MILITARY, NUCLEAR AND SPACE COOPERATION

The element of trust occupies an important position among the factors that undergird India's close relationship with USSR afterwards Russia. Policymakers in India's security establishment feel strongly about the bonds of trust that have been forged over the past five decades and have stood the test of time. Despite India's strong belief in, and leadership of, the nonaligned movement, its close relations with the Soviet Union/Russia have survived major systemic changes over time, explained by the congruence of their philosophical and pragmatic outlooks and priorities.

Military Cooperation

India's connections with Moscow always had a strong military side. Defence is thus the major component of Indo-Russian relations. It underlies the economic and strategic relations between the two. In fact it is the most privileged part of the relation. The Soviet Union had easily been the most important country as far as India's defense acquisitions were concerned. By a rough estimate, almost 60 percent of the Indian army's military hardware, 70 percent of its naval hardware, and 80 percent of air force hardware is of Soviet/Russian origin. New Delhi has bought $33 billion worth of weapons from Moscow since the 1960s, and Russian weapons account for nearly three quarters of India's arsenal.
The Soviet assistance to increase India's defence preparedness dates back to 1955 when the Soviet Union gifted two IL-14 transport planes to the Indian air force, again in 1960, when India asked for more such planes, the Soviet Union complied with the request by readily giving 24 transport planes. During this period, the Soviet Union offered to India, not only to provide MIG-21 supersonic fighter-interceptor planes on rupee credit, but also to give all assistance, including the technical know-how, for enabling their manufacture in the country itself. 1962 agreement provided for the sale of MIGs and for the setting up of a MIG factory in India.

As was expected, this agreement angered the Western countries, particularly Washington and London. Pressure was mounted on India to call off the agreement. But Jawaharlal Nehru made it clear that it was for India to decide from where to buy its defence requirements. Within two years, the area of cooperation between the Soviet Union and India in the field of defence was enlarged and given a new dimension. In 1964, India signed another agreement with the Soviet Union. Under this agreement, India received four squadrons of MIG-21, helicopters, light tanks, missiles and other sophisticated weapons. But what is equally important to note is that India was to pay for these supplies in rupees or in goods produced in the country and that too over a period of ten years. This undoubtedly eased India's efforts to strengthen her defences. This underlines the real significance of Indo-Russian defence cooperation in the sense that Russia not only supplies defence equipment but also gives technology to our industrial units engaged in defence equipment production.
In concrete terms, India's reliance on the Soviet defense supplies had three distinct advantages.

One, the Soviet aircraft, ships and tanks enjoyed significant price advantages over comparable Western equipment.

Two, the period between the signing of contract and delivery of weapons was normally a year, in contrast to the two three years of the US.

Three, in spite of the wide range and volume of the Soviet military sales to India, the bilateral military relationship was of limited association rather than in the nature of an alliance or a protector-client bond.

India's current agenda of force modernization does not seek to deviate from this trajectory of close cooperation. Indeed, it seeks closer cooperation, albeit with the aims of progressively enhancing Indian self-reliance in the design and production of existing technologies/weapons systems and collaborating with Russia in joint design and production of major weapons systems and subsystems in the future. There are many gray areas here to be addressed. India's near total dependence on Russian weaponry and military hardware is as much a native concern as Moscow's willingness to keep India engaged in bilateral defence deals undoubtcdly, defence ties constituted a critical element in Indo-Russian relations.

The greatest impact of political changes in Russia was felt in India's defense sector. The Soviet Union had a dominant position among India's major arms suppliers until its demise in 1991. Almost seventy percent of India's military imports came from the Soviet Union. Practically
all the frontline armor and mechanized units of the Indian army had used
the Soviet made equipment. All but seven of IAF squadrons have used
various versions of MiG, Ilyushins, and Miseries set of helicopters. Most
of the Navy's submarine destroyers and missile boat divisions have come
up on the Soviet equipment. As the Indian armed forces had large
quantities of Russian arms; the supply of spares had also to come from
Russia. The figures provide their own tell-tale story: the rate of
dependency for Russian spares was 40 per cent for the army, 60 per cent
for the air force and 80 per cent for the navy. India's defence requirement
included modernization of equipment and a state-of-the-art air defence.
We have already noted the early hiccups in this defence relationship as a
result of the break-up of the Soviet Union and the breakdown of the
centralized production apparatus in the economy as well as in defence
industries.

Procurement of spare parts and supplies for its Soviet-produced
armaments became the primary short-term military concern for India in
the early 1990s. India's military faced an immediate crisis mainly because
it was unable to build up indigenous capability to produce spare parts and
supplies for these systems. The break-up of the Soviet Union resulted in a
fracture in the supply of Soviet made military ware as the administrative
control of many armament producers now came under the jurisdiction of
the authorities of the newly independent states where the actual locations
of the Soviet defense industries were situated.

Indo-Russian defence cooperation in the post-Soviet era has
undergone radical change. A journey by the then Indian Defense
Minister, Sharad Pawar, to Moscow in September 1991 to try for the
supply of spares was a disappointing experience. But President Yeltsin's visit to New Delhi in January 1993 saw a marked shift in the relationship between the two countries. Yeltsin and Prime Minister P.V. Narasimha Rao signed a 20 years Treaty of Friendship and Cooperation replacing the similar 1971 Soviet -Indian Treaty. The two leaders also signed on sale and production of Russian weapons and the supply of Russian spare parts. June 1994 saw this reiteration once again when Prime Minister Narasimha Rao visited Moscow. In October 1996, Russian defence Minister Igor Rodionov visited New Delhi and signed a military technology cooperation agreement with his Indian counterpart. The former India Defense Minister Mulayam Singh Yadav's visit to Moscow in October 1996 further boosted the military cooperation between India and Russia. The most prominent result of this visit was an agreement between the two countries to extend by another decade their long-term defense cooperation pact, scheduled to expire in 2000. Initially the period was from 1994 to 2000.

As part of their military technical cooperation, India and Russia in 1996 formalized the Joint Indo-Russian Working Group (JIRWOG). This group seeks to organize bilateral defense cooperation along three levels:

(a) It meets every six months to one year and is mandated to take care of older or existing servicing contracts for all three services;

(b) The Military Technical Group meets at the joint secretary level to chart future areas of cooperation;

(c) Service-to-service contacts formalized during the visit of Russia's defense minister, General Rodionov, aim to clarify many
operational aspects of service-to-service cooperation; it also involves exchange of officers, sharing information concerning military exercises, and so forth.

The three-day visit by the then Indian Prime Minister to Russia in March 1997 was another milestone in Indo-Russian relations. Both sides agreed to hold annual summits. India was the only country with which Russia signed this type of bilateral defence cooperation programme in 1994. This extension by a decade has added a new dimension to Indo-Russian relations. India and Russia decided in March 1997 to continue defence tie into the 21st century and Russia offered a new air defence system and a $10 billion military deal. During Prime Minister Primakov’s visit to New Delhi in December 1998 out of the seven agreements signed between India and Russia, the document on long-term military technical cooperation till the year 2010 is the key document. Described as "cooperation 2010 Document" it envisaged partnership in research, development and joint production of sophisticated equipment besides incorporating other defence areas. The long-term bilateral defence cooperation programme will cover such new areas naval nuclear technologies and anti-ballistic missile defence systems. This long-term MTC will enhance the joint R&D capabilities of the two countries in the production of new weapon systems.

On a visit to New Delhi in March 1999 Russian defence Minister Igor D. Sergeyev and his Indian counterpart George Fernandes signed a military cooperation agreement to train Indian defence personnel in key Russian military academies. In January 2004, Russia and India signed
nearly twenty contracts involving the provision of Russian weapons and technology.

**Indian Army**

In February, 2001 India's Defence Minister, George Fernandes and Russian Deputy Prime Minister, Ilya Klebanov had signed a defence deal that made provision for the purchase of 310 sophisticated T-90 battle tanks. The $705 million T-90 deal includes the outright purchase of 124 tanks while the remaining 186 would be partly assembled and partly produced in India. This contract also includes transfer of technology overhauling, and probable joint-manufacturing and marketing of the tank to other countries.

The T-90 battle tanks have superior mobility, better fire power and communication system and night vision capability. These tanks could fire missiles at enemy targets. In the first phase of delivery, India has got 124 tanks assembled at Uralvagonzavod in the Russian city of Nizhny Tagil and the remaining 186 in semi and completely knocked-down conditions will be assembled in India at the heavy vehicle factory in Awadi in Tamilnadu. For this purpose, 40 Indian experts will be trained in Nizhny Tagil in the art of assembling T-90 components. The same visit finalized two other agreements one involved technology transfer and manufacturing of Main Battle Tanks in India, and the other envisaged production of weapon systems of these tanks. The missiles of the tanks will be procured in knocked down condition to be assembled by Bharat Dynamics in India.
The Indian army is negotiating the purchase of 155 mm self-propelled guns (SPGs). The Indian army intends to mount the 155 mm guns on the chassis of the T-72 tanks. However, the user trials of these tanks have not been very successful so far. Negotiations are also on for the purchase of Russia's newest T-90C tanks.

Indian Air Force (IAF)

The IAF is significantly upgrading its strike capability. In 1994 it purchased ten MiG-29 aircraft from Russia to replace aging craft in the existing fleet. Fifty-four of these have been targeted for upgrading. The aircraft have already been delivered, and their assembly plus overhaul of the existing fleet, are being undertaken at various Hindustan Aeronautic Laboratories (HAL) across the country. The IAF ordered forty Sukhoi-30 MK aircraft from Russia in 1996. Eight of these have already been delivered, with the remainder to be delivered by 2008. These planes are being delivered to HAL as components and assembled by HAL personnel, giving them much-needed experience in handling future repairs or upgrading. Negotiations are on for future production of these aircraft under license. Indian scientists are working with their counterparts in Russian design and production facilities, most notably in the area of avionics (for example, the Mission Computer). This exercise is remarkably similar to the systematic collaboration between India and the United States, including on the mission computer, on the light combat aircraft that is being built by the Aeronautical Development Establishment (ADE) at Bangalore. Although up grading the Su aircraft will be an ongoing process, the last eight to be supplied will meet the specifications desired by the Indian
side. These, to be classified as SU-30 MK-I, will then serve as the benchmark, with the previous thirty-two to be retrofitted to come up to their specifications.

In 1995, India ordered 150 MiG-21 BIS aircraft from Russia. This attack aircraft is completely designed by Russia, and Indian input has not yet been agreed on. Russia has recently delivered two of the prototypes to the HAL unit in Bangalore where work on its upgrading and flight testing will commence soon. Russia is to transfer the technology to the HAL unit where future assembly/production is to take place. Russia is designing the weaponry onboard the MiG-21 BIS to Indian specifications, but the chaff dispensers that the craft carries, have been supplied by Israel.

The two sides agreed in summer 1998 that India would receive the Russian Advanced Jet Trainer (AJT), also called the MIG-AT. This deal includes transfer of technology, with production to commence in 1998. The negotiated price for this trainer is almost 50 percent of that quoted for the British Hawk. The deal is even more attractive because the IAF is badly in need of more AJTs. In the current decade, accidents have increased dramatically because the IAF lacks enough good training crafts. With pilots training to fly "fourth-generation" aircraft, good-quality AJTs are particularly valuable. The inertial guidance system and the engine and ring laser gyros for the AJTs are being supplied by France.

Work on upgrading India's fleet of MiG-27 aircraft has begun in earnest at HAL units around the country. This upgradation will receive beneficial spin-offs from the indigenous pool of research conducted for the light combat aircraft (LCA) that India is building. This is particularly relevant in the electronics segment (such as electronic warfare, signal
jamming, communications, and identification of friend or foe). It is noteworthy that keeping the MiG-27 fleet at its fighting best is a priority for the IAF, at least until all the SU-30S are delivered, assembled, flight tested, and inducted into the force. The timeline before the LCA can enter into service is even more extended. The indigenous R&D generated from the three premier projects—the LCA, the main battle tank (Arjun), and the ballistic missile programs (under the Integrated Guided Missile Development Program) - are projected to produce a pool of generic technologies that will considerably augment force modernization objectives. This will be applicable to not only the three projects mentioned above but for many other projects. Thus, the MiG-27s are expected to constitute the bulk of attack aircraft at the disposal of the IAF. Further, India is reported to be negotiating the purchase of a variation of the MiG-29 (called the MiG-29 SMT), which has yet to be inducted into the Russian air force.

In addition, the two sides have reached an agreement on the lease of four Tu-22 Backfire bombers, a maritime reconnaissance and strike aircraft fitted with 300 km range air-to-ground missiles and capable of flying at three times the speed of sound. Moscow has agreed to upgrade the Pechora ground-to-air missile systems' supply S-300 anti-missiles, the Smerch multiple rocket launchers, license production of SU-30 MKI fighters and Kilo and Amur class submarines, lease out A-50 Airborne Warning and Control System (AWACS) and Tu-22 AM3 strategic bombers (which have not been supplied to any other country so far), Mig 29K multi role fighters for aircraft carrier 'Admiral Gorshkov' (which will enhance India's capability to defend high-value assets, such as, oil terminals, industrial centers and nuclear power stations along the coastline.
On December 27, 2000 India and Russia finally signed the single largest arms deal the Su-30 MKI will be manufactured in India with Russian assistance. This means complete transfer of technology to India. This Indo-Russian Sukhoi deal is the single largest defence deal ever signed by Russia with any foreign country. Under this deal, 150 Su-30 MKIs will be manufactured in India, including indigenous production of all the components over a period of the next two decades. The Su-30 MKI will have onboard avionics and other support systems developing by India and also equipment from countries like France, Israel, South Africa, and the United Kingdom.  

The Indian Air Force has also procured the first batch of a fleet of multifunctional Sukhoi-30MKI fighter aircrafts. The official ceremony for induction of these aircrafts was held on 27 September, 2000 at Lohagaon air base near Pune. Considered to be the most advanced fighter plane in the world, Sukhoi-30MKI is, armed with newest air-to-air missiles, air surface missile system, state of the art avionics and phased array radar. Its Al-31 FP engine, featuring thrust vector control capability, makes it a formidable aircraft, provides the fighter in it with unbeatable maneuverability and substantial combat efficiency. Negotiations are going on with Ilyushins Aviation Complex, Irkutsk Aviation association, Hindustan Aeronautics Limited and Roseboro export for making multi-role transport aircraft. It was reported in the Russian press that India had signed a deal worth $ 3.3 billion for procuring six IL-78 tanker aircraft and 140 fighters of Sukhoi modifications in 2003.  

The Air Force requires tanker aircraft to enhance the range and capabilities of deep-penetration fighter aircraft like the, Su-30MKI,
Mirage-2000 and MIG-29. This mid air-to-air refueling will enhance the lethal power of the aircraft by keeping them much longer in the air. The IAF has received four of forty Mil MI-17-IV transport helicopters ordered for $170 million earlier this year. It is expected that all forty helicopters will have 12 Vikhr-M (AT-16) medium range air-to-surface missiles. This laser guided weapon has a maximum range of around 10 km.

**Indian Navy**

The naval component of India's armed forces had not played a very significant part in the four armed conflicts of the past. The domestic strategic community has been seeking to correct this imbalance and be prepared to deliver a "three-way punch" in the event of another war. A review of Indian naval build-up since the 1970S demonstrates that the navy has been engaged in serious "perspective planning" since it has had the luxury of not being expected to play a critical role in any armed conflict in the short run.

Indeed, of the three services, it is the Indian navy that has been most successful in pursuing developmental targets, by enhancing its strike power, maritime surveillance, and sealift capabilities. It has been particularly successful in indigenous efforts at modifying and upgrading diverse imported hardware and technology to suit domestic needs. This is of crucial significance to the defense community because experts have increasingly concluded that the future of deterrence is likely to be seabased. In other words, a country's ability to conduct warfare, whether employing weapons of mass destruction (WMDs) or advanced
conventional weapons, would be greatly augmented if its navy is able to successfully execute these missions.

It is in this context that one should perceive Indian naval build-up and Russia's collaboration in it. India has ordered two kilo-class submarines from Russia, and negotiations are under way to purchase Krivak III frigates as well. The navy will require $75 million for medium-term refits of the kilo-class submarines, with the work to be done in St. Petersburg, Russia. In addition, it needs another $50 million to upgrade four Foxtrot class submarines that it purchased from Russia.

The navy is finalizing negotiations with Russia for the purchase of six Ilyushin-78 planes, beginning with the delivery of two. (24) Two or three of these planes are expected to provide air-to-air refueling facilities for the front-line aircraft, including the LCA. (25) The remainder are expected to provide the platform for an airborne warning and control system (AWACS) by mounting a rotor dome on the Ilyushins, and the onboard radar, with 360-degree coverage, to provide on-site intelligence. The radar has been indigenously produced, and the problem surrounding its miniaturization is expected to be resolved soon with active Israeli help. The rotor dome has undergone successful experimental testing on the Avro aircraft and soon will be mounted atop the 11-78s.

Providing refueling or serving as AWACS platform are mutually exclusive functions given the space constraints on board the craft. Acquisition of the Dlyushin and induction into their respective roles will tremendously enhance Indian capability to conduct both intrusive surveillance and deep strikes of strategic Pakistani territory. By almost
any estimate, recent naval purchases are to be regarded as major force multipliers.

From the navy's long "wish-list" from Russia, another item of special significance is the Admiral Gorshkov. Built in 1984 and decommissioned in 1995, this aircraft carrier is being overhauled for the Indian navy, and there have been reports that a modification of the MiG-29, called the MiG-29 SMT, has been tested for operating off the Gorshkov.^9 Russia will upgrade the Admiral Gorshkov aircraft carrier and deliver it to India by '08. Gorshkov will give the Indian navy the capacity to put a carrier task force within the range of China. India will pay Russia only for the 20-year-old carrier's refurbishment, which will cost around $650 million, plus an additional $730 million for sixteen MiG-29 jet fighters and eight Ka-27 and Ka-31 naval helicopters. There has been considerable speculation about two "side deals" being covertly negotiated along with the Admiral Gorshkov package, both of which are probably related to New Delhi's ambitions as a nuclear power. India has shown considerable interest in leasing Akula-II class nuclear powered submarines from Russia as well as four TU-22 long-range bombers.

While both these pieces of hardware are capable of carrying and delivering nuclear weapons, New Delhi appears far more interested in the submarines. These highly sophisticated machines are difficult to detect, can remain under water for extended periods and-in the eyes of some members of the defense establishment-will enable India to have an effective sea-based nuclear deterrent. Both India and Russia claim that leasing Akula would not violate the provisions of the nuclear
nnonproliferation treaty, which they interpret as covering only nuclear weapons technology and not nuclear-powered submarines.

India is also reported to be negotiating the purchase of the Russian Kamovv (aka Black Shark). This is a highly sophisticated antisubmarine or submarine-hunting device that sends out deep sonar to accurately determine the location of an enemy submarine and eliminate it. There are unconfirmed reports that Russia is assisting Indian scientists in improving the accuracy of the underwater stage of the launch of its submarine-launched ballistic missile Sagarika. These two would significantly upgrade Indian naval capacity to safeguard its territorial waters and patrol the region beyond.

India has broached the subject about the possibility of leasing two Russians nuclear submarines but is evident that any progress on this will have to be within the parameters of Moscow's commitment to the various nonproliferation mechanisms it is a party to. Just before coming to India, Putin had visited a suburban city, Reutovo, near Moscow, where a supersonic anti-ship Brahmos cruise missile is being jointly developed at a mechanical engineering research and production association. This is the most modern naval cruise missile. The second successful test launch of it had taken place in Chandipur in April, 2002 13 and the missile would now be ready for induction to the Indian Navy. In August, 2002, Chief of the Indian Navy, Admiral Madhvendra Singh visited the Baltic wharf in St. Petersburg and supervised the manufacture of, 'latwar and 'Tabar' frigates, specially made for the Indian Navy. Admiral Singh also met the crew of the Trishul frigate, who are undergoing shop performance trial in the Baltic wharf. Trishul will be tested in the Gulf of Finland. In addition
to Sindhuvir and Sindhughos submarines, currently operational in the Indian Navy, India will be provided with another Submarine called Sindhurstana. This will be a diesel-electric submarine with upgraded features. In addition, the Navy is also acquiring three Krivak-class frigates (Project 1135.6) from Russia, which will be used for Anti-Submarine Warfare (ASW) operations. They will have a speed of 30-32 knots and a range of 4000 nm range at 14 knots. These vessels are fitted with SSM-Novator Alfa Klub missiles with a range of 300 kms. Besides these, the New Delhi class missile destroyer is exclusively fitted with Russian weaponry and sensors. These include SSM Zvezda missiles with a range of 130 kms and Gadfly with a range of 25 kms and the associated weapon designation system.

Russian armaments and military hardware are the most competitive in today's world market. The combat characteristic are in no way inferior to the armaments and military hardware being sold by the West. The combat aircraft of Su and MIG family are known in the world for their unique flight characteristics. Diesel electric submarines of the 877EKM and 636 models are in great demand. 'Smerch' multi-launch fire systems, 'BMP-3' infantry combat vehicles, 'T-80U' and 'T-90S' tanks, air-defence systems 'S-300PMU-1 "S-300-V" 'Buk-M-1', 'Tunguska self-propelled SAMs' and 'Igla' are in good demand in the international arms market. The achievements of the Russian defence industries are impressive. After the break up of the Soviet Union, the steady recovery of the defence industries is noteworthy. Full cooperation and joint control has created a solution for the defence enterprises to present the latest equipment and technology in time to its customers in a competitive future.
More attention is to be given to conversion, modification and maintenance. Engineering support services are to be offered in a responsible way to the customers. Russian defence industries are meeting the challenge of the 21st century by delivering the latest combat hardware to their customers.\textsuperscript{11}

The reason for Russian interest is clear. Russian military-industry complexes were in great need for funds. Despite the initial problems faced by the breakup of the Soviet Republics and dispersion of some defense industry, Russia revived the possibility of renegotiating defense contracts and the contracts on rocket and nuclear power technology.

Indian military and defence orders now sustain many defence industries in Russia, especially in St. Petersburg and Irkutsk which would otherwise have faced closure at the time of transition in the Russian economy. India buys more hardware from the Russian defense industry than Russia's own military forces. Estimates show that about eight hundred Russian defense production facilities are kept in operation by Indian defense contracts. The signing of a ten-year Indo-Russian agreement on military-technical cooperation, worth $15 billion, in the aftermath of the Pokhran II tests is an example of this trend. In this sense it can be assumed that at the very least up to 2010, when aging begins of the most advanced Russian models already existing (SU-30MK and SU-35/37, T-90S tank, Mi-28 and Ka-50/52 attack helicopters), Russia can count on preserving a stable Indian demand for relatively large lots of arms and for their manufacturing technology.
The military cooperation between the two countries has now been developing steadily. Russia has been helping India to upgrade its 170 MiG-21 fighters to keep them combat-worthy well into the next century. In July 1994, both countries agreed to set up a joint venture company, Indo-Russia-aviation Private Ltd., in India, with an equity base of $400 million: it would manufacture spare parts for military aircraft of Russian origin. India would be the first country outside Russia to offer maintenance facilities for Russian aircraft on a commercial basis. According to an agreement between Russia and Malaysia in June 1994, Malaysian pilots would be trained in India to fly the MiG-29s which were bought by Malaysia from Russia. India and Russia have jointly been working on many other military related projects.

In the era of intense competition in the international arms market which has been dominated by the United States-Russian defence companies are seeking to supply any armaments from basic to the highly sophisticated ones and many developing countries see Russia as a source for their military equipment. The stress on arms exports is taking place in conditions where the macroeconomic situation is grim. Russia requires hard economic reforms for its growth. The government is committed to radical economic reforms aimed at integrating Russia to the global economy. Developing new armaments through joint collaboration with other countries is a salient feature of the present day corporate policy.

In order to maintain the momentum in arms cooperation, Moscow and New Delhi have been steadily advancing their military cooperation to areas like joint research, development, and co-production. For example, they jointly developed and successfully launched the Brahmos cruise
missile. India is collaborating with Russia on joint production of a fifth-generation fighter that Russia feels is vital to its military future. More broadly, India is the only country collaborating with Russia on joint production of sophisticated and futuristic weapons systems. Moscow is concerned that it will be gradually ceding some of its traditional or potential weapons markets to India as a result of such collaboration. There has been a qualitative change in terms of reference of Russia-India military and technical cooperation. During the Soviet era, this cooperation was characterized by a cash-and-carry procedure catalyzed through concessional credit arrangements. A smooth transition has taken place and now, military and technological cooperation is rooted in joint long-term programmes of research and development and joint production projects between the military and industrial organisations of the two countries. Transfer of technologies and licenses for the production of sophisticated military equipment like the T-90 main battle tank and the SU-30 MK-I fighters are examples of this transition. Such cooperation extends to supersonic anti-ship cruise missiles like the Brahmos.

It is pertinent to mention here that Russia sees the proposed privatisation of the Indian defence industry as a welcome chance for its arms manufacturers to consolidate their foothold in the Indian market. "The Russian weapons industry is ready to look into opportunities for investment in the Indian defence sector," said Viktor Komardin, deputy chief of the Russian arms exporting monopoly, Roseboro export on 17 February 2002. This shows that integration of the Indian and Russian defence industries would be in line with the current shift from the buyer-seller relationship to joint development and production of new weapon systems. "We have joint R&D projects with India in almost all
types of military hardware," Mr. Komardin said, citing as examples the Brahmos cruise missile, built last year, and a medium-haul transport aircraft, to be developed jointly on the lines of the Russian built 11-214 planes. Top defence factory managers of Russian have been visiting India, to examine strategic partnership with India." We take interest in the privatisation of India's defence plants," said Mr. Vladimir Korenkov, General Director of the Bazalt factory, Russia's leading manufacturer of unguided munitions.

Indian experts on Russia on the basis of research work seem to have come to the conclusion that the United States and other Western countries have yet to get over their old assessments about the Soviet Union and the pre-Soviet era. Above all, all said and done Russia continues to be a major military power and its nuclear and space technology cannot be ignored. Therefore, even after the disintegration of the Soviet Union, militarily Russia continues to be a superpower in the area of defence cooperation, the relations between India and Russia are being upgraded. Long-term military and technical cooperation agreement till 2010 has already been signed between the two countries. This agreement was signed in December 1998. This agreement if implemented may have a far reaching significant both for regional security and international stability. This agreement should be assessed in the context of rise of terrorism, secessionism and ethnic conflicts. India understands the need for the Russian defence industry to survive. It wants to deal with the manufacturer directly, not through any agencies. Joint venture and joint development between India and Russia is the need of the hour, which will progressively help in technology development in both the countries. Costing and pricing mechanism is still in the process of being
developed. Inconsistency in the pricing system of the equipment is a matter of serious concern for India. Friendship prices are no longer available and hence, there are prolonged negotiations on the Gorshkov and T-90 deals with Russia. Russia has accorded 'most favored nation' status to India as far as prices go. For the first-time a price list has been finalized.

**Space Cooperation**

Indian and Russia have collaborated in space in a major way. Even before the late Kalpana Chawla ventured into space aboard the American space shuttle the 'Challenger'. Sqdn leader Rakesh Sharma of the Indian Air Force went into a manned mission in space on the 'Cosmos' rocket and docked with the space station 'Mir' in 1984. The flight of Sqdn Ldr Rakesh Sharma, the first Indian in space, was from the Salyut Space Station in the USSR.

Peaceful exploitation and use of outer Space is a traditionally important area of cooperation between India and Russia from the beginning. India has had extensive cooperation in space with the former USSR. The Soviet side assisted India in the setting up of the Thumba Equatorial Rocket Launching Station and India’s first generation experimental satellites Aryabhata, Bhaskara 1 and Bhaskara 2. The Indian remote sensing satellites IRS-1A, IRS1-B were launched by Soviet launch Cosmodrome in the 70's and 80's.

Among the high points for cooperation was the joint space flight in 1984. Since then, India has built very substantial launch capabilities of its own as demonstrated in the Polar, and Geo-stationary Satellite Launch
Vehicle (PSLV) and (GSLV). Russian cryogenic engines were an important element in the third stage of the latest and largest launch vehicle (GSLV). In April 1993 the Russian space company GLANNOSS tied to supply four cryogenic liquid fuelled engines for the Geosynchronous Satellite Launch Vehicle (GSLV) of the Indian Space Research Organisation (ISRO).

It was in the atmosphere of uncertain Russian foreign Policy objectives that the post-cold war relations between Russia and India were further strained by two events. The first of these destabilizing events centered around a contract dispute between the Russian space Directorate "GLAVNOSS" and the government of India or the purchase of cryogenic engines and the related technology. The contract, signed on 18 Jan, 1991, stemmed from India’s desire to gain knowledge of the liquid oxygen propulsion system of Russian cryogenic engines in order to advance India’s geo-synchronous satellite launch Vehicle (GSLV) program, if produced indigenously and without Russian assistance, the project was forecast to require fifteen years until it would be operational. For Glavnoss the $ 250 million dollar would provide crucial funds during a period of tremendous reductions in Russian defence expenditures.

Over the next two years, the united states projected the proposed transfer of missile and technology to India on two grounds that the sale would violate the April 1987 Missile Technology control Regime (M.T.C.R.) the growing threat of missile proliferation became well known to the united states following the Iraqi scud missile attacks during the gulf war and the testing of India’s IRBM missile AGNI in 1989 from the Indian and Russian perspective, the cryogenic engine deal was legal
under the MTCR, on the grounds that the treaty did not block the support of "peaceful space ventures" further more India asserted that US attempts to block the sale were financially motivated since General Dynamics and the French space boosters manufacturer Arianespace had both been outbid by GLAVNOSS. Washington at that time wanted India to buy the expensive ($800,000) engines from the company General Dynamics. When ISRO opted for the cheaper ($300,000) engines the US sought to impose sanctions on both ISRO and GLAVNOSS. These sanctions were imposed under the US domestic law of the Missile Technology Control Act (MTCA).Washington and Moscow are members of the Missile Technology Control Regime (MTCR) created in 1987.

The Cryogenic Deal

A high point of Yelstin's trip as underscored by the media and the man himself, were repeated assurances to India regarding Russia's commitment to the supply of cryogenic engines and the transfer of their technology to India. The issue had already hit the public eye with the controversy generated by earlier US attempts to squash the deal.

The cryogenic deal threw up certain crucial issues. It drew attention to the (decreasing) independence capability factor in Russia's foreign policy-making. It highlighted the growing power status of the US, leading it to indulge in international arms twisting. It also exhibited US nonchalance regarding India's sensitivities, profiling the low priority it attached to Indo-US relations.

Speaking at the meeting with Indian businessmen, President Yelstin declared, "We do not want to be led by others. If two great states
such as Russia and India have signed an agreement on supply of
cryogenic engines from Russia to India and some third party would like
to disrupt it, then this third party is making mistake. It will not come in
our way. We will deliver these engines. "Yeltsin's statement at the press
conference referred to his assurance to the Indian Prime Minister that "the
agreement that we had signed on the delivery of cryogenic engines,
despite pressures from third countries, will be unconditionally complied
with by us. "At the same conference, on being questioned about Russia's
seriousness. He reiterated that Russia would fulfill the agreement and
said, "We would lose our face in the world if we default on this." As for
the possible measures that the United States might take, that is a matter of
common sense and sensibility in the US. We already had some
discussions with President Clinton... yet Russia will not default on its
obligations."

However, loss of face was exactly what Russia had to counter
within a mere six months of these grandiose statements. The pressures
exerted by the US proved too severe. Amidst much criticism from within
and without, Russia was seen to buckle to US exhortations settling for
paltry promises. This apparent backtracking generated much criticism and
controversy leading to an expected tepidity in Indo-Russian relations.
Nevertheless, events preceding and following the formal announcement
by Russia were both curious and extraordinary in terms of diplomacy and
its practice.

Despite his categorical assurance in India that the Cryogenic deal
would continue, in June 1993 on the occasion of the G-7 meeting in
Tokyo, President Yeltsin succumbed to the US pressure on the issue. The
scaling down of the deal under obvious US pressure was a big blow to the Russian prestige and position as an independent great power. The promise of president Yeltsin was compromised, however after the United States applied sanctions in May 1992, and threatened further economic measures. On 16 July 1993, Boris Yeltsin agreed to suspend the transaction and to alter the nature of the transfer to the sale of only the cryogenic engines and not the technology. In exchange, Glavnoss was given bidding rights on over $ 950 million worth of future US space projects.

However both Russia and India slowed the necessary maturity and resilience and did not permit the scaling down of Cryogenic deal to permanently tarnish their bilateral relation. It was agreed between the two countries that those elements of technology that could be used for dual purposes may not be transferred, but the technology not considered would be transferred. Russia also agreed to compensate India by supplying two additional rocket engines. The Agreement on the supply of cryogenic engines from Russia is being not very satisfactorily implemented.12

While the ability of India to indigenously produce G.S.L.Vs and ICBMs were delayed by several years due to the cancellation of the original cryogenic deal, the main concern in New Delhi was that the Yeltsin government had given into western pressure.

Indo Russian relations in space technology have thus withstood the constraints of iniquitous MTCR regime that seeks deny technology to countries outside industrialized west. Washington's obsession with missile proliferation has thwarted Moscow's attempts to collaborate in
Space with India. The signing of the agreement on space cooperation highlights the fact that the transformation of the Glavnoe agreement on supply of cryogenic engine technology to the Indian Space and Research Organisation (ISRO) under US pressure has not been allowed to disrupt the broad cooperation between the two countries on civilian space research.

An Interagency Memorandum of Understanding on Space Cooperation was signed during the visit of the Prime Minister of India to Moscow in November 2003. During the visit of President Putin to India in December 2004, the following two bilateral documents were signed:

(i) Agreement on cooperation in the study and use of space for peaceful purposes,

(ii) Agreement on long-term cooperation in joint development and use of the Russian global navigation satellite system (GLONASS) and launching Russian GLONASS spacecraft by Indian rockets for peaceful purposes.

The protocol signed by Anatoly Perminov of the Russian Federal Space Agency and ISRO Chairman Gopalan Madhavan Nair with President Vladimir Putin and Indian Prime Minister Manmohan Singh in attendance. Nair and Perminov discussed the prospects for the restoration and joint use of the global satellite network for navigation (GLONASS) and the possibility of launching Russian spacecraft on Indian-made space launch vehicles, FSA spokesman Vyacheslav Davidenko said. The cooperation in the area also provides for joint development of new-generation navigation satellites and end-user equipment, stressed
Davidenko. Possible options of sending Russian experts to India and Indian experts to Russian companies were also discussed. Russian Defense Minister Sergei Ivanov, in India, said that Moscow and New Delhi had agreed to launch Glonass-M satellites with the help of Indian booster rockets, and to create new-generation navigation satellites and end user equipment.

India and Russia are also exploring the possibility of developing equipment of Earth probes, joint research in the area of Electric engines for spacecraft, and joint projects for probing lunar surface and building a space based solar observatory to study x-ray radiation. Russia has also indicated its desire to join India’s chandayen lunar project.

Glonass, a Russian version of the U.S. Global Positioning System (GPS), is designed for both military and civilian purposes, and allows users to identify their positions in real time. It can also be used in geological prospecting.

The first launch under the Glonass program took place October 12, 1982, but the system was only formally launched September 24, 1993. Andrei Kozlov, the head of the Reshetnev Research and Production Center in the Siberian city of Krasnoyarsk, Russia’s leading spacecraft manufacturer, said earlier the Glonass system currently has 13 satellites in orbit. The space segment of the Russian system currently comprises 16 satellites in three orbital planes which will be expanded to 24. The agency plans to have 18 satellites in orbit by late 2007 or early 2008, and a full orbital group of 24 satellites by the end of 2011. There are three spare satellites. Under a Russia-India joint venture, India will launch two
GLONASS-M satellites on its GSLV platforms and undertake to share costs of developing the K-series. This was inked at the December 2005 summit between PM Manmohan Singh and Russian president Vladimir Putin. Russia's global space navigation system Glonass can now be used by India in the military-technical sector. India will now be able to access the constellation of active satellites which transmit coded signals in two frequency bands. India's search for a GPS system had seen it engage in negotiations with the European project Galileo, but the deal had run into security concerns. Indian negotiators were not satisfied that the information accessible on the proposed system was adequately fire walled against individuals and possible military users. China is also part of Galileo.

GLONASS availability in Russia is around 50% and globally at 39.8% which means that at least four satellites were visible 39.8% of the time from everywhere on Earth. The three orbital planes are separated 120 degrees and each satellite traverses an orbit of 19, OOO-odd km.

The satellites currently in use are of two modifications - Glonass and its updated version Glonass-M. Glonass-M has a longer service life of seven years and is equipped with updated antenna feeder systems and an additional navigation frequency for civilian users. A future modification, Glonass-K, is an entirely new model based on a non-pressurized platform, standardized to the specifications of the previous models' platform, Glonass-Ks' estimated service life has been increased to 10-12 years, and a third "civilian" L-range frequency has been added. Tests on Glonass-K satellites are scheduled for 2007.
In December 2005, President Vladimir Putin ordered that the system be ready by 2008, and deputy prime minister Ivanov said Glonass would be available to domestic users for military as well civilian purposes by the end of 2007. Perminov said earlier that Russia is also in talks with the United States and the European Space Agency to prepare agreements on the use of Glonass jointly with the GPS and Galileo satellite navigation systems.

**Indo-Russian Nuclear Co-operation**

The Indo-Soviet co-operation for the peaceful uses of atomic energy came to the front in September 1976 when Soviet heavy water was supplied to the second unit of the Rajasthan Atomic Power Station (RAPS II) in lieu of Canada stopping all supplies of heavy water because India had conducted a peaceful nuclear explosive in May 1974. The agreement with the Soviet Union took two years to negotiate as Moscow was insisting on stringent safeguards to ensure that there was no clandestine diversion to non peaceful activity. This in spite of Moscow endorsing in May 1974 the conduct of a peaceful nuclear explosion by India.

President Vladimir Putin's visit to New Delhi in October the year 2000 led to an agreement on Indo-Russian co-operation in the peaceful uses of atomic energy. The earlier agreement with the Soviet Union for the supply of giant atomic power plants with a capacity of 1000 Mw. at Kudankulam, TamilNadu had been signed in May 1988. The Inter-Governmental Agreement on the project was signed on Nov. 20, 1988 by Prime Minister Rajiv Gandhi and Soviet President Mikhail Gorbachev.
The project remained in limits for 10 years. On June 21, 1998 a supplementary agreement was signed by Russian Minister for atomic energy Yevgeny Adamov and India's Atomic Energy commission Chairman Dr. R. Chidambaram.

However, the collapse of Soviet Union in 1991 had delayed the implementation of the agreement. Also wrangles over costs to be paid in foreign exchange and American objections raised after the Gulf war in 1992 greatly delayed implementation of the agreement negotiations with India's Atomic Energy Commission on the renewal of cooperation were carried out in 1993-94. A number of changes concerning the structure of cooperation and the provision of government credits were made to the text of the agreement. In particular, the draft Supplement to the 1998 Agreement provides for changed conditions of cooperation (technical assistance instead of construction on a turnkey basis), as well as modification of the conditions for the granting and repaying of government credits.

After several rounds of negotiations, which took place in 1995-1998, the parties agreed to the Supplement to the Intergovernmental Agreement of November 20, 1988. This supplement was signed by Russia (the Ministry of Atomic Energy) and India (the Atomic Energy Commission) on June 21, 1998.

In order to fulfill the Intergovernmental Agreement, on July 20, 1998, the Contract for a Design Study of the Kudankulam NPP was signed. The contract, between the Nuclear Power Corporation of India (NPCIL) and Russia's Atomstroy export, entered into force in March
1999. During Indian Prime Minister Atal Bihari Vajpayee's November 5-6, 2001 visit to Moscow, Russian Minister of Atomic Energy Aleksandr Rumyansev and Secretary of India's Department of Atomic Energy and Chairman of the Indian Atomic Energy Commission Dr. Anil Kakodkar signed a Memorandum of Understanding regarding construction of the Kudankulam NPP. At the same time, on November 6, 2001, Atomstroy export and the Nuclear Power Corporation Of India signed a General Framework Agreement on the Construction of the Kudankulam NPP (Units 1 and 2). The agreement determined the Russian deliveries and services, the parties' mutual obligations, and the schedule for facility construction (68 months from the date concrete is first poured in the foundation of Unit 1).

The successor state of Soviet Union- The Russian Federation has continued this co-operation and as a result four units are now in place at RAPS and the last of them has attained criticality only recently in October 2000.

On September 29, 2000 prior to the visit of President Putin, Mr. Reshenikov, the Russian Deputy Minister for Atomic Energy pushed a nuclear fuel bundle of natural minimum into the fuel vault of the fourth reactor at RAPS. In the third week of October the reactor was expected to reach 'criticality' and generate electrical power.

The Russian delegation with Mr. Reshenikov included some of the world's best nuclear scientists and technologists. Their arrival ahead of President Putin was significant. Nuclear co-operation in the peaceful uses of atomic energy was firmed up. After the visit to RAPS Reshenikov
made it clear that four more units of the VVER type reactors of 1000 Mw capacity would be set up at Kudankulam. He remarked that from the economic point of view it is viable to have four units at the same site if not six.15

India and Russia have thus entered a new phase of nuclear cooperation. India's desire to increase the number of reactor units at the Kudankulam NPP was voiced during Indian Prime Minister Atal Bihari Vajpayee's visits to Russia in 2001 and 2003. The construction of the Kudankulam reactors with the help of the Russian Federation would improve electricity generation and availability.

Under the first agreement Kudankulam was to be a turn key project with the NPC providing the site. The then USSR was to provide the design of the VVER 1000 type pressurized water reactor (PWR). It would also bring the fuel, equipments, components and spares and build the reactors. Under the supplementary agreement which is a technical one Russia will give the NPC the design and bring most of the equipment whilst the NPC will build the two reactors. Russian will also supply the enriched uranium fuel for the life of the reactors. Unlike the RAPS, light water will be the moderator.

Dr. Malyshev was in charge of the overall design of 1000 Mw reactors' Malyshev has opined that the VVER 1000 type reactors planned for Kudankulam would have additional safety features compared to the prototype made in Bulgaria. Russian nuclear power stations rank third in terms of safety after Japan and Germany, Russia was building two VVER type reactors in Iran and China also.
A major feature of President Putin's visit to India was his trip to the
Bhabha Atomic Research Centre (BARC) at Trombay, Mumbai on Oct.
5, 2000. This was indeed a significant development. It signals the support
of a major head of state towards the strengthening of Indo-Russian
relations. However, there were some points of divergence between New
Delhi and Moscow of today on the politics of nuclear non-proliferation.
Russian President Putin urged India to sign the comprehensive Test Ban
Treaty (CTBT). India has in any case stopped further nuclear testing since
May 1998. Putin made his plea on the CTBT in a meeting with scientists
of the Bhabha Atomic Research Centre. He did however, appreciate the
Indian stand that its natural interests and the needs of its people should
also be considered. Yet Putin felt it would be better for India if it were to
sign the CTBT. 16

The Russian federation, the successor state of the Soviet Union
continues to be a member of the NPT regime as also a member of the
nuclear suppliers group (NSG). The NSG is concerned with nations that
export nuclear technology to countries outside the NPT framework also.

At the April 3, 1992 meeting of the 35 nations that constituted the
NSG, it was decided that as a consequence of Iraq attempting to develop
nuclear weapons at was necessary to strengthen the safeguards system so
as to prevent any more new nuclear states from engaging in clandestine
non-peaceful activity. They decided to adopt full scope safeguards that
would be "triggered" on all nuclear facilities of a country that wished to
import nuclear technology from a state that is a member of the NSG.
Russia at that time refused to comply with the comprehensive safeguards system proposed by the NSG members—even though its predecessor the Soviet Union may have been a party to it at The Hague meeting in 1991.  

In 1998 India became a de facto nuclear weapons state. It considers these weapons to be a critical factor in maintaining nuclear deterrence and national security. Indian leaders have declared repeatedly that they will not abandon the nuclear option. Yet even in this situation there is obvious competition between the leading nuclear suppliers, who find themselves in exactly the same position as Russia India as a non-signatory to the NPT has resisted all attempts to impose "full scope" safeguards on its nuclear activities. Russia was able to pursue the Kudankulam agreement without insisting on full scope safeguards since the NSG guidelines allowed for limited safeguards that applied to the plant transferred alone.

The relevant paragraph in the NSG guidelines dealing with safeguards [(Para 4 (a) INFCIRC/254] Rev 4 [Part 1] states: "Suppliers' should transfer trigger list items or related technology to a non-nuclear weapon state only when the receiving state has brought into force an agreement with the IAEA requiring the application of safeguards on all source and special fissionable material in its current and future peaceful activities".

It is important to bear in mind that the NSG guidelines are to implemented by each NSG member in accordance with its national laws and practices. Decision on export applications are taken at the national
level in accordance with national export licensing requirements. Also the NSG guidelines do not mention anywhere the NPT and hence do not define what is meant by a nuclear weapon or non-nuclear weapon state.

The Russian laws do not define anywhere in their national legislation what is meant by a nuclear weapons state. In fact it is the US alone where the domestic legislation the Nuclear Nonproliferation Act of 1978 and 1994 defines states according to the NPT regime.

There is in the present era division between Moscow and New Delhi on nuclear non-proliferation and arms control issues.

Russia and China are two major powers who are both members of the UN Security Council as also a member of the NPT regime. Their strategic cooperation on military and nuclear issues is necessitated by the need to reduce tensions and concentrate on economic development, Russia would also favor the emergence of a Russia- India-China triangulation of co-operation. The idea has as yet to take shape because neither India nor China would like to be freed from the bilateral arrangement that presently exists with the lone superpower the United States.

It is unrealistic to expect the triad of these countries to discuss the sensitive nuclear issues. In any case Russia was party to the Resolution 1172 passed by a committee of the UN Security Council which called on India to desist from further nuclear testing and immediately sign the CTBT.
Also China favors India's adversary Pakistan as a strategic partner and New Delhi has often enough cited China as a "threat". At another level, it must be pointed that the United States as a unipolar power has sought to object before the nuclear suppliers group to any further Indo-Russian nuclear co-operation in the peaceful uses of atomic energy. In March this year, the Russian Minister of Atomic Energy (Mina tom) Mr. Yevgeny Adamov announced that Russia planned to export five more nuclear reactors to India. As was mentioned earlier in 1992 the NSG had changed its rules in response to the 1991 Gulf War and had decreed that no member state including Russia could supply any nuclear equipment on NSG's list to any non-nuclear weapons state unless all its activities are subject to IAEA's full scope safeguards. This meant that the US in talks with Russia in Moscow held that Russia was barred from selling nuclear reactors to India which was not a party to the NPT.

When the Russian Federation resuscitated the original May 1988 deal with India after the collapse of the Soviet Union, it had argued that Minato's arrangement to sell two VVER reactors to India was covered by an Indo-Soviet bilateral co-operation pact which predated the NSG decision. The US objected to that position in bilateral talks but finally accepted the Russian position before the NSG.

But a senior US official, had said on 6 April Washington will not accept any new claims by Moscow that the Indo-Soviet nuclear accord sanctions sales of additional reactors to India. The official said that if Adamov proceeds ahead with plans to build more VVERs in India, the US would raise the issue in talks with Russian Ministry of Foreign Affairs
and also protest before the NSG that Russian plans violate NSG units. The US is categorical that the NSG would allow more VVERs to be sold to India only if it puts its entire nuclear programme under IAEA safeguards.\(^1\)

In short, then, the Indo-Russian nuclear co-operation agreement in the future would be greatly determined by how Moscow resists the US as a unipolar power in fastening its brand of western hegemony in the feud of nuclear arms control. Yet the prospects for expanding cooperation with India in the peaceful use of nuclear energy depend on the resolution of questions related to the requirements of the international nuclear weapons nonproliferation regime.

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FOOTNOTES

1. Various reports in the Indian press. It is also reported that Slovakia has been involved in the design/testing of certain components of the T-72 tanks.


3. Interview with the director and senior scientists at ADE, Bangalore, December 1997.

4. Given Russia’s resource compulsions (both human and physical), it envisages India as increasingly producing specific weapon systems at Indian locations under licensed contracts; further, it desires that India step up its role in production (of spare parts and components) and servicing of other Russian defense contracts, such as with Malaysia.

5. Chaff dispensers (electromagnetic or thermal signal-jammers, or cluster munitions) serve to confuse/intercept/destroy the target-seeking enemy missiles. The Israelis had offered to sell the entire MiG-21 package, but India declined.

6. Yaacolev, an Israeli company, reportedly has made an even more attractive offer than the Russian one to sell their AJTs. This craft is believed to be more stable aerodynamically, which could be a crucial consideration for training pilots. Details of the offer are not available.


9. Saradzhyan, "Indian Negotiation for Russian Carrier Nears Completion."

10. The submarine-launched ballistic missile Sagarika is being developed by the Integrated Guided Missile Development Program. Russian assistance to Sagarika is not acknowledged by the two countries, although it was tacitly acknowledged during an interview with a senior Russian foreign ministry official in July 1997.

12. Jyotsna Bakshi-Russian Policy towards South Asia page 1380-81, Strategic Analysis, Nov 1999


**Sukhoi Su-30MKI**

Su-30MKI In Service with the **Indian Air Force**

<table>
<thead>
<tr>
<th><strong>Type</strong></th>
<th>Air Superiority fighter, Multirole Fighter, Strike fighter, Heavy class fighter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer</strong></td>
<td><strong>Sukhoi</strong></td>
</tr>
<tr>
<td><strong>Maiden flight</strong></td>
<td>1997-07-01</td>
</tr>
<tr>
<td><strong>Introduced</strong></td>
<td>2002-09-27</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>Active service</td>
</tr>
<tr>
<td><strong>Primary user</strong></td>
<td><strong>Indian Air Force</strong></td>
</tr>
<tr>
<td><strong>Number built</strong></td>
<td>around 50 of various versions leading up to Su-30MKI, 190 planned</td>
</tr>
<tr>
<td><strong>Unit cost</strong></td>
<td>US$33-45 million</td>
</tr>
<tr>
<td><strong>Developed from</strong></td>
<td><strong>Sukhoi Su-30</strong></td>
</tr>
</tbody>
</table>
Sukhoi Su-30 MKI (NATO reporting name Flanker-H)\(^1\) is a variant of the Sukhoi Su-30, jointly developed by Russia's Sukhoi Corporation and India's Hindustan Aeronautics Limited for the Indian Air Force. It is a heavy class, long-range, multi-role, air superiority fighter and strike fighter. The variant also consists of French, Israeli and Indian subsystems. The MKI variant is a much more advanced fighter jet than the basic K and MK variants and is considered a 4.5 generation aircraft. Due to similar features and components, the MKI variant is often considered to be an export version of the Sukhoi Su-35\(^2\). According to the Russian claim, Su-30MKI share 80% commonality with Su-35.

**Su-30 MKI overview**

![Su-30MKI overview](image)

**General characteristics**

- Crew: 2
- **Length**: 22.10 m (72 ft 5 in)
- **Wingspan**: 14.70 m (48 ft 23 in)
- **Height**: 6.38 m (22 ft 89 in)
- **Wing area**: 62.04 m\(^2\) (667.8 ft\(^2\))
- **Empty weight**: 17,700 kg (39,300 lb)
- **Loaded weight**: 34,500 kg (76,100 lb)
- **Max takeoff weight**: 38,800 kg (85,600 lb)
- **Powerplant**: 2× Lyulka AL-31FP turbofans with thrust vectoring, 131 kN (29,400 lbf) each

**Performance**

- **Range**: 3,000 km (1,600 nm, 1,900 mi) unrefueled
- **Service ceiling**: 20,000 m (65,600 ft)
- **Rate of climb**: >303 m/s (60,000 ft/min)
- **Wing loading**: 556 kg/m\(^2\) (113 lb/ft\(^2\))
- **Thrust/weight**: 0.77

Two IAF earlier version of Su-30 MK (rear) without canards and two USAF F-15 Eagles fly with two IAF Mirage 2000 (middle of V-formation) during Cope India '04.

The Su-30MKI version is a development of the Su-27 series. Though a variant of Su-30, the Su-30 MKI is significantly more advanced than the basic Su-30 or the Chinese Su-30 MKK.
Its avionics, aerodynamic features and components are similar to the Su-35.[1] This variant has significant upgrades on it from the basic Su-30 MK version. The aircraft was jointly designed by Russia's Sukhoi and India's HAL.

India exercised its Su-30MKIs against the Royal Air Force's Tornado ADVs in October 2008. This marked the first large scale exercise with any foreign Air Force, in which the IAF used its Su-30MKIs extensively. This exercise was also the first in 43 years with the Royal Air Force.

After 2 years of evaluation and negotiations, in 1996, India decided to purchase Su-30 aircraft.

- India signed a US $1.462 billion deal with Sukhoi on 30 November 1996 for the delivery of 40 Su-30 aircraft. These aircraft were to be delivered in three batches. The first batch were 10 Su-30K or Su-30MK, the basic version of Su-30. The second batch were to be 8 Su-30MK with French and Israeli avionics. The third batch were to be 10 Su-30MKIs featuring canard foreplanes. The fourth and final batch Su-30MKIs of 12 aircraft were to have the AL-31FP turbofans.

- After the delivery of the first batch, the second batch was delayed for unknown reasons. Thus it was decided to take delivery of full-standard Su-30MKIs.

- IAF decided to buy 10 additional Su-30Ks which were originally destined for Indonesia.

- The first batch of 8 Su-30Ks and these 10 additional Su-30Ks were to be upgraded in India by HAL.

- In 2000, an agreement was signed allowing the license production of 140 Su-30MKIs in India. The deal was sealed in Russia at the IAPO factory. The deal combines license production with full technology transfer and hence called a 'Deep License'.

- India will eventually acquire a total of 230 Su-30MKI.

- Recent news indicates that Belarus is to buy the second hand 18 Su-30Ks from India.[5] Though a variant of Su-30, the Su-30 MKI is significantly more advanced than the Su-30MK or the Chinese Su-30 MKK variants.

India signed a deal on Feb 2007 for purchase of another 40 Su-30MKI in light of the declining fleet levels. These will probably feature a new active phased array radar. The MKI's are being further modified to carry at least 2 or 3 cruise missiles.

**Exercises**

The Indian Air Force will participate in Exercise Indra Dhanush-07 with eight Sukhoi-30MKI fighters. The exercise will be held in RAF Waddington Air Force base in England. The SU-30MKI aircrafts will be supported by two IL-78 mid-air refuelers. In the exercise the Sukhoi-30MKI's will be pitted against the Eurofighter Typhoon aircraft of the Royal British Air Force.[6]
Airframe

The Su-30MKI is a highly integrated twin-finned aircraft. The airframe is constructed of aluminium and high-strength aluminium alloys. The engine nacelles are fitted with trouser flaps to provide a continuous streamlined profile between the nacelles and the tail booms. The fin and horizontal tail consoles are attached to tail booms. The central beam section between the engine nacelles consists of the equipment compartment, fuel tank and the brake parachute container. The fuselage head is of semi-monocoque construction and includes the cockpit, radar compartments and the avionics bay.

Flight control

- The aircraft has a fly-by-wire (FBW) with quadruple redundancy. Depending on the flight conditions, signals from the control stick position transmitter or the FCS will be coupled to the remote control amplifiers. These signals are combined with feedback signals fed by acceleration sensors and rate gyros.

- The resultant control signals are coupled to the high-speed electro-hydraulic actuators of the stabilizers, rudders and the canard. The output signals are compared and, if the difference is significant, the faulty channel is disconnected.

- FBW is based on a stall warning and barrier mechanism which prevents development of aircraft stalls through a dramatic increase in the control stick pressure. This allows a pilot to effectively control the aircraft without running the risk of reaching the limit values of angle of attack and acceleration.

Cockpit instrumentation

The displays include an Elbit Su 967 head-up display and seven liquid crystal multifunction displays, six 127 mm x 127 mm and one 152 mm x 152 mm. The HUD was widely misreported to be the VEH 3000 from Thales. Variants of the same HUD have also been chosen for the IAF's MiG-27 and SEPECAT Jaguar upgrades, on grounds of standardisation. Flight information is displayed on four LCD displays which include one for piloting and navigation, a tactical situation indicator, and two for display systems information including operating modes and overall operation status. The rear cockpit is fitted with a larger monochromatic screen display for the air-to-surface missile guidance.

Navigation

The aircraft is fitted with a satellite navigation system (A-737 GPS compatible), which permits it to make flights in all weather; day and night. The navigation complex comprises high accuracy Sagem integrated global positioning system and ring laser gyroscope inertial navigation system.

Communication

The communications equipment comprises secure VHF and UHF radio sets, a secured digital telecommunications system, and antenna-feeder assembly. It mounts a noise-proof target data exchange system, which provides for coordination of the actions of several fighter aircraft.
Two-pilot crew provides higher work efficiency as well as the engagement in close and long range combats and the air situation observation. Besides, the same dual control aircraft can be used as a combat and training aircraft. Additionally, the integrated air-borne equipment enables the aircraft to be used as an air command post to control the operation of other aircraft.

The back seater is the Weapon systems officer (WSO). The pilot flies the aircraft and handles air-to-air and some air-to-ground (ATG) weapons, as well as countermeasures. The WSO takes care of the detailed aspects of navigation, ground radar mapping & target designation, delivery solution for ATG weapons etc.

**Ejection seats**

The crew are provided zero-zero KD-36DM ejection seats. Rear seat is raised for better visibility. The cockpit will be provided with containers to store food and water reserves, a waste disposal system and increased amounts of oxygen. The KD-36DM ejection seat is inclined at 30°, to help the pilot resist aircraft accelerations in air combat.

**Radar**

The forward facing NIIP N011M Bars (Panther) is a powerful integrated passive electronically scanned array radar. The N011M is a digital multi-mode dual frequency band air.

**Features:**

- The N011M can function in air-to-air and air-to-land/sea mode simultaneously while being tied into a high-precision laser-inertial or GPS navigation system. It is equipped with a modern digital weapons control system as well as anti-jamming features.

- For aircraft N011M has a 350 km search range and a maximum 200 km tracking range, and 60 km in the rear hemisphere. A MiG-21, for instance can be detected at a distance of up to 135 km. Design maximum search range for an F-16 target was 140-160 km.

- The radar can track 15 air targets and process engage the 8 most threatening targets simultaneously and attack 4 most dangerous simultaneously. These targets can even include cruise missiles and motionless helicopters.

- The Su-30MKI can function as a mini-AWACS as a director or command post for other aircraft. The target co-ordinates can be transferred automatically to at least 4 other aircraft.

- The radar can detect ground targets such as tanks at 40–50 km.

- The N011M is claimed to detect large sea targets at a distance up to 400 km, and small sized ones at a distance of 120 km.
When integrated with the BrahMos cruise missile, the Su-30MKI could become a formidable anti-shipping platform.

Future upgrades:

- Future upgrade plans include new gimbals for the antenna mount to increase the field of view to about 90-100 degrees to both sides. New software will enable a Doppler-sharpening mode and the capability to engage up to eight air targets simultaneously.

By 2010, when the first totally-built Su-30MKI will roll out from HAL, it could be equipped with a new phased array radar called the Irbis (Snow Leopard), which will replace the N011M Bars. These reports are yet to be confirmed by the Indian Air Force or official sources. The Irbis has been widely misreported to be an active phased array. It is not. NIIP in Vzlet, 2006 (a journal edited by noted aviation journalist A. Fomin) details the Irbis as a high power active electronically scanned array, built using the experience of the Bars project. However, it will have a lighter antenna derived from the NIIP Osa (Wasp) radar, new servos to rotate the antenna in both axes, with a greater field of regard (adding up to a total of 100 degrees), and an entirely new architecture with dual travelling wave tubes, giving a range of 400 km against a 3 meter square target (RCS). Using new high speed computers, the Irbis will be able to track 30 targets and engage 8. It will also be KS-172 capable.

Radar modes:

- Air-to-Air: velocity search, range while search, track while scan, target ID, close combat modes.

- Air-to-Surface: Real beam mapping, DBS mapping, SAR mapping, moving ground target selection, tracking and measuring of ground target coordinates.

- Anti-shipping: Sea surface search, moving sea targets selection, tracking and measuring of sea target coordinates, sea target ID.

Laser-optical locator system

- OLS-27 laser-optical locator system to include a day and night FLIR capability and is used in conjunction with the helmet mounted sighting system. The OLS-27 (Izdeliye 36Sh) is a combined IRST/LR device using a cooled, broader waveband, sensor.

- Tracking rate is over 25 deg/s with 50 km range in pursuit engagement, 15 km head-on. The laser rangefinder operates between 300 and 3000 m for air targets, 300 and 5000 m for ground targets.

- Detection range is up to 50 km, whilst the laser ranger is effective from 300 to 3000 m. Azimuth tracking is accurate to 5 s, whilst range data is accurate to 10 m. Targets are displayed on the same CRT display as the radar. Weighs 174 kg.

Targeting Pod

- Israeli LITENING targeting pod will be used to target the laser guided munitions. Liteni incorporates in a single pod all the targeting features required by a modern strike fighter.
The original pod included a 1st Generation FLIR, a TV camera, a flash-lamp powered laser designator, laser spot tracker for tracking target designated by other aircraft or from the ground, and an electro-optical point and inertial tracker, which enabled continuous engagement of the target even when the target is partly obscured by clouds or countermeasures.

The pod integrates the necessary laser rangefinder and designator, required for the delivery of Laser Guided Bombs, cluster and general purpose bombs.

**Electronic countermeasures**

An integrated ECM system turns on the warning units that provide signals about incoming enemy missiles, a new generation radio recon set, active jamming facilities and radar and heat decoys. It also includes an electronic intelligence unit, a chaff and flare dispenser and a RWR system.

- The RWR system is an indigenously developed system by DRDO, called **Tarang**, (Spectrum in Sanskrit). It has direction finding capability and is known to have a programmable threat library. The RWR is derived from work done on an earlier system for India’s MiG-23BNs known as the Tranquil, which is now superseded by the more advanced Tarang series.

- **ELTA EL/M-8222** a self-protection jammer developed by Israel Aircraft Industries is the MKI’s standard EW pod, which the Israeli Air Force uses on its F-15s. The ELTA EL/M-8222 Self Protection Pod is a power-managed jammer, air-cooled system with an ESM receiver integrated into the pod. The pod contains an antenna on the forward and aft ends, which receive the hostile RF signal and after processing deliver the appropriate response.

**Indian contribution**

Su-30MKI is fitted with several Indian designed and manufactured avionic items. Several avionic items were developed by DRDO under a project code named "Vetrivel" (Spear of Victory Yel in Tamil) in close collaboration with the PSUs and the IAF. These included the mission computer, display processor and radar computer. Other systems supplied by the DRDO and HAL include the INCOM frequency hopping, jam resistant radio set, radar illuminers, IFF units, as well as dial-pointer instrumentation for the cockpit, intended as a backup for the digital Liquid crystal displays.

Some of the components developed by Indian agencies were:


- Radar Computer - RC1 and RC2 (DARE)

- Tarang Mk2 Radar Warning Receiver + High Accuracy Direction Finding Module

- IFF-1410A - Identification Friend or Foe
Further developments in local avionics

- The DRDO has gone a step further and come out with a new design of the Core Avionics Computer (CAC) which can be used with a single module adaptation across many other aircraft platforms.

The CAC which is derived from the computers designed for the Su-30MKI can also be used in the avionics upgrades for the MiG-27 and Jaguar aircraft. The CAC was demonstrated by DRDO at the Aero India exhibition at Yelahanka and attracted a good deal of international attention. It has been suggested that a variant of the CAC may be also retrofitted to the Su-30 MKI. The advantage of the CAC is in its compact design, which performs both mission computing and display processing functions. DARE took up the development and delivery in quantities of Mission Computers, Display Processors and Radar Computers for the Su 30 avionics upgrade. The requirements were analysed and instead of building three different computers DARE developed nine functional modules. The chassis was also common across the computers. These modules use state of the art processors. They are designed as independent modules to do a specific function such as generating computer generated imagery for display on HUD or MFD. But they are able to communicate with the main processor module through high speed Dual Ported RAMs. This makes development of software for these specific functions as independent activities. Also, hardware changes in one module do not affect the other modules. Hence this approach utilizes the benefits of an Open System Architecture. The CAC is housed in an aircraft industry standard 3/4 th ATR chassis with an option rear mount ARINC 404 connector or front mounted 38999 series connectors. The tray is mounted in the equipment bay/rack of the aircraft and the computer is plugged in to the tray. It is forced air cooled and weighs less than 8 kg. At present however, the MKI uses two Mission Computers and two Display Processors. These four units could possibly be replaced by two CAC's or two of the new DARE CPCi based open architecture computers. The DARE is also working on a more powerful CPCi based open architecture computer as well as developing a Power PC 7400 based open architecture computer around the VME standard, for the Light Combat Aircraft. This also combines mission processing, display processing and a video switching unit in a compact line replaceable unit.
HAL and DARE are currently working with SAMTEL India, a prominent Indian manufacturer of television displays, for the development of new multifunctional displays (MFD) which are to be superior to the original Sextant Avionique units currently used on the MKI. These displays will be able to simultaneously display both analogue and digital data on the same screen, and hence help in improved situational awareness for the aircrew.

DARE has developed and inducted the High Accuracy Direction Finding (HADF) payload, on a Siva pod, for the MKI. As the name suggests, this is a direction finding sensor, which works in combination with the onboard Tarang RWR.

**Further Improvements to the MKI**

Other improvements suggested include a higher proportion of composites in the airframe. Drawn from the Indian experience with the Light Combat Aircraft, whose airframe is 95% composite by surface area, and 45% by weight. Such a move, would assist in:

- Weight reduction hence improving the aircraft performance
- Reduce its radar cross section.

**Powerplant**

The Su-30MKI is powered by the two Al-31FP turbofans (P for povorotnoye meaning "movable"). Each Al-31FP is rated at 12,500 kgf (27,950 lbf) of full afterburning thrust.

- Al-31FP builds on the Al-37FU with the capability to vector in 2 planes. The TVC nozzles of the MKI are mounted 32 degrees outward to longitudinal engine axis (i.e. in the horizontal plane) and can be deflected ±15 degrees in the vertical plane. This produces a cork-screw effect and thus enhancing the turning capability of the aircraft.

- Two AL-31FP by-pass thrust-vectoring turbojet reheat engines (75,000 kgf full afterburning thrust) ensure a 2M horizontal flight speed (a 1350 km/h ground-level speed) and a rate of climb of 230 m/s. The time between overhauls for the AL-31FP is given at 1,000 hours with a full-life span of 3,000 hours. The titanium nozzle has a mean time between overhaul of 500 hours.

- There is no a strain-gauge engine control stick to change the engine thrust in the cockpit, rather just a conventional engine throttle control lever. The pilot controls the aircraft with help of a standard control stick. On the pilot's right there is a switch which is turned on for performing difficult maneuvers. After the switch-over, the computer determines the level of use of aerodynamic surfaces and swiveling nozzles and their required deflection angles.

**Range and Fuel System**

- The Su-30MKI has a range of 3,000 km with internal fuel which ensures a 4.5 hour combat mission.

- Also, it has an in-flight refueling (IFR) probe that retracts beside the cockpit during normal operation. The air refueling system increases the flight duration up to 10 hours with a range of 8,000 km at a cruise height of 11 to 13 km.
The IAF in cooperation with the Defence Food Research Laboratories (DFRL) has designed inflight meals to provide nutrition to pilots flying long duration missions.

Su 30 MKIs also can use the Mk 32B buddy-buddy refueling pods.

**Health and usage monitoring system**

Russian Aircraft are often criticized on account of poor serviceability. For acquiring predictive maintenance capability, the IAF joined forces with South Africa's Aerospace Monitoring And Systems Ltd which developed a health and usage monitoring system.

- Predictive maintenance refers to the on and off board processing of aircraft sub-systems data, resulting in an accurate, conclusive indication of the health and usage status of various airborne systems.

- The Su-30MKI on-board health and usage monitoring system (HUMS) monitors almost every aircraft system and sub-system including the avionics sub-systems. It can also act as an engineering data recorder.

The Indian Air Force's Software Development Institute has also developed its own Health and Usage Monitoring systems as well as Mission Planning Systems, which are stated to be comparable to other products available internationally. Variants of these may also be used on Indian made MKIs.

- The Su-30 MKI's avionics also feature modular components as well as extensive reliance on BITE or Built In Tests, so as to assist maintenance personnel with quickly locating and rectifying/ replacing defective avionics items.

**Weapons and payload**

The Su-30MKI combat load is mounted on 12 stations. The maximum advertised combat load is 8000 kg (17,600 lb). The aircraft features the built-in single-barrel GSh-301 gun, a 30 mm weapon, and space for 150 rounds. Over 70 versions of guided and unguided weapon stores may be employed, which allows the aircraft to fly the most diverse tactical missions.
MiG-29 FULCRUM

Origin: Russia.

NATO Codename: Fulcrum.

Juliet Name: Baaz (Eagle).

Type: All weather air-superiority fighter.

Current versions in IAF service: MiG-29B Fulcrum-A; Fitted with the N-109 radar that has a look-down/shoot-down capability and can display ten targets in search and lock-on to one of the highest priority assigned by the computer. Has extended dorsal fins containing IRCM flare dispensers, extended chord nacelles and a hydraulic mechanical flight control system (hydraulic actuator).

MiG-29S Fulcrum-C; Fitted with N-019M radar capable of tracking ten targets with two simultaneous engagements, a new weapon system, improved flight control system and additional fuel capacity.

MiG-29UB Fulcrum-B; A dual-seat trainer without radar and with continuous canopy. Has imbedded training system and a functioning IRST/helmet sighting system. A weapons capability under wing stores pylons is retained, but no chaff or flares. The airframe is 100mm longer with the instructor’s cockpit taking up a small amount of the number one tank capacity. Has a periscope for the rear occupant.

Design Features: Has fire control and mission computers link radar with a laser rangefinder and IRST sensor in conjunction with helmet mounted laser target designator. Targets can be approached and engaged without emission of detectable radar or radio signals. The MiG-29 is capable of a 23° per sec stabilized turn rate.

Accommodation: Pilot seated on a 10° inclined K-36DM/2-06 zero/zero ejection seat under rearward hinged transparent blister canopy in high seat cockpit. Sharply inclined one piece covered windscreen. Three internal mirrors provide the rearward view.

Avionics: Has a coherent, multimode pulse Doppler look-down/shoot-down engagement radar which has search and tracking capabilities. Has a HUD (head-up display) and helmet mounted target designation system, which is tied in with a laser range finder and an infra-red search & track. The IRST ball is mounted on a three-axis gimballed turret protruding above the nose in front of the cockpit.

The radar is supported by an optical-electronic navigation-attack system, which comprises a sighting system, a navigation system, a digital computer, a weapons control
system, and a data presentation system with a HUD. The helmet mounted sight & target
designator is available for use with the R-60MK and the R-73RDM2 close-combat missiles.
The navigation system includes a radio compass, a radar altimeter, a marker beacon
receiver, and a short-range navigation and instrument landing system. The ground-air & air-
radio. The aircraft also has an IFF transponder & interrogator.

Engine: Two Klimov RD-33 turbofans each rated at 18,300 lbs. of maximum thrust.

Maximum Speed: Mach 2.35

Service Ceiling: 18,500 metres; 60,700 feet

Maximum Range: 1500 km; 932 miles - without in-flight refuelling.

..................................2495 km; 1550 miles - with one in-flight refuelling.

G Limit: 9.5+

Armament: Fitted with a 30mm GSh-30 gun with 170 rounds capacity and 150 rounds
loaded. The gun has a maximum effective range of 1200 to 1800 meters against air targets
and 200 to 800 meters against ground targets. It has a maximum firing rate of 25 to 30
rounds per second. IAF MiG-29s can be armed with a range of Russian air-to-air missiles,
like the close-combat R-60MK and R-73RDM2, the medium-range R-27RE1/TE1 and the
long-range R-77RVV-AE. French air-to-air missiles such as the Super 530D and Magic-2I can
also be carried.

Maximum External Stores Load: 3000 kg; 6614 lbs.

Self Defence: The electronic warfare suite is centered around the Sirena-3 Radar Warning
Receivers, two ECM transponders in the wing strake and chaff/flare dispensers built into the
upper surfaces of the main wing. Each dispenser contains flares or chaff cartridges.

Comments: The MiG-29 forms three operational squadrons (No.28, No.47 and No.223) in
the IAF. A fourth squadron was expected to be raised, however plans for that have been
scrapped. IAF MiG-29s have had their share of technical problems, since its induction in
1986. In 1994, a joint aviation venture, the Indo-Russian Aviation Private Ltd., in
maintenance & support was set up by HAL and MiG-MAPO and the technical problems were
rectified to a satisfactory level. SIPRI (Stockholm International Peace Research Institute)
reports that eight MiG-29S Fulcrum-Cs were ordered in 1994 and were delivered by 1996.
Also from a SIPRI report is a 1995 order of two MiG-29UB Fulcrum-Bs, which were delivered
by 1996.

Pushpinder Singh Chopra, in a June 2001 AW&ST issue, said HAL had prepared production
plans for 350 RD-33 turbofans at its Koraput plant. Upon further examination it was
revealed that between 1990 and 1998, that HAL indeed had produced 350 RD-33 turbofans
at its Koraput plant. On 15 July 1998, HAL delivered the first fully rebuilt and upgraded MiG-
29 to the Indian Air Force. The upgrade has enabled the aircraft to fire the R-77RVV-AE
(AA-12 Adder) air-to-air missile, also known as the Amraamski. A test of the Amraamski
from an Indian Air Force MiG-29 was conducted in October 1998. Future upgrades will
include a new avionics fit, with the N-109 radar being replaced by a Phazatron Zhuk-M
radar. The aircraft is also being equipped for air-to-air refuelling to increase endurance.

Source: BHARAT RAKSHAK.
The Mig-29, Fulcrum NATO-codename, is a single-seat, highly maneuverable fighter aircraft designed to engage airborne targets such as aircraft, UAVs and cruise missiles. It features a limited air-to-to US F-15, F-16 and F/A-18 aircraft. More than 1,300 Mig-29s have been produced for 27 countries worldwide.

The Mig-29 aircraft features an integrated fire control system comprising the aircraft radar, and Infrared Search and Track (IRST) device, and a helmet-mounted sight. It can accommodate medium range R-27 and short range R-73 air-to-air missiles, bombs, and rockets as well as a built-in 30mm GSH-301 gun. The Mig-29 is able to outperform any existing western aircraft in a short range engagement employing the combination of R-73 missile, helmet-mounted sight and IRST.

The Mig-29 Fulcrum avionics are not as sophisticated as its NATO counterparts aircraft such as the Mirage 2000, F-15, F-16, and F/A-18. In the event of an air-to-air engagement at medium range NATO-aircraft shall have advantage over the Soviet Mig-29. However in a dogfight the Mig-29 will outperform NATO-aircraft easily. In the ground strike role the Mig-29 doesn't match NATO-aircraft capabilities.

The Mig-29K is a single-seat, carrier-based multi-role fighter designed to operate from the Admiral Kusnetsov-class ships. It is a derivative of the Mig-29 Fulcrum featuring an arresting hook, hardened landing gear, folding wings, new engines, 8 pylons for weapons, and advanced air-to-surface capabilities. It retains the helmet-mounted sight, the built-in IRST and cannon from early Mig-29s with Zhuk-ME multifunctional multi-mode pulse-Doppler radar.

Despite the first carrier-based Mig-29K was introduced in 1992, the current Mig-29K with sophisticated avionics, weapons and equipment underwent live fire validation flights between 2002 and 2005 logging more than 600 sorties. The flight range has been increased more than two times compared with Fulcrum-A aircraft. The new RD-33MK engine provides higher thrust and extended life cycle as well as better fuel economy.

The Mig-29K's underwing pylons can accommodate R-77 and R-73 missiles for air-to-air engagements, Kh-31A and Kh-35 anti-ship missiles, KH-31P anti-radiation missiles, KAB-500KR TV-guided bombs, KAB-500D/KAB-500l laser-guided bombs, free fall bombs and rockets. It also features a probe-based retractable in-flight refueling system for long endurance missions, which is something new for a Russian-made aircraft.

During the 1990s the Mig-29K development frozen due to economic turmoil throughout Russia, thereafter development was restarted since 2002. The Mig-29KUB is the two-seat version of the Mig 29K featuring exactly the same advanced characteristics of the single-seat model. The two-seat model is specially suitable for training and attack missions carrying precision guided weapons thanks to the increased workload capacity provided by the second crew member.

In 2004, India purchased Admiral Gorshkov aircraft carrier, to be commissioned as Vikramaditya by the Indian Navy, along with a
weapons package including the Mig-29K/KUB carrier-based multi-role fighter. According to MIG corporation sources, the Mig-29K deal was valued at $700 million including new avionics as well as French and Indian subsystems. The first four aircraft were scheduled for delivery to India by mid-2007 and deliveries will continue through 2009. A contract option related to the same contract establishes that the Indian Navy could purchase 30 additional aircraft until 2015. The Indian Navy’s Mig-29K/KUB aircraft fleet service life could extend until 2050.

The Mig-29K (KUB) sale to India marked an important milestone for the Russian defense industry. Training of pilots and technical personnel, simulators, spare parts and after sale support in India will be provided by the Russian contractors under this agreement. The RD-33MK engines, Phasotron-NIIR Corporation’s Zhuk-ME radar, multifunctional color displays and HOTAS like controls are among the improvements of the Mig-29Ks to be delivered to India.

MIG Corporation finally announced the beginning of Indian Mig-29K/KUB series production on February 3, 2005. These aircraft will be equipped with 3 multifunctional color displays (7 on Mig-29KUB), four-channel digital fly-by-wire flight control system, passive anti-radar missile homing system from Russia; France’s Sigma-95 GPS receiver and TopSight helmet-mounted targeting system (the same developed for Dassault Rafale); Electronic Countermeasures (ECM) from Israel; and the Indian Industry supplies the communications equipment.

In August 2005 Svezda company announced that the BKDU-130 oxygen generator system development was completed on the Mig-29M aircraft. The new oxygen generator system was meant to remove the oxygen bottles from Russian manufactured fighter aircraft such as the Mig-29M. Mig-29K, Mig-29KUB, Mig-AT, and Yak-130. Moreover, Svezda stated that there was an agreement between the Russian Air Force and the design bureaus Mig, Yakovlev and Sukhoi on this issue.

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Origin: Russia.

NATO Codename: Flogger.

Indian Name: Bahadur (Brave).

Type: Variable sweep attack fighter.

Current versions in IAF service: ML; Single-seat, variable geometry, fighter ground attack.

Design Features: Has a shoulder wing variable geometry configuration. 2 hydraulic wing sweep motors driven separately by main and control booster systems. If one system fails, wing sweep system remains effective at 50% normal angular velocity. The wings can move back to 72° to perform fast low level attacks. The rear fuselage is fully detachable between the wing and the tail plane for engine servicing.

Accommodation: Pilot only on KM-1M ejection seat in an air-conditioned and pressurised cockpit. Has a bulletproof windscreen.
Avionics: One transponder and a 16-item vocal warning system. Also has an automatic flight control system, an angle of attack indicator, a radio altimeter, a navigation and attack system, a rangefinder and a bullet shaped antennae above each pylon associated with missile guidance. The stub-shaped nose has an in-built laser guidance system for accurate bombing.

Engine: One K-29B-300 turbojet rated at 25,353 lbs. of maximum thrust.

Maximum Speed: Mach 1.7

Service Ceiling: 14,000 meters; 45,000 feet

Combat Radius: With two Kh-29L/T ASMs and 7% fuel reserves - 225km; 140 miles. With two Kh-29L/T ASMs, two R-60MK AAMs and three 790L fuel tanks - 540km; 335 miles.

G Limit: +7.0

Armament: One six barrelled 30mm GSh-30 gun in the fuselage belly pack with 260 rounds. A bomb rack is fitted on each side of the rear fuselage. Five other pylons can carry air-to-air missiles, air-to-surface missiles, 57mm and 240mm rocket pods, napalm and even a tactical nuclear payload.

Maximum External Stores Load: 4000 kg; 8818 lbs.

Self Defence: Infra-Red jammer and radar warning receiver.

Comments: The MiG-27ML forms 7 operational squadrons and is also part of IACDE (Tactics and Air Combat Development Establishment). An upgrade program, reportedly similar to the MiG-21 upgrade, is underway and will keep the MiG-27 viable well into the first quarter of the 21st century. The upgrade is being undertaken by HAL Ozhar Division, the Defence Avionics Research Establishment [DARE] and CEMILAC/DGAQA. The first aircraft to be upgraded is TS-640 which was recieved by Nasik in May 2002. The aircraft was upgraded and first flown by HAL on 25th March 2004 and has been given to the AS&E in April 2004.

Source: BHARAT RAKSHAK.
Origin: Russia.
NATO Codename: Flogger.
Indian Name: Vijay (Victory - BN variant), Rakshak (Saviour - MF variant).
Type: Single-seat, variable geometry, multirole fighter.

Current versions in IAF service:

MF: The air defence variant fitted with a R-29 jet engine, a J-Band radar, a Sirena-3 RWR system, Doppler navigation and a small IRST sensor pod under the cockpit. First Russian combat aircraft, which has the ability to track and engage targets flying below its own altitude.

BN: The ground attack version with a laser rangefinder in the nose, a raised seat, cockpit external armour plate and large low pressure tires. On the bottom of each side of the fuselage a RWR system has been added.

UM: Tandem two seater suitable for both operational training and combat use with individual canopy over each seat. The rear seat is slightly higher than forward seat, with a retractable periscope sight for the occupant.

Accommodation: Pilot on zero/zero ejection seat in A/C and pressurized cockpit under small hydraulically actuated rearward hinged canopy. Has bullet proof windscreen and small electrically heated rear view mirror on top of canopy.

Avionics: One J-band radar dish which has a search range of 85 km; 53 miles and a tracking range of 54 km; 34 miles behind the dielectric nosecone. A suppressed UHF antennae and AoA sensor is on the port side. An ILS antennae is fitted under the radome and at the tip of the fin. A SRO-2 IFF antennae is fitted immediately forward of the windscreen. Also has an infra-red sensor pod which is under the nose.

Armament: Both MF and BN versions are fitted with one 23mm GSh-23L twin barrel gun in the fuselage belly pack. The MF version is primarily used for the air defence role and carries air-to-air missiles like the R-23, the R-27, etc. The BN version is primarily used in the ground attack role and carries air-to-surface missiles, bombs, rocket pods and other ordnance.

Engine: One R-29B turbojet, rated up to 27,500 lbs. of maximum thrust.

Maximum Speed: Mach 2.35

Combat Radius: 485 - 700 nautical miles (900 - 1300km; 560 - 805 miles).

Self Defence: Sirena-3 Radar Warning Receiver system.

Comments: The MiG-23 forms two operational squadrons, with the last MF squadron (No.224) and BN Squadron (No.221) due to retire by 2006. An indigenous RWR developed by DRDO, called Tranquill, has been fitted. The same system is being re-fitted on the IAF's MiG-27s. The MiG-23UMs are expected to soldier on as the type trainers with the MiG-27 Squadrons.

Source: BHARAT RAKSHAK.
MiG-25 FOXBAT [Garuda]

Origin: Russia.

NATO Codename: Foxbat.

Indian Name: Garuda (Mythological Eagle King).

Type: All weather, high-speed reconnaissance aircraft.

Current versions in IAF service: MiG-25R; Single-seat, high-speed reconnaissance. MiG-25U; Dual-seat, used for conversion training.

Design Features: The MiG-25U trainer, which had first flown in 1973 and entered service soon after, differed from the single-seat MiG-25 variants in having a totally redesigned forward fuselage component containing two separate cockpits. This trainer version has no SLAR (side-looking airborne radar) nor any reconnaissance capability and is solely used for conversion training.

Accommodation: Pilot on zero/zero ejection seat in A/C and pressurized cockpit.

Avionics: The MiG-25R is equipped with a number of electromagnetic-spectrum sensors along with a larger and a more capable side-looking airborne radar (SLAR). It is fitted with two left-to-right rotating cameras of a focal length of 650mm and 1300mm that can be fitted in the three interchangeable camera bays located in the nose cone of the aircraft.

The two cameras shoot through two port and two starboard windows, and a vertical camera with a shorter focal length is located under the cockpit to make the horizon to horizon linking shots.

Armament: Can carry short & medium range air-to-air missiles for self protection.

Engine: Two Tumansky R-15BD-300 engines each rated at 10,210 kg. of max. thrust.

Maximum Speed: Mach 3+

Service Ceiling: 70,000+ feet

G limit: ?

Maximum Range: ?

Self Defence: ?

Comments: With an inventory of 10 MiG-25R and 2 MiG-25U, they form the No.102 Trionics Squadron at Bareilly AFB. An indigenous life extension on the MiG-25 is being studied and reportedly the IAF has received preliminary good results.

Source: BHARAT RAKSHAK.
MiG-21 FISHBED

Origin: Russia.

NATO Code Name: Fishbed.

Indian Name: Trishul, Vikram, Bison.

Type: Single-seat, multi-role fighter.

Current versions in IAF service:

FL (Type 77);?

MF/MF (Type 96); Multi-role version with one R-11-300 turbojet with 13,688 lbs. of thrust. Has 4 pylons which can carry external fuel tanks, air-to-air missiles or twin barrel guns. Has a zero speed, zero altitude ejection seat. The MF variant has a R-11F2S-300 turbojet, otherwise similar to the 'M' variant.

Bis (Type 75); Advanced variant with further improved avionics indicated by the ILS antennae under the nose and on the fin tip. The airframe has a lifespan of 2,685 hours.

Bison; Most advanced variant with further improved avionics incl MFDS, HOTAS, RWRs and BVR Capability.

U/M/US-Mongol (Type 66); Two seat trainer version with cockpits arranged in tandem, larger main wheels, one piece forward air brake and pilot boom repositioned above intake. Has no cannon armament. Has a broader-chord vertical tail surfaces and a under brake parachute housing, with a deeper dorsal spine and no dorsal fin fillet. One R-13 turbojet and 4 under-wing store pylons.

Accommodation; Bis; Pilot on zero/zero ejection seat with spring loaded arm at top which ensures that seat cannot be operated unless hood is closed. The canopy has a small rear view mirror, a flat bullet proof windsheer and and air-conditioned cabin. Armour plating forward and aft of cockpit. The Bison is equipped with a frameless windshield and a 'Bubble' Canopy.
MI - 28 Helicopter

First flown in November 1982, and designed to fulfil the same role as the American AH-64 Apache which it generally resembles, the agile Mi-28 'Havoc' military helicopter was scheduled to enter full service with the CIS forces in 1992, but lost out to the Kamov Ka-50. The three prototypes had a conventional three-bladed tail rotor but this has since been replaced by a 'delta 3' x-configured rotor comprising two independent two-bladed propellers mounted on the same shaft. The gunner, seated in a heavily-armoured front cockpit ahead of the pilot, controls a 30mm cannon normally used on ground vehicles. This is mounted under the nose, which contains a low light level TV and FLIR night control systems. Stub wings, each fitted with two hardpoints, can carry AT 6 'Spiral' radio-guided ATMs, UV-20 pods, or fuel tanks. Infra-red suppressors and decoy dispensers are also fitted to the 'Havoc', which is designed to offer high survivability in battle.

Technical data for Mi-28

Crew: 2, engine: 2 x Klimov TV3-117VM turboshaft, rated at 1620kW, main rotor diameter: 17.2m, length with rotors turning: 21.6m, height: 3.82m, take-off weight: 11200kg, empty weight: 7000kg, fuel: 1337kg, max speed: 300km/h, cruising speed: 270km/h, rate of climb: 13.6m/s, service ceiling: 5800m, hovering ceiling: 3500m, range with max fuel: 460km

TYPE: Attack helicopter.

PROGRAMME: Design started 1980 under Marat N Tislin;henko; first of two flying Mi-28 prototypes (012) flew 10 November 1982; each prototype different: first and second (022) had upward-pointing exhaust diffusers and fixed undernose fairing for electro-optic equipment; first also had conventional three-blade tail rotor; second replaced this with the definitive "Delta-H" configuration. The first Mi-28A (032) introduced the definitive downward-pointing exhaust suppressors and flew in January 1988; second Mi-28A prototype (042) demonstrated at Moscow in 1992 and represented the intended production configuration.

CURRENT VERSIONS:

Mi-28: First two prototypes with 1,434kW TV3-117BM engines and VR-2R gearbox.

Mi-28A (Type 280): Basic version, as described in detail, Third and fourth aircraft built.

**Mil Mi-25/35 Hind [Akbar]**

**Origin:** Russia  
**Type:** Attack helicopter.

**Accommodation:** Two crew. Pilot in rear cockpit and systems operator in rear cockpit. Engineer and up to eight fully equipped troops can be carried in the main cabin.

**Design Features:** A conventional semi-monocoque structure of pod and boom type.  
Vital areas protected by titanium armor plating.  
5-blade main rotor like, with similar systems to the Mi-8. The helicopter has a retractable tricycle type landing gear with differential braking for steering.

**Rotor Span:** 17.30m, length - 21.5m, height - 3.90m and disc area - 253 m²

**Weights:**  
Empty - 8,200 kg (18,040 lbs.)  
Gross - 12,000 kg (26,400 lbs.)

*The Mi-35 can carry an additional 750 kg (1,650 lb) of ordnance.

**Avionics:** VHF/UHF radio. IFF transponder, RWR and air data sensors, IR suppressor aft of rotor, chaff/flare dispensers aft of cabin. Map display, INS, high resolution LLLTV, FLIR.

*The Mi-35 differs in having improved avionics and FLIR gear. Helmet mounted sights being incorporated.

**Engine:** Two 2400 shp Isotov TV3-117T. Air intakes fitted with auto synchronization systems as well as FOD deflectors. APU present. Self sealing fuel cells.

**Speed:**  
Maximum - 335 km/h (201 mph; 175 knots)  
Max. cruising speed - 297 km/h (178 mph, 155 knots)

**Service Ceiling:** 4500 meters (14,760 ft.)

**Range:** Operational - 203 nautical miles (390 km; 234 miles)

**Armament:** The Mi-25 has a nose-mounted four barrelled 12.7mm Gatling gun with 1400 rounds. Plus up to 4200 kg of ordnance (UV-57-32 57mm unguided rocket pods, ATGMs, AAMs, irui bombs) on six wing pylons. The Mi-35 has a three barrelled 23mm cannon in the chin turret with 250 rounds per gun and can carry up to a maximum of 4750 kg of ordnance.

**Self Defence:** Flare/chaff aft of cabin and IR suppressors aft of engines.

**Comments:** The IAF currently operates two Mi-25/35 Helicopter Squadrons (No.104 Firebirds and No.125 Gladiators) and has a requirement for at least another unit. SIPRI (Stockholm International Peace Research Institute) reports that 15 helicopters of this type were ordered from Kyrgyzstan in 1994 and were delivered by 1995. The designation is uncertain (Mi-25 or Mi-35) and are apparently second-hand/re-furbished helicopters.

A $20 million contract has been awarded to the Tamam Division of Israel Aircraft Industries (IAI) for the mission system upgrades of some 25 IAF Mi Mi-25 attack helicopters will involve installation of Tamam’s 30 kg (65 lbs) multi-mission digital-soroptic stabilised payload (HMOSP) package. This achieves all-weather acquisition and weapon targeting from variable field-of-view LLLTV and FLIR sensors, with automatic target tracking. A helmet-mounted sighting and display system, revised tandem cockpit layout with a digital map, new mission data management equipment and an integrated defensive aids suite are also included in the HMOSP package.

**Source:** BHARAT RAKSHAK.
**Mil Mi-26 Halo**

**Origin:** Russia

**Type:** Heavy transport helicopter.

**Accommodation:** Four crew. Two pilots seat side-by-side along with one engineer in the cockpit. A load master is usually carried in the cabin. Up to 85 fully equipped troops can be embarked in the cabin.

**Design Features:** A conventional semi-monocoque structure of pod and boom type. Vital areas protected by titanium armor plating. Eight blade titanium main rotor. The helicopter has a retractable tricycle type landing gear with carbon disc brakes. Differential braking for steering. Fully pressurized cabin.

**Number Procured:** 4

- Two (Z-2897, Z-2898) in May 86
- Two (Z-3075, Z-3076) in Feb 89

**Units Equipped:**

- 126 Helicopter Flight "Feather Weights"

**Rotor Span:** 32m, length - 40m, height - 8.15m and disc area - 804 m²

**Weights:**
- Empty - 25,000 kg (55,000 lbs.)
- Normal - 49,000 kg (107,800 lbs.)
- Maximum - 56,000 kg (123,200 lbs.)

**Avionics:** INS, flight computer, Map display, weather radar, TFR, and full blind/adverse weather instrumentation. Four axis auto stabilization.

**Engine:** Two Loratev D-136 free turbine turbo-shafts rated at 11, 600 shp. Auto synchronization and boosters for emergencies.

**Speed:**
- Maximum - 306 km/h (184 mph; 160 knots)
- Max. cruising speed 240 km/h (144 mph, 125 knots)

**Service Ceiling:** 8000 meters (26,240 ft.)

**Range:**
- Maximum - 338 nautical miles (650km; 390 miles).
- Operational - 167 nautical miles (320 km; 192 miles).

**Comments:** The IAF currently operates a single unit of Mi-26s. The helicopters have been a tremendous asset in sustaining the Indian Army's high altitude deployments in Ladakh. The unit, No.126 Helicopter Flight "Featherweights" is based at Chandigarh and is equipped with four Mi-26s.

**Source:** BHARAT RAKSHAK.
Mil Mi-17 Hip [Rana]

Origin: Russia

Type: Utility and assault helicopter.

Accommodation: Four crew. Two pilots seat side-by-side along with one engineer in the cockpit. A load master is usually carried in the cabin. 24 troops can be embarked in the cabin.

Design Features: Same as Mi-8. The Mi-17 can be recognized because it has the tail rotor at the starboard side, instead of the port side.

Rotor Span: 21.2m, length - 25.3m, height - 4.7m and disc area - 365 m²

Weights: Empty - 7260 kg (15,972 lbs.)

Gross - 12,000 kg (26,400 lbs.)

Avionics: Same as Mi-8 with an improved Doppler navigation system.

Engine: Two 1900hp Isotov TV3-117M engines with contingency rating of 2300 shp in free turbine mode. Air intakes fitted with auto synchronization systems as well as FOD deflectors. APU present.

Speed: Maximum - 288 km/h (173 mph; 150 knots)

Max. cruising speed - 240 km/h (144 mph, 125 knots)

Service Ceiling: 5062 meters (16,600 ft.)

Range: Maximum - 625 nautical miles (1200 km; 720 miles).

Operational - 307 nautical miles (590 km; 354 miles)

Armament: Fitted for a 12.7mm machine gun in the chin. Can also carry up to six UV-57 57mm unguided rocket pods and ATGMs on pylon outriggers. Provision FLIR and weapon delivery sights.

Self Defence: Flare/chaff dispensers in clamshell doors and IR suppressors on aircraft aft engines.

Comments: Progressively replacing the Mi-8 in IAF service. The Mi-17s were very active in providing CAS (Close Air Support) to Indian troops during the Kargil campaigns during 1999 at altitudes in excess of 15,000 feet. One helicopter and all its crew, from 152 HU, were lost when it was shot down by Pakistani stingers.

In May 2000, India and Russia signed a $170 million deal for 40 additional Mi-17 helicopters. These are of the Mi-17-1B variant, which have more powerful engines and enlarged side doors, allowing quicker disembarkation of personnel. The first four choppers were delivered on 19 October 2000 and the last batch will reach India in mid-2001. The helicopters will be fitted with sixteen Vikhr-V (AT-16) anti-tank guided missiles after all 40 helicopters have been delivered.

Source: Jane's Information Group.
Origin: Russia

Type: Utility and assault helicopter.

Accommodation: Four crew. Two pilots seat side-by-side along with one one engineer in the cockpit. A load master is usually carried in the cabin. 24 troops can be embarked in the cabin.

Design Features: A conventional semi-monocoque structure of pod and boom type. Tail rotor acts as a small vertical stabilizer at the end of the boom. The helicopter has a non-retractable tricycle type landing gear with differential braking for steering.

Rotor Span: 21.29m, length - ?, height - 5.65m and disc area - 356 m².

Weights: Empty - 7260 kg (15,972 lbs.)
............Gross - 12,000 kg (26,400 lbs.)

Avionics: RR-842 HF R-860 radios, RV-3 radio altimeter, Doppler navigation systems and autopilot.

Engine: Two Isotov TV2-117A engines, each developing 1500 shp.

Speed: Maximum - 275 km/h (166 mph; 145 knots)
............Max. cruising speed - 212 km/h (127 mph, 110 knots)

Service Ceiling: 4500 meters (14,760 ft.)

Range: Maximum - 625 nautical miles (1200km; 720 miles).
............Operational - 248 nautical miles (475 km; 285 miles)

Armament: Fitted for a 12.7mm machine gun in the chin. Can also carry four UV-57 unguided rocket pods.

Self Defence: Provisions for dispenser containing flares or chaff cartridges.

Comments: For a long time the Mi-8 was the mainstay of the IAF's helicopter fleet. Progressively being replaced by the Mi-17.

Source: BHARAT RAKSHAK.
Antonov An-32 Cline [Sutlej]

Origin: Russia

Type: Short/Medium-range transport

Accommodation: Five crew.

Weights: Empty - 17,308 kg (38,158 lbs.)
MTOW - 27,000 kg (59,525 lbs.)

Engines: Two Ivchjenko AI-20D turboprops, each producing 5112 ehp.

Speed: Max. cruising speed - 266 knots (329 mph; 530 km/h) at 8000 meters (26,245 feet)

Service Ceiling: 9000 meters (29,530 ft.)

Range: 1565 miles (2520 km) with maximum fuel.
746 miles (1200 km) with maximum payload.

Capacity: 39 paratroopers on tip-up seats.

Avionics: None.

Armament: None.

Self Defence: None.

Comments: Known as the Sutlej in the IAF, the An-32 is the workhorse of the transport fleet traveling to far off bases such as Leh, to deliver much-needed supplies to the Army outposts in the area. An estimated 80 aircraft are in service with the IAF. Deliveries to the IAF began in July 1984.

Source: BHARAT RAKSHAK.
Ilyushin-Beriev IL-76MD / IL-78MKI Candid [Gajraj]

*Origin:* Russia

*Type:* Heavy freight transport.

*Accommodation:* Four crew.

*Weights:* Empty - 75,000 kg (165,347 lbs.)

MTOW - 170,000 kg (374,786 lbs.)

*Engine:* Four Soloviev D-30KP-1 turbofans, each producing 26,455 lbs. of thrust.

*Speed:* Maximum - 459 knots (528 mph; 850 km/h) at 11,000 meters (36,090 feet)

Max. cruising speed - 432 knots (497 mph; 800 km/h)

*Service Ceiling:* 12,000 meters (39,370 ft.)

*Range:* Maximum - 3107 miles (5000 km) with a 40,000 kg (88,185 lbs.) payload.

*Capacity:* 225 paratroopers or 40 tons freight, wheeled or tracked armoured vehicles, etc.

*Avionics:* Search Radar.

*Armament:* Twin 23mm cannon in tail turret.

*Self Defence:* Electronic Counter Measures (ECM).

*Comments:* Known as the Gajraj (King Elephant) in the IAF, the IL-76MD forms the strategic/heavy transport fleet. An estimated 28 aircraft are in service in two squadrons. Deliveries to the IAF began in 1985 and they were used in the Maldives in 1987 and in Sri Lanka during 1987-1990 to great effect. In 1990, two IL-76MDs were modified and their objective was to test the system's effectiveness to divert fire power of heat seeking air/surface-to-air missiles, shoulder-fired guns, and also jamming of radar by dispensing chaff around the aircraft.

Defence Minister Jaswant Singh, in a written reply to Parliament in July 2001, said the IAF is acquiring six IL-78/78M in-flight refueling aircraft from Uzbekistan. The price negotiation committee completed its work in February 2001 and the contracts were signed in April 2001. The price per aircraft has been put at approximately $50 million.

The first two IL-78s arrived in the first half of 2003 and are believed to be part of a newly raised No.78 "Battle Cry" Squadron. We should however mention that the information on the Squadron is yet to be confirmed by official sources. The IL-78MKI as it was designated in the IAF made its first public appearance in the Air Force Day Parade on 8th October 2003. It is evident from photographs that the IL-78s had carried out operations with the Su-30MKIs and various variants of the Jaguar family.

*Source:* BHARAT RAKSHAK.
T-90S Main Battle Tank, Russia

The T-90S is the latest development in the T-series of Russian tanks and represents an increase in firepower, mobility and protection. It is manufactured by Uralvagonzavod in Nizhny Tagil, Russia.

The T-90S entered service with the Russian Army in 1992. In February 2001, the Indian Army signed a contract for 310 T-90S tanks. 124 were completed in Russia and the rest are being delivered in 'knocked down / semi-knocked down' form for final assembly in India.

"The T-90S Russian tank represents an increase in firepower, mobility and protection."

The first of these was delivered in January 2004. The locally assembled tanks are christened 'Bhishma'. The tanks are fitted with the Shtora self-protection system and Catherine thermal imagers from Thales of France and Peleng of Belarus.

In January 2005, it was announced that a further 91 T-90S tanks would be procured for the Russian Army, although this number was later reduced. 31 tanks are due to be delivered in 2006.

In March 2006, Algeria signed a contract for the supply of 180 T-90S tanks from Uralvagonzavod, to be delivered by 2011.

In November 2006, India ordered a further 300 T-90 tanks, to be licence-built by Heavy Vehicle Factory (HVF), Avadi. Deliveries are to begin in 2008.

ARMAMENT

The T-90S armament includes one 125mm 2A46M smoothbore gun, stabilised in two axes and fitted with a thermal sleeve. The gun tube can be replaced without dismantling inside the turret. The gun can fire a variety of ammunition including APDS (Armour Piercing Discarding Sabot), HEAT (High Explosive Anti-Tank), HE-FRAG (High Explosive Fragmentation) as well as shrapnel projectiles with time fuzes.

The T-90S gun can also fire the 9M119 Refleks (NATO designation AT-11 Sniper) anti-tank guided missile.

The T-90S main armament is a 125mm 2A46M smoothbore gun.

The T-90S a derivative of the T-72.

The constituent parts of the 9M119M laser-guided missile of the Refleks guided weapon system.

T-90S during demonstrations.

T-90S on exercise.
Tunguska M1 Low Level Air Defense System, Russia

Tunguska-M1 is a gun/missile system for low-level air defence. The system was designed by the KBP Instrument Design Bureau in Tula, Russia and is manufactured by the Ulyanovsk Mechanical Plant, Ulyanovsk, Russia. It can engage targets while stationary and on the move, using missiles for long-range targets and guns for close-in defence. It is designed for defence against both fixed-wing aircraft and helicopters and can also fire on ground targets.

Tunguska entered service with the Russian army in 1988 and has been exported to Germany, India, Peru and Ukraine. Morocco ordered 12 Tunguska M1 systems in December 2004.

ARMAMENT

The Tunguska-M1 vehicle carries eight 9M311-M1 surface-to-air missiles. The missile (NATO designation SA-19 Grison) has semi-automatic radar command to line-of-sight guidance, weighs 40kg with a 9kg warhead. It is 2.5m long with a diameter of 1.7m and wingspan of 2.2m. The missile's maximum speed is 900m/s and can engage targets travelling at speeds up to 500m/s. Range is from 15 to 6,000m for ground targets and 15 to 10,000m for air targets.

Two twin-barrel 30mm anti-aircraft guns are mounted on the vehicle. These guns have a maximum firing rate of 5,000 rounds per minute and a range of 3,000m against air targets. This extends to 4,000m against ground targets.

FIRE CONTROL

The system has target acquisition radar and target tracking radar, optical sight, digital computing system, tilt angle measuring system and navigation equipment. Radar detection range is 18km and tracking range is 16km.

VEHICLE

The Tunguska-M1 system is mounted on a 34t tracked vehicle with multi-fuel engine. It has hydromechanical transmission, hydropneumatic suspension which allows for changing road clearance and hydraulic track-tensioning. The armoured turret has both laying and stabilisation drives and power supply. Air-conditioning, heating and filtration systems are fitted.

A Tunguska-M1 battery is composed of up to six vehicles and will also include a transloader as well as maintenance and training facilities.

The armoured turret has both laying and stabilisation drives and power supply. Air-conditioning, heating and filtration systems are fitted. A Tunguska-M1 battery is composed of up to six vehicles and will also include a transloader as well as maintenance and training facilities.
IGLA-19K310 [SA-16 GIMLET]

An Indian Air Force Sergeant, with the Iгла-19K310 SAM

Army Jawans, with the Iгла-19K310 SAM

The SA-16 Gimlet is a further development from the SA-14 and SA-7 series of man-portable SAMs. The SA-16 is an improved version of the SA-18 Grouse, through the addition of a new seeker and modified launcher nose cover. The SA-16 has an aerodynamic cone which is held in place with a wire tripod. The protective cover of the SA-16 is tubular with a prominent lip at the forward edge. The 9M313 missile of the SA-16 employs an IR guidance system using proportional convergence logic, and an improved two-color seeker, presumably IR and UV. The seeker is sensitive enough to home in on airframe radiation, and the two-color sensitivity is designed to minimize vulnerability to flares.

Source: BHARAT RAKSHAK.
RAJPUT {KASHIN II} CLASS

**Vessel Type:** Guided Missile Destroyer.

**Names & Pennant Numbers with commission dates:**
- INS Rajput D51 (30 September 1980)
- INS Rana D52 (28 June 1982)
- INS Ranjit D53 (24 November 1983)
- INS Ranvir D54 (28 October 1986)
- INS Ranvijay D55 (15 January 1988)

**Structure:** Built as new construction for India at Nikolayev, Russia with considerable modifications to the Kashin design. The helicopter hanger has been replaced by a lift from the flight deck. The 76mm twin mount gun and the four launchers which house the P-20M (SS-N-2D Scud) ASHMs are sited forward of the bridge. The BrahMos ASCM fitted on INS Rajput has replaced two of these launchers with its own boxed launchers.

**Displacement:** 3050 tons standard, 4974 tons full load.

**Dimensions:** Length - 147 metres, Beam 15.0 metres, Draught - 5 metres.

**Main Machinery:** Four 72,000 hp gas turbine engines and two shafts.

**Maximum Speed:** 35 knots.

**Maximum Range:** 4000 miles at 18 knots, 2600 miles at 30 knots.

**Complement:** 320 (incl. 35 Officers).

**Radar:**
- **Navigation:** Two 'Don Kay', I-band.
- **Air:** One MP-500 Kliver (Big Net-A) radar at C-band (range - 100n miles; 183 km).
- **One Bharat RAWL (Dutch Signaal LW08) radar at D-band frequency fitted on D53.**
- **Air/Surface:** One MR-310U Angara (NATO: Head Net-C) radar at E-band frequency (range - 70n miles; 128 km).
- **One ELM-2238 STAR radar on one (or probably both) of the last two vessels.**
- **Fire Control:** Refer to 'Weapons' sub-section.

**Sonar:** A hull mounted Vycheda MG 311 sonar with active search & attack with medium frequency. Also has a 'Mare Tall' variable depth sonar in active search with medium frequency.

**Weapons:** Four P-20M (SS-N-2D) ASHMs, in single-tube launchers, with infra-red (Mod 2) homing to 45n miles; 83 km at 0.9 Mach. Becomes a sea skimmer at the end of run. Has a 513 kg warhead. The forward P-20M missile cells (port and starboard).
aboard INS *Rajput* have been replaced with two boxed launchers housing four P-10 (BrahMos) ASCMs. D51 served as the trials platform for the missile, which can be fitted with a conventional or nuclear payload of 200 kg. The missile has a range of ~300 km at 14,000 metres or 120 km at 10 to 15 metres. The missile is believed to have a first stage solid-fuelled booster and a second stage liquid-fuelled ramjet.

A pair of twin launchers is fitted with the S-125M (SA-N-1) SAM. This surface-to-air missile has a range of 17 n miles; 31.5 km at Mach 2+. The missile has a 60 kg warhead weight and has a maximum altitude of 75,000 ft. The missiles, total of 44 on board, have some surface-to-surface capability. Fire control is provided by two (NATO: Peel Group) radar at H/I-band frequency with a range of 40 n miles (73 km).

One twin 76mm main gun with 80° elevation and 90 rounds/min to 8 n miles; 15 km with fire control provided by one (NATO: Owl Screech) radar at G-band. In the CIWS role, the first two vessels are fitted with four AK-230 30mm gunmounts with 85° elevation and 500 rounds/min to 2.7 n miles; 5 km with fire control provided by two MR-104 (NATO: Drum Tilt) radar at H/I-band frequency. The third vessel had its AK-230 gunmounts replaced with four AK-630M 30mm gunmounts with an unspecified fire control director to be fitted in due course. It is possible that a BEL-developed AIO (Action Information Organisation) system will be installed. As of July 2005, no such system was visible on the vessel. The last two vessels have four AK-630M 30mm guns with 85° elevation and 3000 rounds/min to 2 km with fire control provided by two MR-123 (NATO: Bass Tilt) radar.

One (or probably both) of the last two vessels have had a pair of their AK-630M gunmounts replaced with the Barak SAM system, with fire control provided by a pair of EL/M-2221 STGR radars. The MR-123 radars were replaced by the Elta STGR radar, during the installation of the Barak system.

One 533mm PTA 533 quintuple torpedo tube launcher is fitted amidship. Armed with the SET-65E; anti-submarine, active & passive homing torpedo to 8.1 n miles; 15 km at 40 knots with a 205 kg warhead and the Type 53-65; passive wake homing torpedo to 10.3 n miles; 19 km at 45 knots with a 305 kg warhead.

Two RBU-6000 mortar with 12 tubes and a range of 6000 meters. The maximum target submarine engagement depth is 500 meters. Has a 31 kg warhead.

**Helicopter Capacity:** Has one helicopter pad in the aft of the vessel which carries the Ka-28 Helix-A. Can also carry the HAL Chetak helicopter if required.

**Countermeasures:** INS *Rajput* has an EW (Electronic Warfare) suite which comprises a Bharat Ajanta ESM system. Reportedly the other vessels in the class will have their Russian-designed ESM systems replaced with the Ajanta ESM system. Four barrelled chaff launchers are used as radar decoys.
Comments: It is possible that an Italian combat data system compatible with Selenia IPN-10 is installed. Immarsat is fitted. New EW equipment was fitted in 1993/1994. First three vessels are based at Vizag and the last pair at Mumbai. There were plans for modernization with Ukrainian assistance, but it appears that the Indian Navy has turned to Russia for help. INS Ranjit and INS Suvarna, a Sukanya Class large patrol craft, proceeded to Mozambique on a diplomatic mission. On 25 June 2003, this pair of ships attended the 28th Independence anniversary celebrations of Mozambique and presented medicines to the Vice Minister of Health of Mozambique on board INS Suvarna. At the request of President Joaquim Chissano of Mozambique, who boarded these ships on 30 June 2003, the Indian Navy ships remained in the area to provide cover for the African Heads of States Union, which was held from 4th to 12th July 2003. They also trained the Mozambique Navy and weaved bonds of friendship during their stay.

INS Rajput served as the trials ship for the PJ-10 (BrahMos) cruise missile, which is expected to carry part of the strategic second-strike capability of the armed forces. The missile has been test fired four times - 12 February 2003, 23 November 2003, 03 November 2004 and 18 December 2004. The tests involved a moving target, which was a decommissioned vessel of the Indian Navy. The targeted ship ended up in pieces, due to the power of the missile and its kinetic energy derived from its supersonic speed. This test was witnessed by Admiral Arun Prakash, Chief of Naval Staff; A S Pillai, Chief Executive Officer and Managing Director, BrahMos Aerospace, which manufactures the missile in India; Vice Admiral Sureesh Mehta, Deputy Chief of Naval Staff; Rear Admiral Pratap Singh Byce, Flag Officer Commanding, Western Fleet and other senior Naval officers.

Source: BHARAT RAKSHAK.
VIKRAMADITYA {KIEV} CLASS  
(Admiral Gorskhov)

**Project Update:** The Vikramaditya is currently undergoing a refit and modernisation program at Severnaye Shipyard in Severodvinsk, Russia. As per Defence Minister A K Antony, in a written reply in Parliament on 17 May 2007, the vessel is expected to be delivered to the Indian Navy by late 2008.

**Vessel Type:** Aircraft Carrier, Project 1143.

**Future Commissions:** Vikramaditya (formerly Admiral Gorskhov) - 2000.

**Displacement:** 44,570 tons.

Originally built as the modified Kiev (Krechyet) Class (Type 1143.4) carrier Baku, she is the last in the series of four Project 1143 air defence ships, officially known as aviation cruisers. The vessel was designed by St. Petersburg’s Nevskoye Design Bureau, led by Vassily Anikeyev as a VSTOL (Vertical Short Take-Off and Landing) carrier. She was laid down at the Chernomorsky Shipyard, Nikolayev in December 1978 and was launched on 31 March 1987. Some reports indicate the ship was launched on 17 April 1982. The ship was commissioned in December 1987 (some reports indicate January 1987), nine years after its building started, following sea trials which began in June 1986. The Baku was later renamed as the Admiral Flota Sovetskogo Soyuza Gorskhov (later changed to Admiral Gorskhov) to honour the Russian Navy’s and arguably the world’s greatest naval tactician, Admiral of the Fleet of the Soviet Union Sergey Georgievich Gorshkov who retired from Russian Naval service in 1985.

The Admiral Gorskhov was originally designed to carry twelve VSTOL Yak-38 [NATO: Forger] fighters, twelve Ka-27 [NATO: Helix-A] helicopters in the SAR (Search & Rescue) & ASW (Anti-Submarine Warfare) role and a pair of Ko 31 RLD [NATO: Helix] AEW helicopters. As the Yak-38 was a VSTOL (Vertical Short Take-Off and Landing) aircraft, the need for a long deck was not required and thus the forward area of the deck was fitted with twelve P 500 Bazalt [NATO: SS-N-12 Sandbox] cruise missile launchers and four Antey Kinzhal [NATO: SA-N-9 Gauntlet] surface-to-air missile launchers. When the Yak-38s were phased out of Russian Naval service in 1992, the carrier adopted a new role as a helicopter carrier. The ship suffered extensive damage in 1994 due to a boiler room explosion and a subsequent fire and she was docked at Severodvinsk on 02 February 1994. After extensive repairs she was finally put back to sea in 1995. However, she was withdrawn from service in 1996 and has remained docked at Severodvinsk since. Her sister ships were withdrawn by 1993.

**Images and models of Admiral Gorskhov prior to her refit**

The vessel was offered for sale to India and negotiations over acquiring the 44,570-tonne aviation cruiser for the Indian Navy have reportedly been on since 1994. The two countries signed a Memorandum of Understanding (MoU) in December 1998, during a visit by Russian Prime Minister Yevgeny Primakov, by which India agreed to acquire the carrier and fund a refit & refurbishing program. This program was developed by the Nevskoye Design Bureau and will be carried out at the Severnaye shipyard at Severodvinsk. Preparatory work for the proposed conversion is being carried out at the Northern Machine Building Enterprise at Severodvinsk. In October 2000, during a visit by Russian President Vladimir Putin, an inter-governmental agreement was signed confirming the acquisition of the vessel. The final contract of delivery was supposed to
be signed in October/November 2001, but disagreements over the price of the conversion left the deal hanging.

In February 2002, during the visit of Russian Deputy Prime Minister Ilya Klebanov, acquisition of the aircraft carrier was again discussed, but still a fixed price could not be reached. Finally on 20 January 2004 in New Delhi, the deal to acquire the aircraft carrier, was signed between Russian Defence Minister Sergei Ivanov and his counterpart, Defence Minister George Fernandes. The deal also consists of nearly 20 separate contracts for new shipboard weapons and technology. The conversion is expected to be completed within five years of contract signature, which results in the Indian Navy receiving the carrier only by 2009, which is around the time the Indian Navy's other aircraft carrier, INS Virat, is expected to retire. However a MoD Press Release, dated 21 July 2004, stated that the vessel is expected to be handed over to the Indian Navy in August 2008. The vessel is to be named as INS Vikramaditya, as per official communication from the Indian Navy.

Conceptual drawings and models of the Vikramaditya (formerly Admiral Gorshkov) after refit

While the aircraft carrier itself is coming for free, a substantial refit will be undertaken to bring the vessel up to modern naval standards. The cost for this refit is estimated to be in the region of $675 to $700 million. A related $740 million contract for 16 carrier-based MiG-29 aircraft has also been signed. The price of the MiG-29 contract was confirmed in an MoD press release, dated 22 December 2004. The contract also includes the full hardware for training maintenance and flying personnel, including simulators and interactive ground and sea based training systems. Delivery of the first aircraft are expected in June 2007 and is expected to commence before the upgrade of the carrier has been completed and before the carrier is transferred to India. An option to acquire 30 additional aircraft by 2015, is also included in the contract. The vessel will also carry a mix of Ka-28 ASW and Ka-31 AEW helicopters.

The conversion plans for the aircraft carrier would see all the armament, including the P-500 Bazalt cruise missile launchers and the four Antey Kinzhal surface-to-air missile launchers fitted on the front of the carrier, removed to make way for a 14.30 bow ski-jump. Two restraining stands will also be fitted, allowing combat aircraft to reach full power before making a ski-jump-assisted short take-off. The ability to launch only one aircraft at a time, might prove to be a hindrance. Under the modernization plan, the 20-ton capacity elevator beside the ship's island superstructure will remain unchanged, but the aft lift will be enlarged and its lift capacity increased to 30 tons. Three arresting gears would be fitted on the aft part of the angled deck, although the model (centre image) displayed above shows four. Navigation and carrier-landing aids would be refitted to support fixed-wing STOBAR (Short Take-Off But Arrested Recovery) operations including the LAK optical-landing system.

Source: BHARAT RAKSHAK.
TYPE 15 DELHI CLASS

Vessel Type: Guided Missile Destroyer.

Names & Pennant Numbers with commission dates:
INS Delhi D61 (15 November 1997)
INS Mysore D60 (02 June 1999)
INS Mumbai D62; Ordered - 30 March 1992, Laid Down - 12 December 1992

Structure: The Delhi Class design, for which Russia's Severnoye Design Bureau (SDB) acted as a consultant, are hybrids of Western and Russian technology - incorporating elements of the Sovremenny Class destroyer and the Rajput Class (Kashin-II) destroyer with the locally-designed Godavari Class frigate, including the frigate's most unique aspect, namely the large dual helicopter hangar for two Sea King Mk.42B helicopters. The huge missile blast deflectors, installed behind the KT-184 launchers, on INS Delhi indicate an original intention to arm these destroyers with the supersonic 3M-80 (SS-N-22) ASH which was later deemed too costly. INS Mysore and INS Mumbai lack these blast deflectors.

Displacement: 6700 - 6900 tons full load.

Dimensions: Length - 163 metres.
......................Beam - 17 metres.
......................Draught - 6.5 metres.

Main Machinery: The vessels are powered by two Ukrainian Zorya Production Association M36E (E for Export) gas turbine plants that produce over 64,000 hp. The M36E gas turbine plant comprise four DT 59 reversible gas turbines grouped in two pairs, driving two propellers through two RG-54 gearboxes. There are four separate Russian-made gas turbine generators, two in each engine room. Fresh air for the turbines is drawn through two large stacks, one after the bridge superstructure, and one aft.

Maximum Speed: 32+ knots.

Economical Speed: 14 - 18 knots.

Maximum Range: 5000 miles.

Complement: 360 (incl. 40 Officers).

Radar: Air Surveillance; One MR-775 Fregat MAE (NATO: Half Plate) planar array radar.

Surface Surveillance; One Bharat RAWL (Dutch Signaal LW08) radar, operating at D-bond frequency. INS Mysore also has SRA-01 IFF equipment atop the radar antenna.

Navigation; Three MR-212/201 navigation radars, operating at I-
missile can handle target aircrafts traveling at 420 to 830 m/s and incoming missiles moving at 330 to 830 m/s. The reaction time is
16 to 19 seconds and the advertised kill percentage is 81 to 96%
with altitudes from 15 metres to 15 km. Ranges against incoming
missiles are 3.5 km to 12 km with altitudes from 10 metres to 10
km. The missile probably has a secondary anti-ship capability.

One 100mm AK-100 single-barrelled, water-cooled gun, for use
against ship and shore targets. The AK-100 can engage aerial and
surface targets at a rate of fire of 30 to 50 rds/min and the turret
can traverse through an arc of 220°. Fire control for the gun is
provided by the T91E radar, a part of the MR-145 or MR-184
(NATO: Kite Screech) fire control radar system along with a turret
mounted Kondensor optical sight. Each shell weighs 16 kg.

Four multi-barrelled 30mm AK-630 Gatling guns, two on either
beam, to shoot down incoming anti-ship missiles, at 3000 rounds
per minute to 2.5 km. Fire control is provided by two MR-123-02
(NATO: Bass Tilt) directors at the H/I/J-band frequency
incorporating EO sensors (including laser rangefinder attachments)
along with a manual backup sight for each pair of guns. Each gun
can throw up a defensive wall of lead at 5500 to 6000 rounds per
minute out to about 2.5 to 5 km. Unlike Western CIWS like
Phalanx or Goalkeeper, this is not a closed loop system.

INS Delhi and INS Mysore have been refitted with the Barak SAM
system and the pair of MR-123-02 (NATO: Bass Tilt) directors
have been replaced by two EL/M-2221 STGR radars, in addition to
deckhouse modifications. Two of the four AK-630 guns aboard INS
Delhi and INS Mysore have been removed, to place vertical
launchers for the Barak system. As of July 2005, INS Mumbai has
not been fitted with the Barak system and still has its original
equipment fit.

Five 533mm PTA 533 quintuple torpedo tube launchers are fitted
amidships. The launchers are of modular construction and can fire
different types of heavyweight torpedoes such as wire guided or
wake homing types. The Delhi Class destroyers are armed with the
SET-65E; anti-submarine, active & passive homing torpedo to 8.1n
miles; 15 km at 40 knots with a 205 kg warhead and the Type 53-
65; passive wake homing torpedo to 10.3n miles; 19 km at 45
knocks with a 305 kg warhead.

Anti-submarine armament comprises of two 12 barrelled RBU-
6000 AS rocket launchers mounted in front of the bridge. These
weapons are controlled by the Purga ASW fire control system. The
RBU-6000 fires RGB-60 depth charge rockets to engage
submarines at depths of 500 metres at a maximum range of 6000
metres. The system may carry up to 192 rockets, each with a 31
kg warhead. It is likely that the new RF-91 ASW rockets could be
retrofitted to these vessels in due course. They use the same RBU
launcher complex.

The vessels reportedly have the capability to fire the SS-N-15 or
the SS-N-16 ASHM. The former can be fired from 533mm torpedo
tubes, while the latter needs a 650mm torpedo tube due to its
band, are mounted on the foremast. JRC SATCOM (Satellite Communication) equipment is standard on these vessels. INS Mumbai can be visually differentiated from INS Mysore by its cylindrical SATCOM antenna.

**Fire Control:** Refer to 'Weapons' sub-section.

**Sonar:** The first two vessels in the series - INS Delhi and INS Mysore - have a Bharat APSOH (Advanced Panoramic Sonar Hull) hull-mounted sonar, which provides active search with medium frequency and a Garden Reach Model 1S-750 variable depth sonar, also known as HUMVAAD, which is mounted in a Canadian Indal-designed 'fish' deployed from a ramp in the transom. INS Mumbai features more advanced sonar systems, namely a Thales ATAS (Advanced Towed Array Sonar) system and a Bharat HUMSA (Hull Mounted Sonar Array) system.

**Weapons:** Sixteen 3M-24E (Kh-35 Uran or NATO: SS-N-25 Switchblade) ASHMs, housed in four quadruple KT-194 launchers, angled at 30°, two on either side of the bridge superstructure. Equivalent to the Harpoon Block 1C ASHM, these missiles have active radar homing (ARH) out to a range of 130 km at 0.9 Mach, with a 145 kg warhead. All 16 missiles can be ripple-fired in 2-3 second intervals. The Delhi Class will be retrofitted with the GLONASS-steered, land-attack 3M24E1 Uranium ASHM at a later date. The 3M24E1 ASHM - export variant of the 3M24M1 - has more fuel, which extends range to 250 km.

Fire control for the missiles, is provided by a Garpun-Bai FC (NATO: Plank Shave) radar, mounted atop the bridge. This radar combines active and passive channels and in the active target designation mode, it operates in X-band (I/J-band) and can handle up to 150 targets at ranges between 35 - 45 km, although it is possible to obtain ranges of more than 180 km in wave-guide propagation conditions. The passive channel operates in the ESM mode searching for pulse and CW signals, and accurately identifying the bearing of hostile emitters from a built-in classification library of up to 1000 signatures. The maximum range of the passive channel is over 100 km depending on the frequency.

In the air defence role, a pair of 3S-90 launchers - one installed forward of the bridge and the other atop the dual helicopter hangar - are fitted with the Shtil SAM system. The Shtil system comprises of the 9M38M1 (SA-N-7, navalised SA-11) missile and 24 such missiles are carried in a below-decks magazine. The launchers elevate up to 70° but have a limited firing arc of 30° within the centreline. The launcher groups require a crew of 20 men and weigh about 50 tons. Target tracking data is provided by the MR-775 Fregat MAE planar array radar which can engage up to 12 targets at ranges of 32 km. Target illumination and semi-active homing is provided via six MR-90 Orekh (NATO: Front Dome) illuminators, four mounted forward and two aft.

The 9M38M1 SAM, designated as Kashmir by the Indian Navy, is armed with a 70 kg high-explosive warhead, has a maximum speed of Mach 3 (830 m/s) and can manoeuvre up to 20 g. The
BrahMos PJ-10

Country: India  
Class: S/Su/L/ALCM  
Target: Land, Ship  
Length: 9.00 m  
Diameter: 0.67 m  
Launch Weight: 3900.00 kg  
Payload: 200 kg HE  
Propulsion: Ramjet w/ solid booster  
Range: 300.00 km  
Guidance: INS, GPS, active and passive radar  
Status: Development  
Related Country: Russia

The BrahMos is a supersonic cruise missile that can be launched from submarines, ships, aircraft or land. It is a joint venture between India’s Defense Research and Development Organization and Russia’s NPO Mashinostroenienya who have together formed the BrahMos Corp. Propulsion is based on the Russian Yakhont missile, and guidance has been developed by Brahmos Corp. At speeds of Mach 2.5 to 2.8, it is about three times faster than the American subsonic Tomahawk cruise missile.

The BrahMos PJ-10 is a short-range, ramjet powered, single warhead, supersonic anti-ship cruise missile developed and manufactured by India and Russia. Ship-, air-, ground-, and submarine-launched versions exist. It is currently among the most formidable cruise missiles in development.

The BrahMos has been developed as a joint venture between the Defence Research and Development Organization (DRDO) of India and the Federal State Unitary Enterprise NPO Mashinostroyenia (NPOM) of Russia under BrahMos Aerospace. The missile is named after two rivers, the Brahmaputra and the Moskva.

As an anti-ship missile, the BrahMos PJ-10 is distinguished by its reported supersonic speed of Mach 2.8, approximately one kilometer per second. In addition to making it difficult to intercept, this speed also imparts a greater strike power. In comparison, the U.S. RGM/UGM-109 “Tomahawk” cruise missile, which has been used successfully in both Iraq and Afghanistan, operates at a subsonic speed of less than Mach 1.0. Most other anti-ship missiles fly at subsonic speeds as well.

In addition, the BrahMos is equipped with stealth technology designed to make it less visible to radar and other detection methods. The missile also has a high level of accuracy, which has been established by recent test flights as close to zero circular error probability (CEP). The missile operates on the “fire and forget” principle, meaning that