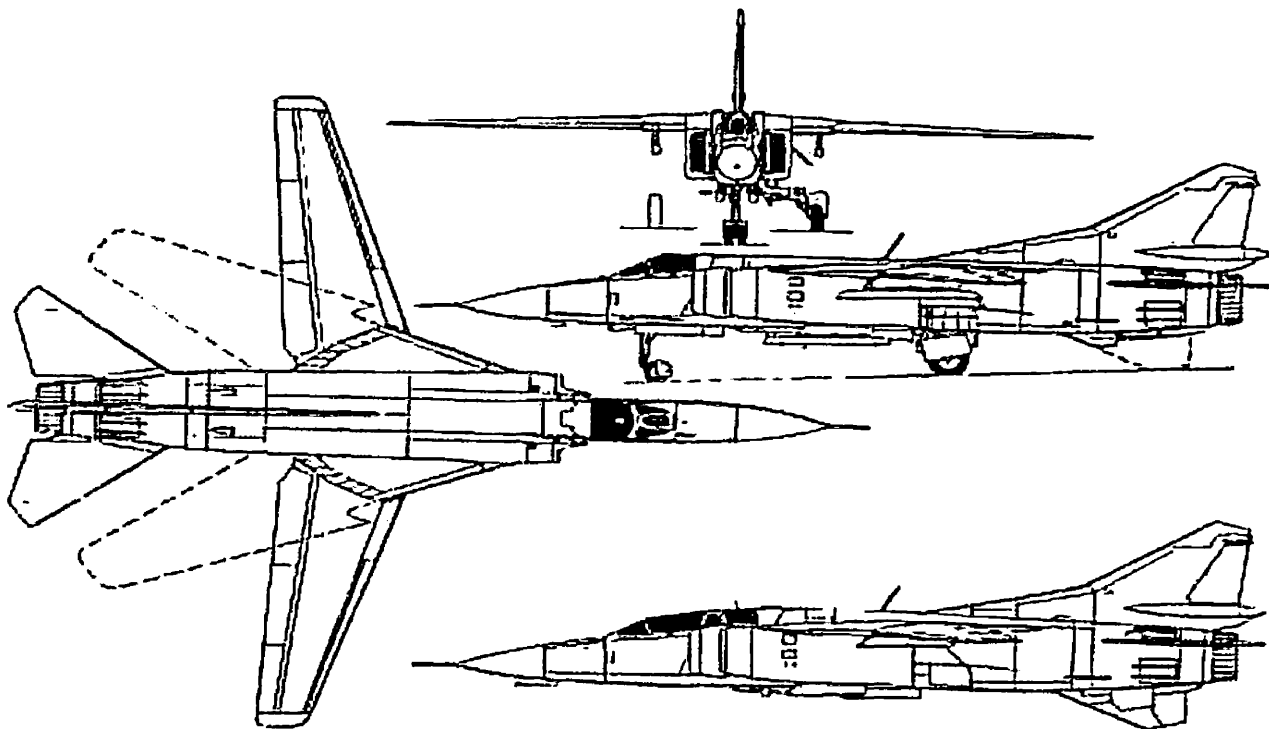
The VG aircraft demonstrated superiority over the variable thrust aircraft during the ensuing competition. Though meeting the requirements of the TsKB, the variable thrust aircraft fell short of the performance of the VG aircraft. It simply did not have the fuel efficiency, its engines took up too much room within the fuselage and the weight of the systems cut into payload capacity. The VG

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<sup>134</sup> This technology was later used in the Soviets answer to the British Harrier, the Yak-38 FORGER that was adopted by the Soviet Navy in the 1970's.

<sup>135</sup> Butowski pg 101

aircraft won the competition easily and its design was accepted by the TsKB as the MiG-23S.



Sketch of MiG-23 and two seat MiG-23UB<sup>136</sup>

First delivered to VVS units in 1972, the newly designated MiG-23S was issued in limited numbers. The final tally totaled around 100 aircraft.<sup>137</sup> Though the MiG-23 aerodynamically won the design competition, the radar and fire control systems that would allow the BVR capability dictated by the TsKB were not ready to be fielded. The radar unit, (NATO codename HIGHLARK), was designed with data and hardware acquired from the captured remains of the Westinghouse AN/AWG-10 in F-4 Phantoms shot down over Vietnam. The

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<sup>136</sup><http://www.todo-aviones.com.ar/rusos/mig23/mig-23-scheme.jpg>

<sup>137</sup> Butowski pg 101

HIGHLARK radar unit was quite an advance over the previous JAYBIRD radar found in later MiG-21's. The HIGHLARK's Doppler pulse system, operated in the J band, possessed a search range of 50 miles and a tracking range of 35 miles.<sup>138</sup> More importantly, the new radar unit allowed the devolvement of a completely new fire control system capable of firing the new R-23 (NATO Codename AA-7 APEX) BVR semi-active radar guided missile.<sup>139</sup>

VVS units complained the initial batch of MiG-23S's were underpowered and lacked the promised acceleration. Thus, when the new MiG-23M was introduced it was powered by the much more powerful Tumansky R-29-300 engine, making the MiG-23M the first Flogger that was truly defined by its fast acceleration and high speed. In addition the MiG-23M featured the incorporation of the HIGHLARK radar and fire control system, a step over the system found in the MiG-23S. Soviet airpower theorists learned much from the war in Vietnam, including the effectiveness of high speed slashing attacks by MiG-21's. They also learned the capability of the better equipped American F-4's to engage the nimble MiG-21, on their own terms by utilizing their higher speed and better radars. Thus the MiG-23 was a departure from the standard Soviet air superiority fighter. The MiG-21 was a highly maneuverable, low weight aircraft capable of turning inside of, and defeating, most Western fighter in a traditional dogfight. However, the tactics used by the Americans in Vietnam helped to negate this feature and the Vietnamese resorted to high speed, single pass slashing tactics. The MiG-23 was optimized for just this tactic.

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<sup>138</sup> Butowski pg 101

<sup>139</sup> Spick 474

Most Western aircraft that incorporate VG technology, the F-111 and the F-14 in particular, are highly maneuverable. This was not the case with the MiG-23. In fact its wings can only be swept to three preset positions-16deg, 45deg and 72deg- for takeoff/landing, cruise/maneuver and high speed respectively. Pilots who have flown in or against the Flogger describe it as performing much the same as the 1960's vintage American F-104 Starfighter. The Flogger is extremely fast while climbing and in straight line performance, but not very maneuverable in a dogfight.<sup>140</sup> One British Tornado pilot, escorting a MiG-23 to an airshow in the UK during the 1990's states, "The lack of visibility for the pilot of the Flogger was plainly obvious, as was its lack of maneuverability even in this undemanding environment- the wings were never swept throughout the flight and when it turned it did so with rigid, angular movements."<sup>141</sup>

This statement came from a Tornado pilot flying a highly maneuverable VG equipped aircraft and is especially telling. VG technology is incorporated in the MiG-23 to meet the requirements of a high speed aircraft capable of operating from short, improvised landing strips, not to increase its maneuverability. This is another case of the Soviet design bureau's difficulty overcoming the "requirement pull", a design implemented to satisfy a requirement, rather than the West's tradition of "technology push" whereby a new technology dictates requirements.

The MiG-23 was a substantial technological leap from the fairly simplistic MiG-21. The transition of pilots from one aircraft to the other was not as smooth as the VVS had hoped; in fact the Flogger's accidental loss rate was quite

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<sup>140</sup> Peebles pg 235

<sup>141</sup> Black, Ian. Tornado Pilot. (Osprey. London, 1994) pg 122

astounding.<sup>142</sup> Originally, there had been no plans for a two seat trainer version, but in 1973 TsKB and the VVS began conversion of a number of MiG-23M airframes to two-seat trainer MiG-23UM's, to help alleviate some of these problems. The aircraft was quite difficult to fly, even by American standards.

The US acquired a number of MiG's, including MiG-17's, -21's and 23's, through sources like Israel (who had received them from defectors) and Egypt (who in the early 1980's, began an era of military friendship with the US). The MiG's were put through their paces and treated much as any "black" project would at the secret airfield near Groom Lake, Nevada. However, the MiG-23 proved to be a difficult aircraft to master even for the experienced pilots of the USAF test squadron based at Groom Lake. On April 26, 1984, Lt General Robert Bond was killed flying a MiG-23, possibly in a mock interception against the then new, F-117A Stealth Fighter. According to Air Force reports, Bond was in a high-speed, high-altitude run when he attempted a high-G right turn. As recorded voice transcripts from the accident report demonstrated, Bond lost control of the aircraft in a spin he could not recover from. He was forced to eject, and was subsequently killed. Investigation of the accident revealed all systems on the aircraft were performing normally prior to the departure from controlled flight. The accident was ruled as pilot error. That Bond was a highly experienced test pilot supported what had been reported previously by defecting MiG-23 pilots the MiG-23 had a tendency to spin in high speed, high G situations.<sup>143</sup> It is also apparent that the

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<sup>142</sup> Butowski pg 102

<sup>143</sup> Peebles pg 238

Soviet lost many aircraft in similar situations. Also evident was a fault within the wing pivot mechanism that had a tendency to separate at inopportune times.

Though the MiG-23 was designed as an interceptor/fighter a fighter bomber version was also created. Though derived from the MiG-23 airframe, it was given the designation the MiG-27, though NATO did not assign it a new codename. The MiG-27 had a totally redesigned nose to increase over the nose visibility and to house new sensors. It also had a greater payload, albeit at a sacrifice to speed, and carried a new six barrel Gatling 30mm cannon for attacking armored targets. Importantly the MiG-27 lacked air-to-air radar, though it retained the ability to fire infra-red guided Atoll missiles.<sup>144</sup>

The MiG-23/27 saw heavy service with the VVS in Afghanistan in the ground support role. On some occasions the aircraft were engaged by Pakistani Air Force F-16's after crossing the Pakistani frontier, with negative results during all engagements. Iraq heavily deployed the MiG-23 in its war against Iran in the 1980's, though information about its success is limited at best. The only true air battle fought by the MiG-23 was in the Bekka Valley during the 1982 Israeli invasion of Lebanon.<sup>145</sup> Due to high maintenance and high accident rates coupled with low success rates in combat, the MiG-23 was withdrawn from Russian service in 1997. Perhaps one of the largest disappointments for MiG OKB, the Flogger became fodder for the Israeli Air Force in the skies over Lebanon.

### The Air War over the Bekka Valley

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<sup>144</sup> Spick 478

<sup>145</sup> On January 4<sup>th</sup>, 1989 two Libyan MiG-23's were intercepted by F-14 Tomcats from the carrier Nimitz in the Gulf of Sidra. The resulting engagement ended with both Floggers being downed in quick succession by the USN aviators. Taped recording of that engagement can be found at <http://www.flight-level.com/dogfight/>

Aerial combat over the skies of the Bekka Valley in June of 1982 was decidedly one-sided. Israel claimed a 100:1 kill ratio over the Syrian Air Force, greater than kill ratios in 1967 (30:1) or 1973 (50:1).<sup>146</sup> Though the purpose of this study is not to investigate kill ratios, one must take both Syrian and Israeli claims with a grain of salt.<sup>147</sup> Both countries have a propensity to exaggerate their victories, in fact, most historians and military officials back the claim that Israel did lose a small number of aircraft (1-3) to air-to-air combat with the Syrians in the Bekka Valley.<sup>148</sup> Any observer to that battle could plainly see that the Syrian were outfought, however the purpose of this work is to examine the MiG-23's role in combat, along with the reasons for the dismal performance by the Syrian Air Force.

When Israel began strikes against SA-6 batteries within the Bekka Valley, the Syrian Air Force was obligated to meet the threat posed by the IDF to both Syria proper and her forces within Lebanon. Syrian pilots in both elderly MiG-21's and cutting edge MiG-23M's met similar fates at the hand of Israeli pilots, more often than not they were destroyed before even detecting the IAF Fighters. However, the majority of these losses were not the fault of the aircraft, but rather

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<sup>146</sup> Van Creveld, Martin. *The Sword and the Olive. A Critical History of the Israeli Defense Force.*(Public Affairs, 1998.) pg 295

<sup>147</sup> A RAND corporation report to the USAF claims "Indeed, we cannot rule out the possibility that much of the press comment that has appeared on the Bekka Valley operation has been the product of Israeli disinformation." Lambeth, Benjamin. Moscow's Lessons from the 1982 Lebanon Air War. (RAND, Project Air Force Report. Santa Monica, CA 1984) Pg 4

<sup>148</sup> Niccolle, David and Tom Cooper. Arab MiG-19 and MiG-21 Units in Combat. (Osprey Publishing. Oxford. 2004 ) pg 77 At least two MiG-21's scored kills against an already damaged F-4 Phantom and a A-4 Skyhawk.

the fault of either the pilots, ground commanders or the Syrian military as a whole.

Riad Ashkar, an authority on the IDF, in an interview in *The Journal of Palestinian Affairs* during the summer of 1978, was asked how the MiG-23 compared to new, Western supplied aircraft of Israel. He stated that “The MiG-23 is in some ways superior to the F-4; it is to some extent comparable with the latest American fighters”<sup>149</sup> These fighter include the F-15 and F-16, both employed by the Israelis in the Bekka Valley. An anonymous IAF officer took it further saying “The problem was that [Syrian] pilots didn’t do things at the right time or in the right place...the pilots behaved as if they knew they were going to be shot down and waited to see to when it was going to happen and not how to prevent it or attempt to shoot us down... They could have been flying the best fighter in the world, but if they flew it the way they were flying we would have shot them down in exactly the same way. It wasn’t the fault of the equipment, but rather their tactics.”<sup>150</sup> When asked what the IAF learned about Syrian MiG-25 Foxbat operations IAF commander, General Eitan stated “Answering that question is difficult, because the Syrians did not know how to fly or operate the MiG-25. If we had been flying the MiG-25 nobody would have touched us.”<sup>151</sup> Even the Soviets, notorious for institutionalized military thinking, seem to have learned a lesson from the Bekka Valley campaign. In a TASS release after the war a Soviet general is quoted as saying “to fully use these capabilities (i.e. the MiG-23), those

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<sup>149</sup> Ashkar, Riad and Kassim Jaafar. “Military Options in the Middle East” *The Journal of Palestine.* Vol 7, No.4 (Summer, 1978) pg 105

<sup>150</sup> Lambeth pg 9

<sup>151</sup> Lambeth pg 31



who exploit and maintain this equipment must possess comprehensive and deep knowledge.”<sup>152</sup> The entire performance of the Syrian Air Force is best described by Ezer Weizman, former IAF commander: “The human factor will decide the fate of war, of all wars. Not the Mirage (a type of French supplied IAF fighter), nor any other plane, and not the screwdriver, or the wrench or radar or missiles or all the newest technology and electrical innovations. Men-, and not just men of action, but men of thought. Men for whom the expression ‘by ruses shall ye make war’ is a philosophy of life, not just the object of lip service”<sup>153</sup> If it was not the fault of the MiG’s in which the Syrian were flying, why were the losses by the SyAF so high?.

Israel dominated the airspace over the Bekka Valley in every possible aspect, this made offensive and even defensive operations by Syria nearly impossible. Israel had excellent intelligence about Syrian MiG operations. Lebanon was the first war to make heavy use of RPV (remote piloted vehicle) technology. Israel had long been developing its own indigenous design. By 1982 Israel had deployed its RPV called, quite fittingly, the Scout. Using its long range cameras, the Scout was able to relay a real-time picture of Syrian MiG’s taking off from airbases within Syria. This information was relayed to an orbiting E-2C Hawkeye AWACS (Airborne Warning and Control System) aircraft. The Hawkeye was equipped with an APS-125 radar mounted above the fuselage, able

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<sup>152</sup> Lambeth pg 16 The Soviet military seems to have been quite dismayed by the performance of their equipment in Syrian hands. Jokes circulated through the Soviet officer staff that during the war Syria had maintained a departure control for its fighters, but no approach control. This follows what seems to be a long tradition of joking about the performance of its Arab client states. During the 1973 war it was joked that new Egyptian tanks were to have back up lights and that the defense minister, after studying the Soviet success in World War II was still waiting for the long Russian winter to set in over the Suez.

<sup>153</sup> Lambeth pg 35

to scan 3 million cubic miles of airspace, monitor over 200 aircraft simultaneously and control over 150 engagements at ranges of over 250 miles.<sup>154</sup> A controller sitting within the Hawkeye would relay the information to IAF pilots who would either engage or egress the area, depending on the situation. Thus, every move the Syrians made was monitored from takeoff to eventual shoot down by the IAF.

Syrian pilots however, were trained in the Soviet fashion of GCI (Ground Control Intercept) engagements. GCI interceptions were dictated to a pilot by a controller inside a ground radar station. Little room was left for proactive flying. Additionally, Syrian GCI control also because the radar range was somewhat limited by the mountainous terrain of southern Lebanon. Syrian pilots found this all to be a moot point though, as Israel effectively jammed data and voice link communication between both GCI and pilot with state of the art ECM (Electronic Counter Measures) gear, thus negating any control. Trained in the strict Soviet system, Syrian pilots found themselves without guidance and flew blindly, not knowing what to do next. As one Western observer noted “I watched a group of Syrian fighter planes fly figure-eights. They just flew around and around and obviously had no idea what to do next”<sup>155</sup> Meanwhile Israel utilized effectively employed counter-jamming technology and was able to respond quickly to any attempt by Syria to jam its communication lines. Israel dominated all aspects necessary for warfare on a modern battlefield, command, control and communication (C<sup>3</sup>).

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<sup>154</sup> Hurley

<sup>155</sup> Lambeth pg 9



Though MiG's themselves may not have been to blame for the horrific losses suffered by Syria, certainly the armament they carried was inferior to missiles carried by IAF fighters. Syrian fighters were armed with AA-2 ATOLL infra-red heat seeking missiles. These missiles were rear aspect only; they could only be fired from behind a target. They were comparable to early Vietnam era American AIM-9 Sidewinder missiles and had similar PK (probability of kill) of ratios of about 19 percent. On the other hand, the Israelis employed the latest generation of AIM-9 Sidewinders missiles, the AIM-9L. Earlier that year during the Falklands, British Harriers scored 25 hits for 27 launches against faster, more maneuverable aircraft in poor weather to achieve a pk of 93 percent. Similar pk

<sup>156</sup> <http://www.libanmall.com/main/map.htm>

ratios were achieved by the Israelis.<sup>157</sup> The missile also gave the IAF another great advantage. The L model Sidewinder was an all-aspect heat seeking missile. It could acquire, lock on and be fired against a target at any angle, including head on. Achieving the traditional “6 o’clock” position behind a target in a dogfight was no longer needed. The IAF achieved the majority of its kills as MiG’s closed with IAF fighters, never giving Syrians pilots an opportunity to maneuver. Hence most kills achieved by the IAF occurred without the Syrian pilots releasing any weapons.

Regardless of these reasons, the Syrian Air Force was defeated. The SyAF lacked effective training of both pilots and ground crew. Syrian pilots were trained in the rigid standard of the 1970’s Soviet doctrine, one that eschewed the principle of domination of the air by sheer numbers. By constantly sending up available fighters to engage the IAF, Syria followed just that doctrine. It is important to note however that this tactic also requires a numerical superiority over the enemy, which the Warsaw Pact would have over NATO, but Syria did not possess over Israel.

Syrian pilots were trained to rely on GCI for their every movement. As a result, they failed to exploit any advantage that presented itself, such as the maneuverability of the MiG-21 or the blazing speed of the MiG-23. When GCI control ceased, Syrian pilots lacked the initiative to take the fight to the Israelis. Soviet doctrines might have worked very well in a war in Europe. The VVS would have held a huge numerical advantage and would be able to sustain great losses in a European conflict. They would not have had to shoot down every

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<sup>157</sup> Hurley

NATO fighter-bomber, only disrupt their missions so that Soviet ground forces could advance. The VVS would have been ready to accept massive losses to ensure that ground forces achieved their objectives. This was not the case in Syria. The Syrian Air Force could not sustain massive losses, thus the entire doctrine of domination through numbers was flawed.

Even when viewed by their Soviet counterparts, Syrian pilots were poor. After the 1973 war, the air force was decimated. Most pilots who flew in 1982 were young and inexperienced. They did not fly as many hours as their Israeli or even Soviet counterparts. When commenting on the performance of the SyAF during the war, one senior VVS officer noted “it is all very well that GCI operators should assist us fighter pilots...one should not rely on their support for everything”<sup>158</sup> Even Soviet pilots knew personal initiative in the air was valuable.

The Israeli domination of C<sup>3</sup>, coupled with superior training, intimate familiarity with its geography, and the fact that the IAF had flown over the Bekka Valley unopposed for years, allowed the IAF to dominate the largest air battle seen since the end of the Second World War. Though the MiG-23 did not perform well during its baptism of fire, it did not perform poorly either. Rather the support structure that flew, maintained and controlled it was fatally flawed. The MiG-23 was not inferior, the Syrians were. The war was won through IAF domination of airspace and was an indicator of future air-to-air combat. Combat would no longer be a close maneuvering fight, but rather BVR and head on shots that would require high levels of coordination and training to succeed.

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<sup>158</sup> Lambeth pg30

In an ironic twist, the invasion of Lebanon began with total domination of Syrian armed forces by Israel, with the IAF achieving kill ratios that are the highest ever achieved. It did so through technology and training, yet the war in Lebanon rekindled a civil war within Lebanon and created a guerilla war that neither the IAF nor IDF were prepared to handle. The war that began in such a spectacular manner soon became a quagmire, and as Martin van Creveld in his book *The Sword and the Olive* observed, it nearly tore the nation of Israel apart. The Lebanese War became Israel's Vietnam. It was the only war which Israel did not win and the first war to see massive dissent within the country. Initial "shock and awe" victories against a conventional army did not guarantee victory in the subsequent guerilla war.

## Chapter VIII

### Wars of the 90's and the Scoreless MiG-29

The MiG-29 Fulcrum, currently a front line fighter in Russia, Ukraine, India and many other nations, has not enjoyed much good publicity since it's unveiling to the West in 1986. From highly public airshow crashes in England and France to its dismal performance in places such as Eritrea, Serbia and Iraq, the MiG-29 has been overshadowed by the more successful and perhaps more glamorous cousin, the Sukhoi Su-27 Flanker. The MiG-29 has scored no confirmed kills in aerial combat, except two US civil registered Cessna's, flown by anti-Castro Cuban activists, downed by the Cuban Air Force. It has been on the receiving end of kills by aircraft from countries as varied as Holland and Ethiopia. However, despite its fruitless record, the MiG-29 is still regarded as an able fighter in today's threat environment. India has recently selected the navalized version, the MiG-29K, to serve on their new aircraft carrier, the former Russian Naval Ship, *Admiral Gorshokov*.<sup>159</sup> Other Southeast Asia countries are purportedly looking at the MiG-29 to replace their aging fleets of 1960's vintage fighters. Even Peru operates the Fulcrum.

A vindicating factor for the Fulcrum was the German Luftwaffe's successful operation of an entire squadron of MiG-29's, until mid 2004. It had inherited the MiG-29's from the former East Germany after reunification. German Fulcrums, flown by well-trained Luftwaffe pilots, were regular as aggressors in NATO exercises and have become proof positive that the MiG-29 has a place in

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<sup>159</sup> Kappan, Rasheed. "Indo-Russian Deal on MiG-29K Ready" The Hindu Online [India]. February 11, 2001. <http://www.hindu.com/thehindu/2001/02/11/stories/02110004.htm>

today's air forces. After fighting the German Fulcrums most Western pilots agree that, despite some problems, the MiG-29 is a capable WVR (Within Visual Range) combat aircraft. Some even concede its superiority in that realm over similar American aircraft.<sup>160</sup>

Its fleet is too large to economically operate, to pay debts to former satellite nations such as Slovakia, Russia has been using the MiG-29 lending to its growing popularity. As if to prove the MiG-29 poses a threat, the USAF, through Cooperative Threat Reduction Program funding, bought twenty-one nuclear capable MiG-29S's from Moldova.<sup>161</sup> In much the same fashion as the MiG-21, Western companies are beginning to offer upgrade packages to extend the MiG-29's usable lifespan. These efforts have been despite the fact the MiG-29 has yet to achieve a kill in true aerial combat.

The Fulcrum, born of the arms race of the Cold War, the Fulcrum is now at the heart of the imperiled success of MiG OKB as they progress into the 21<sup>st</sup> century. The future of the company relies on the success or failure of Fulcrum sales in the near future.

### The Fulcrum

As the air war over Vietnam unfolded and evolved, the United States was only one of the interested parties. The Soviet Union watched intently as tactics

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<sup>160</sup> Hehs, Eric. "Schlemming with the Fulcrums, F-16/MiG-29 training in Italy" Code One Magazine. Lockheed Aeronautics Company, June 1995.

[http://www.codeonemagazine.com/archives/1995/articles/jul\\_95/july2a\\_95.html](http://www.codeonemagazine.com/archives/1995/articles/jul_95/july2a_95.html)

<sup>161</sup> "Moldovan MiG-29 Purchases" National Air Intelligence Center Online, Maxwell Air Force Base, AL. <http://www.wpafb.af.mil/naic/mig29%20purchase.htm>



and technology began to dictate the next development in aircraft design. It soon became apparent that dog-fighting, once in the realm of dinosaurs, was an essential tool in aerial combat. Beyond Visual Range (BVR) combat proved its limitations in Vietnam and maneuver combat was included in any new fighter design format in either countries. American designers built such aircraft as the F-16 Fighting Falcon and the F-15 Eagle in response to this new need. Not blind to the burgeoning trend in aerial combat, the Soviets designed the highly maneuverable MiG-29 (NATO codename Fulcrum) and the Sukhoi Su-27, (NATO codename Flanker).

During the early 1970's, in response to realized inadequacies of frontline aircraft, the Soviets launched the *Perspektivnyi Frontovoi Istrebitel* or PFI (Advanced Tactical Fighter) program.<sup>162</sup> Split into two programs, MiG received a contract to produce a lightweight fighter, equivalent to the US F-16. Sukhoi received a contract for the heavy fighter to counter the American F-15. As per requirements by TsKB, the PFI design was to be capable of autonomous<sup>163</sup> operations from unimproved airfields to achieve tactical battlefield air superiority. Secondly the PFI was to provide limited escort capability to fighter-bombers over hostile territory; thirdly it was to have limited ground attack capabilities. All these requirements were expected on top of the requirement for a highly maneuverable aircraft.

MiG took note of designs in the US such as the F-14 Tomcat and FX program (later the F-15), the TsAGI presented both design bureaus with top secret

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<sup>162</sup> Tartar, Easy. "MiG-29 in Study" Fighter Tactics Academy. December 2003  
<http://www.sci.fi/~fta/MiG-29.htm>

<sup>163</sup> Autonomous meaning free from centralized GCI control

information gathered from espionage in the US.<sup>164</sup> The secret information included utilizing twin tails, coupled with widely spaced engines, to provide a lifting body shape similar to the US Navy's F-14 Tomcat. Thus, both the Su-27 and the MiG-29 shared many design similarities. For MiG, this design was important for national security, but also internally. The PFI program was the first design conceived after the death of Artyom Mikoyan and the retirement of Mikhail Gurevich. It would be a test of the bureau under its new chief, Rostislav Belyakov.

Belyakov joined MiG in 1941, shortly after graduating from the Moscow Aeronautic Institute. He participated, in most aspects with all design since then and was a driving force behind the MiG-23 and -25. He was also the liaison between MiG and the military, industrial plants and government officials.<sup>165</sup> Thus Belyakov knew the firm from both a design and business standpoint and assumed the role of chief designer shortly after Mikoyan's death in 1970. As head of the design bureau Belyakov's first test was the MiG-29 design, "Product 9" within the Bureau.

The first flight of the prototype occurred on October 9, 1977 with MiG test pilot Aleksander Fedotov at the controls. The next month, the West got its first look at the MiG-29 when a spy satellite over flew the test airfield at Ramenskoye. Dubbed the RAM-L by Western analysts, it became the subject of much speculation and theory, most of which was untrue.<sup>166</sup> Unfortunately for MiG, the MiG-29's test period was fraught with problems, stemming from the newly

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<sup>164</sup> Butowski 113

<sup>165</sup> Butowski pg 112

<sup>166</sup> Spick pg 488

developed Klimov RD-33 turbofan engines which powered the MiG. Multiple crashes plagued the program. Some of these crashes may have resulted in tests to determine the correct placement of the engines; the RD-33 was later found to be very sensitive to disturbed airflow.<sup>167</sup> Two prototypes crashed in 1978 and 1980 respectively and the MiG-29 did not enter service with the VVS until 1983, while the PVO did not receive its first MiG-29's until 1984.

The West received its first close-up view of the MiG-29 in 1986. Between July 1 and July 4, six MiG-29's flew to Rissala Air Base in Finland as part of an ongoing cooperative exchange program between the Soviets and Finns. This program also brought the MiG-23 and the MiG-21bis to the West for the first time in 1983 and 1974 respectively. After a display by MiG pilot Vladimir Chilin, it was apparent to all onlookers that the MiG-29 was a highly maneuverable aircraft, an observation that would be built upon two years later. The MiG-29 also landed in the impressively short distance of 450 meters, proving it could operate from dispersed airfields.<sup>168</sup>

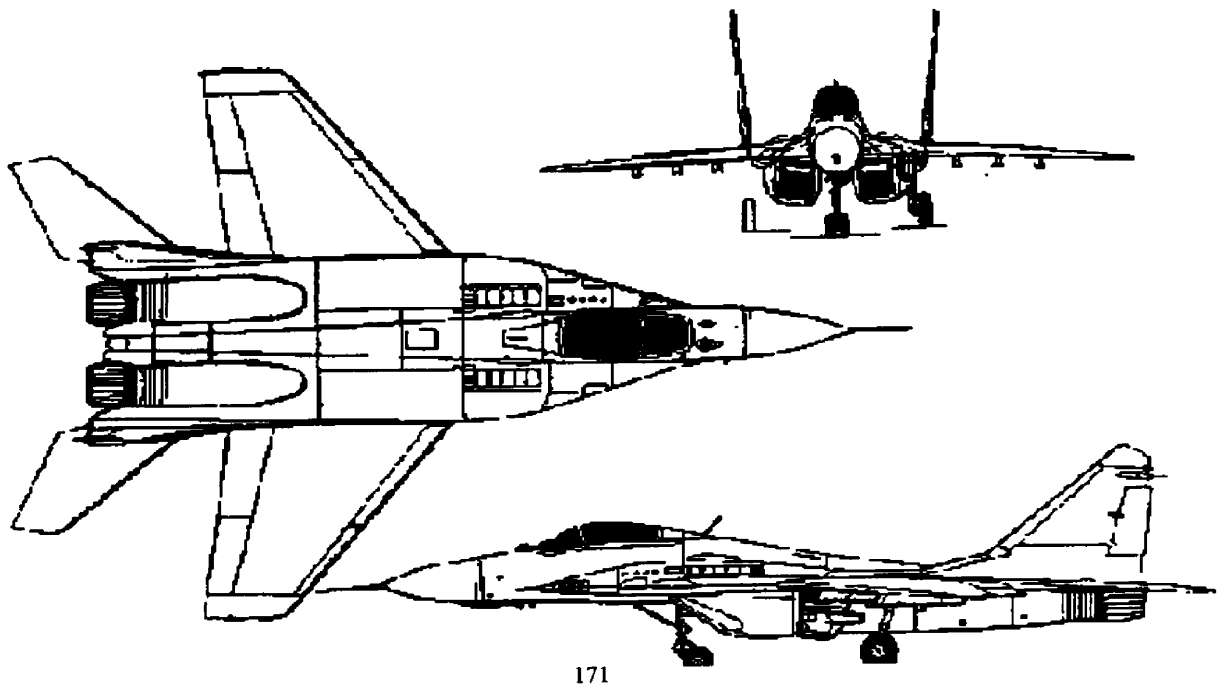
In 1988, quite unexpectedly, two MiG-29's appeared at the Farnborough Airshow. Also present was chief designer Belyakov and his deputy designer Mikhail Waldenberg. This was a first for a Western airshow! The MiG-29 performed both solo and joint routines, putting on a display that impressed Western onlookers. Of particular interest was a sustained 9 g, 360° turn in 12.5 seconds and another 360° turn with a radius of 700 meters, at speeds approaching

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<sup>167</sup> Spick pg 487

<sup>168</sup> Butowski 114

800km/h.<sup>169</sup> However, the most impressive display was saved for last, when test pilot Anatoily Kvotchur performed a tail, or “Cobra” slide at extremely low altitude. Though not particularly dangerous when performed at altitude, the MiG-29 demonstrated its ability to fly vertically to a stop, slide backwards with its nose still in the vertical position and recover quickly to a flyable speed. Western onlookers were amazed when this dangerous maneuver was performed at an altitude less than 1,000 meters. According by the MiG designers this maneuver is a feasible combat tactic as it breaks the lock of Doppler radar systems. However in later years it was discovered not be viable with a full compliment of fuel and weapons on the aircraft.<sup>170</sup>



Sketch of MiG-29

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<sup>169</sup> Butowski pg 114

<sup>170</sup> Tartar, Easy. “MiG-29 in Study” Fighter Tactics Academy. December 2003

<http://www.sci.fi/~fta/MiG-29.htm>

<sup>171</sup><http://www.geocities.com/aboutaircraft/mig29.htm>

It was at the 38<sup>th</sup> annual Paris Airshow in 1989 that the MiG-29 gained notoriety. During a routine air demonstration, MiG test pilot Kvothchur experienced a bird strike in the starboard engine at 513ft from the ground. This loss of power, at an already low speed, led to a stall situation and forced Kvothchur to eject from his stricken aircraft. The image of the MiG-29's nose impacting the ground, milliseconds before fire engulfed the aircraft, appeared the world over. Kvothchur's escape from the doomed MiG also showed one of the Fulcrum's one of the many innovative features to the Western world.

Ejection seat technology stagnated in the Soviet Union until the late 1970's. The new Zvezda K-36 ejection was a leap forward in aircraft egress technology for the Soviets, and the MiG-29 was the first to incorporate it. In fact, experts consider the K-36 seat to be on par, or even superior, to Western seats. In point of fact, the seat is now being produced under license in Connecticut.<sup>172</sup> The seat was also seen in action during the 1993 Royal International Air Tattoo in Fairford, England; two Russian MiG-29's collided whilst performing an aerial display.

By showing the MiG-29's incredible agility and, tragically, its K-36 ejection seat, these early airshows gave the West an unparalleled, close look at the MiG-29. During the 1988 visit to Finland it was revealed that the aircraft has large doors in front of the air intakes that close while the aircraft was on, or near, the ground. Air for the engines was supplied by vents on top of the aircraft during

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<sup>172</sup> Connecticut, Department of Economic and Community Development. "Governor Rowland Announces IBP Aerospace Facility Will Create 200 Jobs in East Hartford" December 1, 1998. <http://www.ct.gov/ecd/cwp/view.asp?a=1104&q=249982>

this period. Speculation ran wild as to the reason for this design feature, but deputy designer Waldenberg stated it was simply to avoid FOD (Foreign Object Debris) from entering and damaging the engines when the aircraft was operating from unimproved airfields. Additionally the MiG-29 can also fly at speeds up to 800km/h with the doors closed, perhaps to prevent bird strike damage.<sup>173</sup>

Two very interesting features of the MiG-29's fire control system were also revealed. First, the 30mm Gryazev/Shipunov GSh-30-1 single barreled cannon is extremely accurate, thanks to its coupling to a laser range finder and the Doppler radar system. Though the MiG-29 only carries 150 rounds (or five seconds of firing), few rounds are necessary before a hit can be attained.<sup>174</sup> Secondly, and more importantly, the MiG-29 pilots can use a helmet mounted sight to track enemy aircraft. This feature is very valuable when combined with the R-73 (NATO codename AA-11 ARCHER) missile featuring thrust vectoring capabilities. This system allows a MiG-29 pilot to engage an enemy without using telltale radar, giving the MiG-29 less possibility of being detected. However, the true advantage of the system is its flexibility. It allows the pilot to shoot at an aircraft up to 45° off bore sight of the nose. This ability reduces the amount of maneuver required before a shot can be taken, the entire point of dogfighting. German pilots who flew the MiG-29 in Luftwaffe service after reunification said that, "The helmet mounted sight is a real advantage when it comes to engagements requiring a visual identification."<sup>175</sup> Despite the advantages offered by the MiG-29, the German pilot then illuminates one of the key problems with

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<sup>173</sup> Spick pg 489

<sup>174</sup> Spick pg 490

<sup>175</sup> Hehs

aircraft. “It offers no advantage in BVR (Beyond Visual Range) engagements, however, unless you can enter a short range fight, which is not likely against as AMRAAM<sup>176</sup>-equipped opponents.” This observation would become painfully evident for MiG-29 pilots over Serbia and Iraq.

Indeed, the original MiG-29 suffered in many areas, including radar. MiG-29A’s did not have a viable BVR capability. It’s radar was not powerful enough nor could it carry long range missiles. Alpha (NATO phonetic alphabet for A) model Fulcrums also lacked a fly by wire system, instead they relied on antiquated hydraulics that increased pilot fatigue and compromised maneuverability in high G situations. Also not included on the A model were hardpoints for external fuel tanks. This was something which was desperately needed owing to the small internal fuel supply. Later models such as the MiG-29S (SE for export) alleviated most of these issues with the incorporation of fly-by-wire systems, external fuel tanks, improved radar and the ability to fire the new BVR R-77 Vypel missile.

The ergonomics of the cockpit were not improved upon in the S model, something which German pilots, having flown Western aircraft, had difficulty dealing with. According to Luftwaffe Capt. Michael Raubbach “Just to get a simple lock on and fire a missile may take up to half a dozen hands off stick switches.<sup>177</sup>” German pilots complained the switches were not laid out in a logical manner. This was a problem as most basic operations required an inordinate amount of movement within the cockpit. by MiG this rectified somewhat with the

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<sup>176</sup> Advanced Medium Range Air to Air Missile fielded by NATO as the AIM-120. The missile is radar guided and capable of accurate long range interceptions.

<sup>177</sup> Hehs

introduction of the MiG-29SMT, which incorporated a glass cockpit and was, to a large degree, compatible with Western avionics.<sup>178</sup> Maintenance is also not up to Western standards; a replacement of the RD-33 engines being required every 400 hours.<sup>179</sup>

Most of the world's MiG-29s that have seen combat are Alpha models, thus the shortcomings were quite apparent. However, as the Luftwaffe JG73 squadron flying the MiG-29A have shown, the MiG-29 is still a formidable aircraft. According to its own pilots the MiG is capable of holding its own against such aircraft as the F-16 and F/A-18 Hornet. As one F-16 pilot pointed out "whoever makes the first mistake (in a close range fight) loses"<sup>180</sup>. In fact one pilot claims it to be "more than capable".<sup>181</sup> Though the German pilots have proved the MiG-29 to be a worthy aircraft, it is only such when in the hands of a capable, well trained pilot. Though dreadful the combat record of the MiG-29 proves without a doubt the value of training and proficiency.

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<sup>178</sup> Spick pg 492

<sup>179</sup> Hehs, In comparison the F-16 Pratt and Whitney's 200 series engines require replacement every 4,000 hours.

<sup>180</sup> Hehs

<sup>181</sup> Hehs



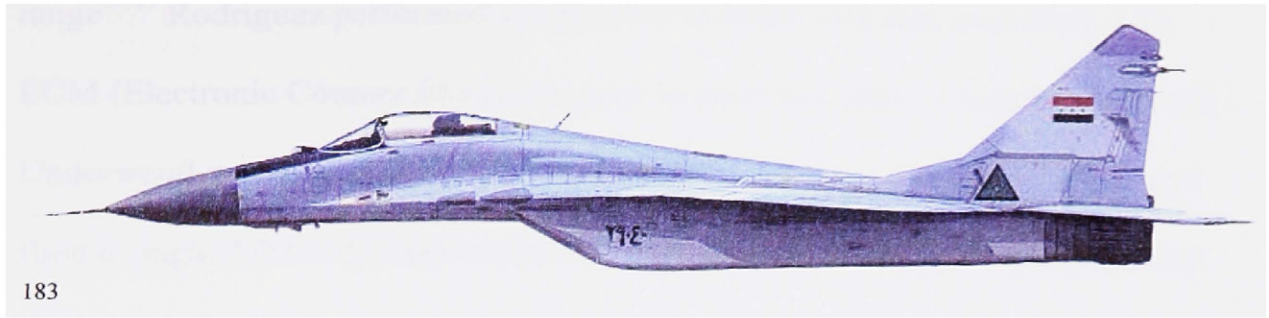
## The Fulcrum in Combat: A Story of Woe

The baptism of fire for the Fulcrum was by no means glorious. The Gulf War of 1991 was a one-sided victory for the Coalition forces against Iraq. The war in the air was no different. Coalition forces followed the model of airspace domination set forth by the Israelis during 1982. On the first night of the war, January 17, 1991, US and Coalition aircraft attacked airfields, radars, GCI sites and command and control bunkers. They destroyed Iraq anti-aircraft defense network, crippled its ground based fighter control system and decimated most airfields very quickly. The night of January 17 was also the first combat for the MiG-29 Fulcrum.

After strikes by F-117 Stealth fighters focused on C<sup>3</sup> targets in Baghdad, F-111 and F-15E's began attacking the air defense network around the capital city. Top cover was provided by USAF F-15C's and USN F-14's. During the ingress to the target, two Iraqi fighters managed to get airborne and challenge the attackers. However a comedy of errors ensued. As the lead MiG-23 crossed in front of his wingman that was flying a MiG-29, the wingman fired and destroyed his comrade. Just after his fratricidal maneuver, the MiG-29 flew into the ground.<sup>182</sup> To say the least, this was not a elegant combat debut for the MiG-29.

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<sup>182</sup> Gulf War Air Power Survey Volume II: Operations and Effects and Effectiveness. US Government Printing Office. Washington D.C. 1993 pg 125



### An Iraqi MiG-29A

As the F-15E's and F-111's egressed from attacking their targets, another group of fighters rose from H-2 or H-3 air base. AWACS (Airborne Warnings and Control Systems) picked up the fighters closing with a group of F-15's heading for a tanker to refuel. The top cover F-15C's, (callsign Pennzoil and Citgo) were vectored to intercept. At sixteen miles, the target was identified as a lone MiG-29 and the lead F-15 fired a long range AIM-7 Sparrow missile. Apparently, the MiG pilot did not realize he had been fired upon, and continued to climb, taking no evasive action as the missile struck and destroyed the aircraft. Later that night, two more MiG-29's were downed by Citgo and Pennzoil flights.<sup>184</sup>

Two days later, on January 19, the MiG-29 made another poor showing. Captains Caesar Rodriguez and Craig Underhill were performing a daylight fighter sweep near the Baghdad area when they detected two MiG-29's. As the F-15 flight tracked the two MiG-29's they were bounced by another two undetected MiG-29's. Very quickly one the MiG's obtained missile-lock on Rodriguez. For some reason the MiG did not fire, though Rodriguez was "well within his

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<sup>183</sup> artwork courtesy of Tom Cooper ACIG.org editor

<sup>184</sup> Gulf War Air Power Survey vol II pg 126

range”<sup>185</sup> Rodriguez performed a maneuver to break lock and used his F-15’s ECM (Electronic Counter Measures) gear to spoil any shot; “I kept him off until Underwood would target and take him out.”<sup>186</sup> Underwood obtained a lock and fired a single AIM-7 that destroyed the MiG behind Rodriguez. With this threat eliminated, Rodriguez engaged the remaining MiG-29 in a classic turning dogfight. The fight began at 8,000ft and very quickly descended to 300ft. Finally, when neither pilot could obtain an optimum firing position, the MiG performed a split-S maneuver, miscalculated and flew into the ground. Rodriguez was credited with a kill by maneuver. Two MiG-29’s were also killed by F-15C’s on February 15 as they attempted to flee eastwards to Iran.

American F-15’s were credited with five MiG-29 kills They had also watched two crash into the ground whilst attempting an intercept. The subject of much discussion, the reasons for these two crashing is generally blamed on the heads down configuration of the MiG-29A radar and fire control system. It was not possible to both, fly the aircraft in an offensive manner, track a target, and fire a missile and while still watching outside the cockpit. This problem was later described by German Luftwaffe pilots as they transitioned to the MiG-29.

The air war during the first Gulf War progressed much the same as Israeli operations over the Bekka Valley. Coalition aircraft controlled the airspace and decimated the Iraq air defense network. When opposing aircraft did manage takeoff to intercept, they lacked coherent control and a good situational picture of the surroundings. Thus, the Iraqi pilots were easy targets for US fighter sweeps.

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<sup>185</sup> Grant, Rebecca. “The Missing Aces” Air Force Magazine, The Journal of the Air Force Association Online. Sept 2004 vol 87 no 9. <http://www.afa.org/magazine/Sept2004/0904aces.html>

<sup>186</sup> Gulf War Air Power Survey vol II pg 127

Additionally, the Iraqi experience during the Iran-Iraq war gave advantage to the Coalition. During that conflict neither side had attempted to dominate the air they instead relied on their respective armies to achieve victory in the battlefield. It was Saddam Hussein's decision to put his aircraft in supposed bombproof shelters, riding out the initial air strikes that crippled the Iraqi air force for the remainder of the war. Hussein relied on his vast air defense network to blunt coalition airstrikes, rather than his air force.<sup>187</sup>

The MiG-29 did not fair well during the Gulf War due to the low skill level of its pilots, the vast destruction of the defense network, and the high proficiency level of coalition pilots. These same variables would doom the MiG-29 in its next combat performance over the skies of the Balkans.

Yugoslavia received its first MiG-29's in 1987 from the Soviet Union. These were not new aircraft, in fact they were some of the first MiG-29's produced. They had been flown by the VVS and then put into storage prior to their sale to Yugoslavia. When Yugoslavia broke up in 1991, the MiG-29's were under the control of Serbia (Serbia at the time, still referred to itself as Yugoslavia). During the civil wars that racked the Balkans in the 1990's, MiG-29's were employed to fly CAP (Combat Air Patrol) missions along the borders of Austria, and later, flew numerous ground attack missions against the Bosnians and Croats. Croatia and Bosnia claimed to have destroyed at least four MiG-

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<sup>187</sup> Keaney, Thomas A and Eliot A. Cohen. Gulf War Air Power Survey Summary Report. (US Government Printing Office. 1993) pg 56

29's during the war, but post war analysis by NATO revealed that all fourteen aircraft survived the civil wars.<sup>188</sup>

When Serbia was confronted by NATO in 1999, the condition of all MiG-29's was very poor. All MiG-29's were assigned to one squadron, the 127<sup>th</sup> Fighter Aviation Squadron based at Batajanica airfield near Belgrade. The pilots of this squadron were only averaging only twenty flying hours a year, hardly enough to stay proficient.<sup>189</sup> The MiG-29's were maintained very poorly, with rarely more than five aircraft deemed flight ready. Thus, when ordered by Belgrade to sortie against incoming NATO fighters, only five aircraft were serviceable and were spread out to among dispersed airfields.

On March 24, 1999, during the early hours of Operation Allied Force, three MiG-29's were scrambled from Batajanica airfield to intercept incoming allied fighter-bombers. As the flight gained altitude the MiG-29's were picked up by a British E-3D Sentry AWACS aircraft patrolling over the Adriatic. Also in the area were four Royal Netherlands Air Force F-16AM's assigned to CAP duty around Belgrade. After being vectored into the area of the MiG's, the four F-16AM's detected the lead aircraft on radar. The lead pilot shot an AIM-120 AMRAAM eighteen kilometers from the target. Soon after he reported a "large fiery explosion" and was informed by the AWACS that the MiG had disappeared from radar.<sup>190</sup> This was the first Dutch air-to-air victory since the Second World

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<sup>188</sup> "Yugoslav and Serbian MiG-29s" Air Combat Information Group Journal. Oct 2003.

[http://www.acig.org/artman/publish/article\\_380.shtml](http://www.acig.org/artman/publish/article_380.shtml)

<sup>189</sup> Dawes, Alan "Surviving NATO Shootdowns" Air Forces Monthly. (July 1999 pg 70-71) pg 71

<sup>190</sup> Jok, Joris Janssen. "How Dutch F-16AM's shot down a MiG-29" Janes Defence Weekly. May 1999. [http://www.janes.com/defence/news/kosovo/jdw990401\\_01\\_n.shtml](http://www.janes.com/defence/news/kosovo/jdw990401_01_n.shtml)

War. The other two MiG-29's exited the area at high speed and avoided contact with the Dutch F-16's.

Luck ran out quickly for the two escaping Fulcrums, however, as they were tracked by AWACS aircraft. USAF Col. Caesar Rodriguez, who had downed two MiG's during the Gulf War flying a F-15C, was vectored to the two remaining MiG-29's. One of the MiG-29's was on course to intercept a flight of incoming F-117 Stealth Fighters. According to the MiG-29 pilot, Major Iljo Arizano, he detected a number of targets, among them an F-117. Firing a missile at the Stealth Fighter, he missed. Whilst moving to reengage it, Arizano's aircraft was struck by a missile in the rear fuselage and entered an uncontrollable spin. As smoke filled the cockpit Arizano decided to eject and landed in a vineyard southwest of Pristina.<sup>191</sup> He was downed an AIM-120 AMRAAM fired by Col Rodriguez.

Just as this engagement concluded, USAF Capt. Michael Showers detected two MiG-29's departing the airfield at Batajanica. Capt. Showers was escorting a flight of F-117 Stealth Fighters, when the two MiG's began an intercept on his flight; Showers engaged them with two AIM-120 AMRAAMS's. However both missiles missed their mark. As the MiG's closed with Showers he described the situation, "I didn't think I had a choice of turning and running away, you've got a MiG-29 running around in the area, and there is a chance he could get lucky and find a Stealth."<sup>192</sup> Surprising an F-117 pilot who was only 2,000ft from in front of his aircraft, Showers launched another AMRAAM, which found

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<sup>191</sup> Air Force Monthly July 1999 71

<sup>192</sup> Grant

its mark, and destroyed a MiG-29 piloted by Major Nebojsa Nikolic. Nikiolic later claimed he had engaged and fired an AA-8 Aphid missile at his attacker but this was never verified.<sup>193</sup>

Two days later, two MiG-29's were scrambled to intercept a high flying NATO reconnaissance aircraft that was flying north west over Serbia. As they climbed to intercept the aircraft, both MiG-29's began to experience malfunctions with their radar systems. Directed by GCI the two aircraft attempted a visual intercept of the NATO aircraft as it crossed the Bosnian border. As their radars malfunctioned, they failed to detect a flight of USAF F-15C led by ANG Capt. Jeffery Hwang. The Mig-29's were both shot down by AIM-120 AMRAAMS before they could take evasive action.<sup>194</sup>



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<sup>193</sup> Air Force Monthly July 1999 71

<sup>194</sup> Air Force Monthly June 1999 21



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Photos of MiG-29 downed by Capt. Hwang over Bosnia

<sup>195</sup> all pictures of downed MiG-29 are courtesy of Sgt. Colby Jackson who visited the wrecked while serving with SFOR as part of the Montana 163<sup>rd</sup> National Guard in 2002



Despite the fact that they had failed to score a single kill against Allied aircraft, Serbian MiG-29's continued to challenge Allied aircraft. The last MiG-29 kill of the conflict occurred on May 4, 1999 when two F-16CJ's engaged a single MiG-29, destroying it very quickly with another AMRAAM.

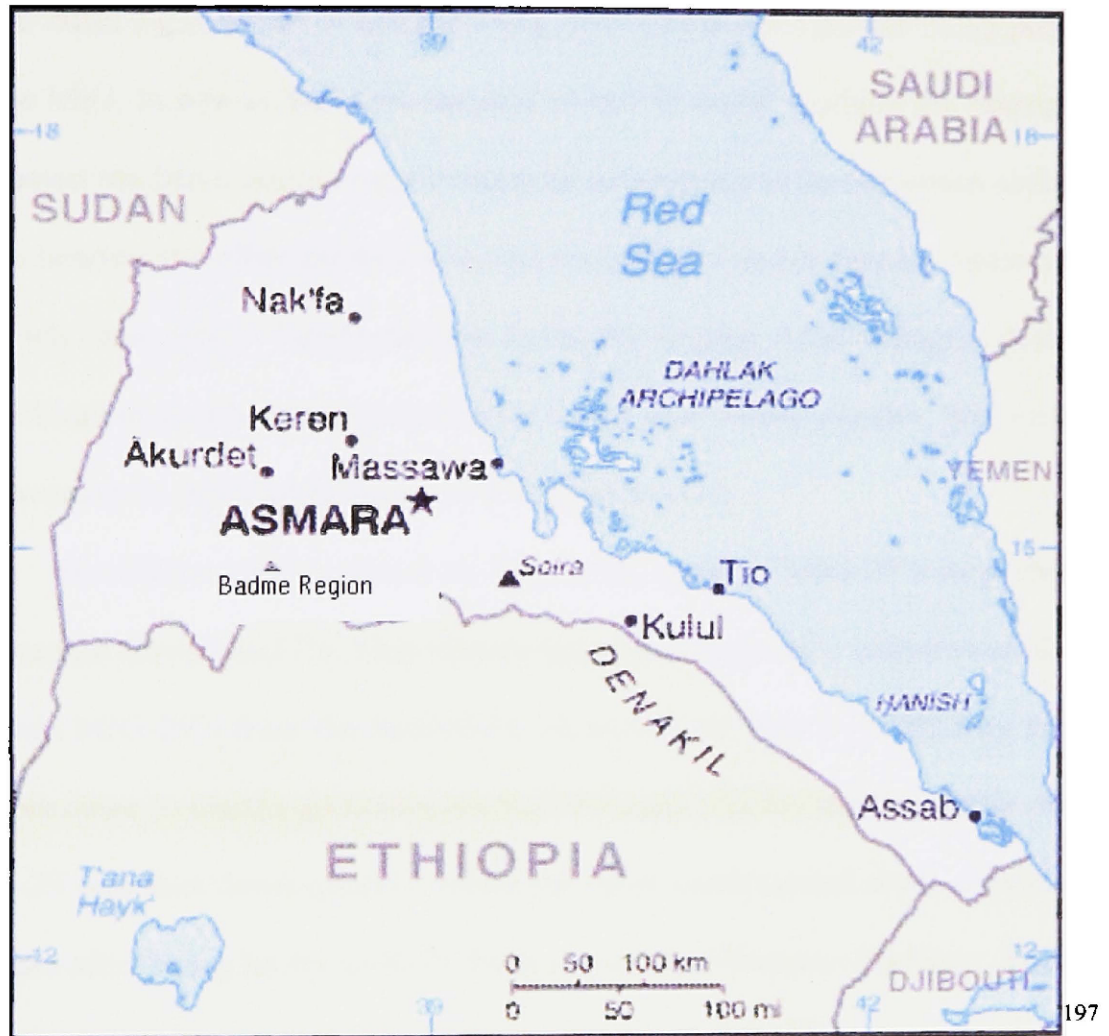
Intercepts by MiG-29's during Operation Allied Force were doomed to fail from the beginning. Flight hours were as low as twenty a year and no pilot had the proficiency enough to engage NATO pilots on an equal footing. Additional, the MiG-29's, were in a poor state of repair. Of a fleet of 14, only six were able to fly. Of those MiG-29's, a major malfunction was reported in either a radar or fire control system during every flight. By the spring of 2004, Serbia could not maintain the aircraft and MiG-29 operations ceased.<sup>196</sup>

The skies over eastern Africa would be the next combat arena for the Fulcrums as Ethiopia and Eritrea were fighting over land disputes stemming from the Eritrean war of independence. Since 1990 Ethiopia and Eritrea had long endured a simmering border conflict over the Badme area. Hostilities erupted numerous times and in 1997 Ethiopia, with the help of the Russian mercenary group Rosvoorouzhnie, began to import Su-27 Flanker fighters. Eritrea, lest it fall behind in the arms race, purchased a number of MiG-29A from a Ukrainian mercenary company. Due in part to friction within the Rosvoorouzhnie Company, Russians within the company supported the Ethiopians, while the Ukrainians supported Eritrea! The Ukrainians broke from the firm and worked

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<sup>196</sup> Cooper, Tom "II Ethiopian Eritrean War, 1998-2000" [Air Combat Information Group Journal](http://www.acig.org/artman/publish/article_189.shtml).(Sept 2003) [http://www.acig.org/artman/publish/article\\_189.shtml](http://www.acig.org/artman/publish/article_189.shtml)

exclusively for Eritrea. Eritrean pilots were sent to Ukraine for a crash course on the MiG-29. This was a great step up as they previously flown fairly simple Italian Aermacchi MB.339's. In February of 1999 tensions flared into open hostilities.



During the morning of February 25<sup>th</sup> 1999, four MiG-29A's, piloted by Eritrean pilots, intercepted two Su-27's flown by Russian mercenaries near the disputed area. The Fulcrums bounced the two Russians, firing a salvo of AA-10 missiles. All missed. After evading the missiles, the Russians turned and engaged the Eritrean's. The MiG-29's could not evade the faster Flankers and one was shot

<sup>197</sup> <http://zhenghe.tripod.com/maps/eritrea.jpg>

down, reportedly flown by the Eritrean Air Force commander, Brig. Gen. Habte Zion Hadgu.<sup>198</sup>

The next day, a lone Su-27, flown by a female Ethiopian pilot, came across an unarmed Eritrean two seat MiG-29UB, apparently out on a training flight. After a good deal of maneuvering, the female pilot gained firing position on the MiG. In one of the more unusual events in aerial warfare, the Ethiopian contacted the MiG, requesting he relent to be escorted to an Ethiopian airfield. Upon hearing the other pilots voice, she realized it was her former instructor, a pilot who had defected and was now flying for Eritrea. After a lengthy discussion, the Ethiopian shot her former instructor down with 30mm gunfire. She was the first woman to score an aerial victory in a jet aircraft.

Hostilities continued and on March 18, a pair of MiG-29's were shot down by Russian flown Su-27's. This victory led to the temporary withdrawal of Eritrean MiG-29's from the battlefield. However, on May 16, 2000 they made a reappearance to challenge Ethiopian Su-27's again. In the ensuing battle one MiG-29 was shot down quickly, while the other crash landed at the airport in Asmara after being hit by an R-73 from one of the Ethiopian Flankers. This was the last known operational use of the Eritrean MiG-29's.<sup>199</sup>

Interesting in this conflict was the battle between the MiG's and it VVS stable mate, the Su-27. Though the Su-27 is larger and supposedly less maneuverable, nearly every battle was a turning fight, one in which the MiG was supposed to excel. Also apparent were the skills of the Russian mercenaries,

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<sup>198</sup> Cooper

<sup>199</sup> Cooper

especially against relatively poorly trained Eritrean pilots. This plays poorly for MiG OKB as they struggle to increase sales against their competitor Sukhoi. If MiG is to increase sales, its aircraft must perform well, especially against its prime economic competition. Performance in well trained and experienced hands, such as the German Luftwaffe or Indian Air Force, has shown the MiG-29 Fulcrum to be a worthy adversary; however in the hands of an inexperienced or poorly supported pilot it has no chance to prove its worth.

## **Chapter IX**

### **Conclusion**

Many lessons can be drawn from MiG's aircraft combat performance. These lessons include the value of highly trained pilots and ground personnel, a competent C3 structure and situational awareness in combat. Without any of these factors and when faced by a force proficient in all aspects of them, pilots are doomed to failure.

Many Western aviation authors and researchers are convinced of the supremacy of Western aircraft. They have often looked upon Soviet/Russian aviation as a generation behind not a threat to Western aircraft. This is a dangerous assumption which must be avoided. Any aircraft with a proficient pilot, regardless of the state of technology, should be regarded as a threat. The Western aircraft design industry, as well as the air force it supplies, is dominated by technology. Though pilot training in the US and other Western countries is the best in the world, the industry and tacticians focus on the role of technology in warfare. While playing a large role in success on the battlefield, technology is not the end all it is sometimes portrayed as. The human brain is still the fastest, most advanced part of any weapons system.

Soviet aircraft have had a reputation as being inferior to their Western counterparts. In part this is due to a history of combat failures, examples of which have been examined in this study. However, as any historian knows, the danger lies in taking something out of the context of time or place. All current MiG

designs were created during the Cold War, a time of tense nerves and nuclear brinkmanship. Whereas Western design firms marketed and relied on foreign sales, Soviet era OKB's had but a single customer. Any foreign sales were negotiated by the Soviet government and were not the concern of the company. MiG OKB was tasked with equipping the VVS and PVO with frontline fighters and fighter/bombers; it did not design aircraft for foreign customers. Therefore the OKB's designs were quite specialized. Had a war occurred in Europe involving the Soviet Union and NATO, Soviet aircraft might well be considered in a different light.

The Soviet Union relied on superior numbers on the battlefield for victory. The VVS and PVO possessed far more aircraft than NATO, though not as advanced. The role of the Soviet Air Force differed from its Western counterpart. The VVS and PVO were to support the advancing army by disrupting NATO air operations. They were expected to sustain heavy losses, offset by their numerical superiority. Luckily, this scenario never occurred. However, along with military hardware the tactics that would have been employed by the VVS were exported to Soviet client states resulting in poor performance by Soviet designed aircraft.

The air war over North Korea placed the MiG-15 in an environment for which it was designed, point defense of static targets from fighters and bombers. When coupled with quality Soviet pilots, the MiG-15 excelled in this role. However, though flying the same aircraft, relatively untrained North Korean and Chinese pilots suffered heavy losses in the same role. This was a direct result of poor, insufficient pilot training.

When MiG's rose to meet American fighters and bombers over Vietnam their initial success was limited due to lack of training, As the war progressed the NVAF, aided by restrictions imposed on American pilots by the US government, greatly improved their performance. They broke from traditional Soviet tactics and developed their own indigenous ones, suited to the varied combat over Vietnam. This was especially important to the NVAF as they did not possess numerical superiority. North Vietnam also possessed a very advanced GCI system that vectored and provided information to pilots quickly and effectively. Eventually the NVAF produced thirteen aces, due in part to the pilot's initiative and ability to operate independently from the Soviet model. Ten years later Syrian pilots discovered the fallacy of exporting a tactical doctrine ill suited for the environment.

When Syrian and Israeli aircraft engaged one another over the skies of the Bekka Valley in 1982, the Soviet system became the laughing stock of air forces the world over. The Syrian Air Force suffered heavy losses to the guns and missiles of the IAF for numerous reasons. Though the SyAF was flying highly advanced and capable MiG-23's, they could not be employed in an effective manner. Syrian pilots were not proficient in ACM, lacked all personal initiative in battle and did not maintain C3 control. They were highly dependent on the Soviet system of GCI to intercept IAF aircraft. When this was lost, so too was their situational awareness as they had not been taught the skills necessary to continue the battle independently. The MiG's over the Bekka Valley were destroyed in record number due to organizational and pilot error, not because the hardware was

inferior. Unfortunately for MiG, its aircraft continued to suffer throughout the 1990's at the hands of inexperienced pilots.

The loss of MiG-29's in both Gulf War I and Yugoslavia was the direct result of poor pilot skill. In one aforementioned case, a MiG-29 shot down his wingman, and then crashed into the ground while being engaged by American F-15's. Over Bosnia and Serbia, MiG-29's were not serviced to a combat ready status and sent into battle deaf, dumb and blind. No aircraft can be expected to survive in such an atmosphere.

Despite the horrendous combat record of MiG-29's there is hope. The German Luftwaffes demonstrated unequivocally during the 1990's showed that with a well-trained pilot a MiG-29 could defeat Western aircraft. The key to this success is not an innovative fire control system or excellent maneuverability, but rather the human brain within the cockpit.

In aerial combat the most significant factor is still the human factor. To win in aerial conflicts, countries must have necessary resources and willingness to train pilots effectively. They cannot rely on technology alone to dominate the battlefield. Though MiG aircraft have not performed since 1950 as well as their Western counterparts, the fault lies not in their design, but in their implementation. A multimillion-dollar aircraft is worthless without a multimillion-dollar pilot, a fact that many countries fail to understand.



## Epilogue

### The Future of MiG: Can a Soviet Era OKB Survive in Today's Market Economy?

MiG is struggling to cope with the former Soviet Union's new economic situation. Gone is the VVS and MoD guidance for aircraft design. Instead Russian OKB's must design aircraft marketable to a broad audience. Gone also are the vast amount of funds available under Soviet rule. Now OKB's must lobby for money from either governments or private sources, much like their Western counterparts. Today the production lines of MiG are at a near standstill, producing aircraft to replace fleet attrition losses. The design bureau is still producing and researching upgrade packages for aircraft such as the MiG-21, -29 and -31, but is falling behind other companies in particular, MiG has taken a backseat to IAI (Israeli Aircraft Industries) which is marketing upgrade packages for many Eastern European Fishbed operators. MiG has made a number of partnerships with the hope of staying competitive.

After the fall of the Soviet Union in 1991, MiG merged with its key production facility, MAPO (Moscow Aircraft Production Organization)<sup>200</sup> creating MIG-MAPO.<sup>201</sup> The group acquired the helicopter company, Kamov, and sought foreign partners such as Singapore based, Agio Countertrade. Business is still slow, perhaps due to MiG ties with former head bureau chief, Belyakov.

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<sup>200</sup> Norman, Iain. The Fall of MiG or How Sukhoi Stole the Spotlight. Unpublished Manuscript

<sup>201</sup> MIG, with a capital I, now stands for Moscow Industrial Group, however the aircraft design bureau is still known as MiG.

Belyakov backed the coup which attempted to oust Yeltsin from power and relied very heavily on friendships in the old Soviet VVS to maintain funding for aircraft programs.<sup>202</sup> His retirement from the company in 1995 is construed some as a blessing. MiG's main competitor, Sukhoi, has done remarkably well in the post Soviet era, It has sold its premier fighter the SU-27 (and variants thereof) to many countries outside the old Soviet sphere of influence. Unlike Sukhoi, MiG has not learned the value and skill of marketing.

During the years of drastic inflation right after the collapse of the Soviet Union, there were reports that the chief of the Sukhoi bureau traded sport aircraft for Toyotas. By doing this, Sukhoi avoided the drastic deflation of the ruble. Dollars that were made were securely banked in the West. Sukhoi has made a point to bring its Su-27 to as many large airshows as possible to wow crowds and diplomats alike with its fantastic maneuverability. Sukhoi changed the historical method of simply assigning a letter at the end of the aircraft to denote a new version (i.e. MiG-29S/SE/K etc), instead they renumber each new derivative (i.e. Su-30, Su-33, Su-35 all variations of the Su-27), thereby making the aircraft seem like a new design.<sup>203</sup> Sukhoi has, for all practical purposes, unseated MiG as the premier Russian design OKB. All is not lost for MiG though, and there may be hope for the struggling company.

India has recently acquired nearly 30 MiG-29K aircraft to operate from their former Soviet aircraft carrier.<sup>204</sup> Malaysia has also recently purchased MiG-

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<sup>202</sup> Tartar

<sup>203</sup> manuscript of Iain Norman

<sup>204</sup> Kappan, Rasheed. "Indo-Russian Deal on MiG-29K Ready" [The Hindu Online \[India\]](http://www.hindu.com/thehindu/2001/02/11/stories/02110004.htm). February 11, 2001. <http://www.hindu.com/thehindu/2001/02/11/stories/02110004.htm>

29's and MiG is seeking to expand into commercial aircraft production with the MiG-110. MiG also is developing the stealthy MiG 1.44, designed as a fifth generation fighter, although this project seems to be stalled. As of early 2003, the MiG Corporation was offering the MiG-21-93 upgrade program, the MiG-23-98 upgrade program for this maintenance intensive aircraft, a cockpit upgrade for MiG-27's, the MiG-29 as the basic A and advanced S version, the carrier borne K version and finally an the MiG-31 as a whole aircraft for China and the VVS/PVO or as an upgrade package to existing airframes.<sup>205</sup>

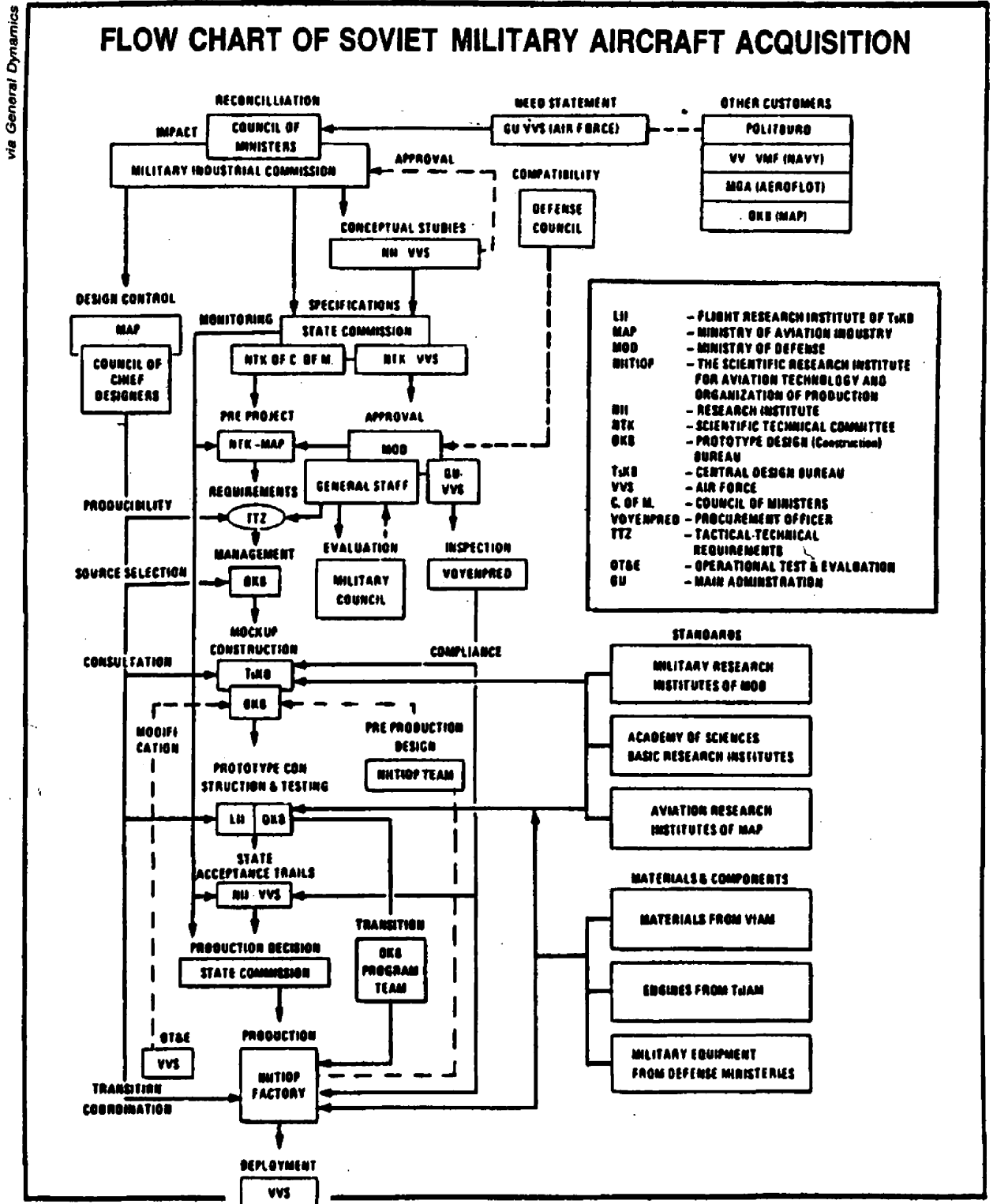
MiG must stay competitive with Sukhoi in order to survive. Efforts abroad at marketing and upgrading current versions will be the company's only salvation. The Su-27 was in respect a poor choice for many nations that have already bought it. The aircraft is expensive to buy and to maintain, whereas the MiG-29 is cheaper and less maintenance intensive. MiG must effectively market the strong points of its current offering, much as it did with the Indian Navy and continue to research and develop its military and commercial designs. If MiG does not do this, it will not survive. In thirty years MiG may have made an admirable comeback or it will be only an entry in history books like so many of its predecessors. If MiG dies, with it goes the legacy of the premier designer of the Cold War Soviet era and a name that so many people worldwide associate with fighter aircraft. The design bureaus death will be a sad day indeed.

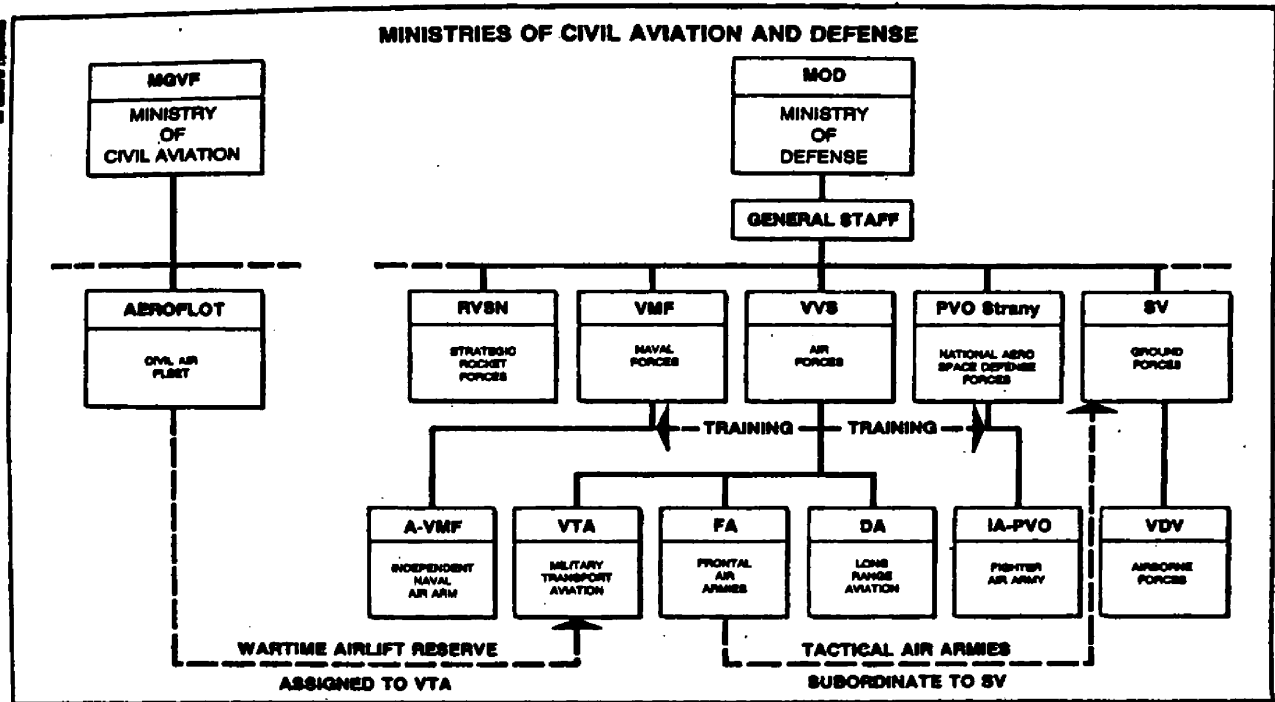
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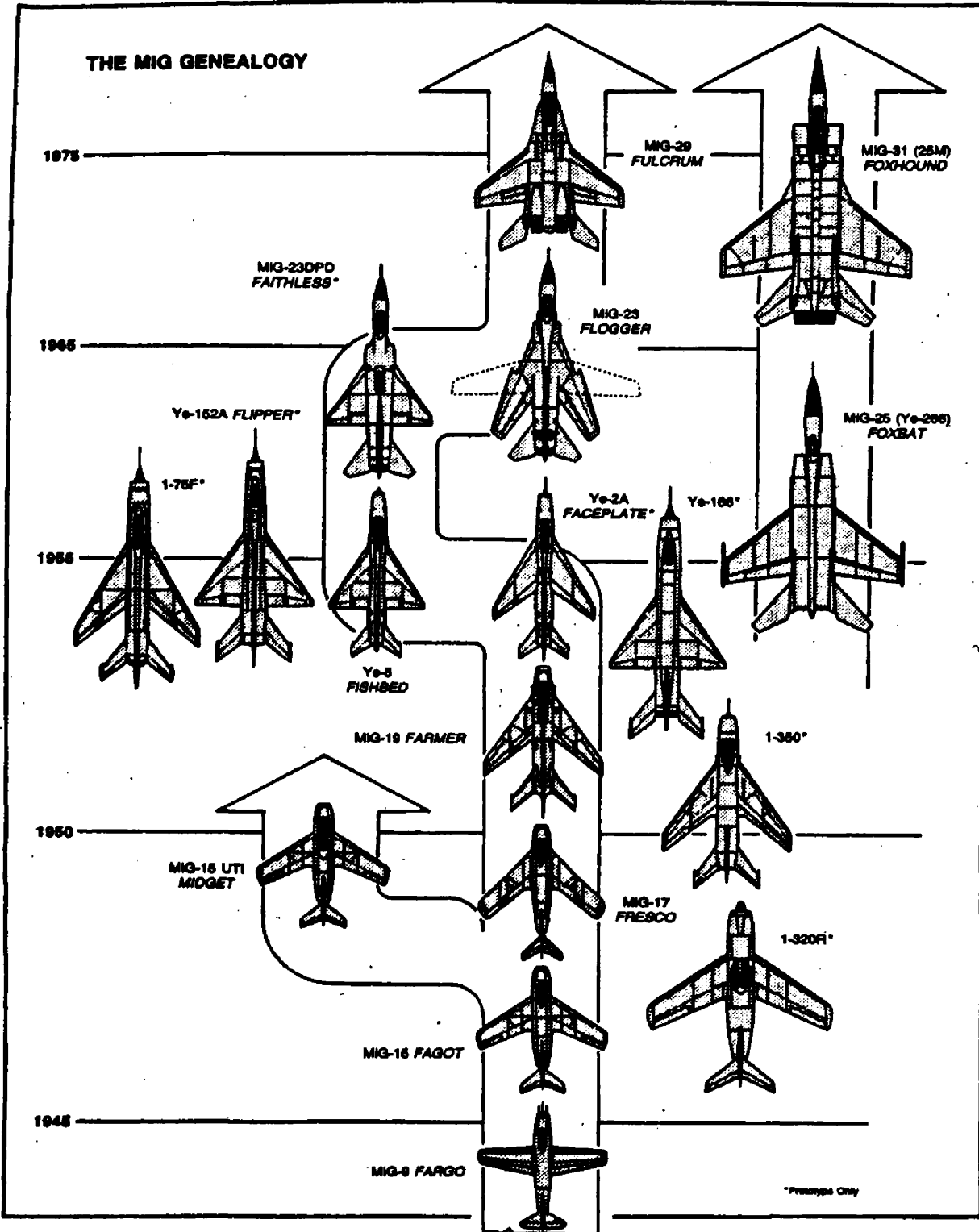
<sup>205</sup> manuscript of Iain Norman

# Appendix

All Flow charts from General Dynamics via Piotr Butowski and Jay Miller  
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The illustrations above are General Dynamics

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