

Several projects being developed successfully for the services: DRDO Chief G Satheesh Reddy

DRDO is undertaking a number of projects for the Indian Army – these include Development trials of Advanced Towed Artillery Gun System (ATAGS) which are completed

By Huma Siddiqui

In the second part of the interview, DRDO Chief Dr G Satheesh Reddy talks about the progress made in various projects including the Main Battle Tank for the Indian Army, Light Combat Aircraft and other platforms. Following are the excerpts.

What are the plans for the Main Battle Tank (MBT) ‘Arjun’? Have the technical issues been resolved?

‘Arjun’ is one of the best in the class of Main Battle Tanks. Improvements suggested by the user during the exploitation of the first two regiments of Arjun and a number of upgrades like Track Width Mine Plough (TWMP), Remote Control Weapon System, Explosive Reaction Armour, Automatic Target Tracking, Commander’s Panoramic Sight with Night Vision, etc., have been incorporated in Mk1A version which has undergone user trials.



124 MBTs have already been manufactured at Ordnance Factory Board (OFB) and delivered to the Indian Army. Production capacity exists to meet the Army demand. Placement of indent for additional regiments of Arjun MBT Mk 1A is likely to happen soon.

By when do you think the AIP will be ready to be integrated on the Indian Navy’s submarines?

The AIP has passed the development trials demonstrating the endurance test at limited power levels. Full power trials are scheduled this year. Parallely, work is also going on in chalking out an integration plan on the submarines by 2024.

Do you have a supply chain like some of the foreign companies have here?

The Indian private sector is involved in the development of various subsystems for DRDO and becomes part of the supply chain during the production phase after successful evaluation of the system. The supply chain of vendors for all products developed by DRDO gets established by the time the evaluation of the system is completed.

Transfer of Technology (TOT) is provided to the concerned industries. The industries working with DRDO have developed good capability and have become established as a proven vendor base for DRDO developed systems.

For example, in Akash missile production there are more than 200 industries involved, supplying various components and subsystems. In fact, the lead production agencies mostly integrate the systems from the components and sub-assemblies sourced from the specified vendors developed by DRDO. Our strength is the industry base developed by us for specific products with quality standards.

What are the projects for the Indian Army that DRDO is focusing on?

DRDO is undertaking a number of projects for the Indian Army – these include Development trials of Advanced Towed Artillery Gun System (ATAGS) which are completed; Development trials of Pinaka guided rocket including salvo firing and demonstration of range with pin-point accuracy has been conducted. Development of Quick Reaction Surface-to-Air Missile (QRSAM) Air Defence on move systems having the capability to search, track and engage targets on short halts have been

proven. Indian Air Force (IAF) order for additional squadrons of surface-to-air missile system (SRSAM) Akash has been placed. The Indian Army is also in the process of procuring two more Akash regiments fitted with the indigenous seeker. Medium-Range Surface-to-Air Missile (MRSAM) is in an advanced stage of realization. NAG has completed the development and user trials and is ready for induction. Man-Portable Anti-Tank Guided Missile (MPATGM) & Helina is in advanced stages of development.

A number of variants of radars for different applications have been developed by DRDO for the Army like, ADFCR and ADTCR. Weapon Locating Radar SWATHI has already been deployed after inducted and is being exported now.

What is the status of Advanced Multi-role combat aircraft (AMCA)?

AMCA is a 5+ generation aircraft with twin engines and stealth capability. The design phase is underway seriously. Development plans are made.

DRDO has been involved in the Light Combat Aircraft (LCA) Project. Are you satisfied with its journey?

LCA 'Tejas' has come a long way and matured in terms of the first indigenous fighter aircraft. Final Operational Clearance (FOC) for LCA Tejas has been issued and the production order for Tejas Mk1 has been placed. Successful trials of LCA Navy version from INS Vikramaditya, both landing and take-off have placed India in an exclusive club of nations with this capability. A lot of technologies have been developed, eco-system has emerged and the experience gained in configuration, design and development of fighter class aircraft will help us in taking up much more technologically advanced programs. There are only a few nations in the world that have achieved this feat of making a fighter aircraft of their own and India is one of them.

India has not succeeded in making its own engines. What are the challenges being faced?

We have got a lot of knowledge base during the development of Kaveri engine. Insights were gained in the field of material developments, various subsystem development, manufacturing, and assembly and testing of an engine of this class. Kaveri Engine developed may not meet present LCA requirement, but variants will be used in other applications. Now, the teams are equipped to take up the development of next-generation aircraft engine.

<https://www.financialexpress.com/defence/several-projects-being-developed-successfully-for-the-services-drdo-chief-g-satheesh-reddy/1891392/>



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China hates India's fast and sneaky BrahMos missiles

No way to counter it?

By Sebastien Roblin

- **Key point: China has no good way to defend itself against India's missiles. However, both countries are nuclear powers and so will deter each other.**

While many of us remain mesmerized by the unfolding shambles in the Middle East, the world's two most populous countries have gotten into a tiff over missiles. And I'm *not* referring to the ballistic kind for once.

“India deploying supersonic missiles on the border has exceeded its own needs for self-defense and poses a serious threat to China’s Tibet and Yunnan provinces,” complained the People’s Liberation Army Daily. “The deployment of BrahMos missile is bound to increase the competition and antagonism in the China–India relations and will have a negative impact on the stability of the region.”

“Our threat perceptions and security concerns are our own, and how we address these by deploying assets on our territory should be no one else's concern,” an Indian military source sniffed in response.

We’ll first look at the BrahMos’s capabilities and why they are considered a big deal, then plunge into why their deployment and export by is perceived as such a threat by China.

Indeed, the BrahMos cruise missile is stealthy, fast and extremely difficult to shoot down. It also has become a point of contention in a complicated web of overlapping alliances between India, China, Russia and potentially Vietnam.

Supersonic Carrier Killers

BrahMos began in the 1990s as a joint project between Russia and India to develop an Indian version of the P-800 Oniks cruise missile. The missile’s name is a portmanteau of the rivers Brahmaputra and Moskva in India and Russia, respectively.

Cruise missiles are designed to be fired at long ranges from their targets so as not to expose the launching platform to enemy retaliation. The quintessential cruise missile is the Tomahawk, developed in the United States. Fired by ships and aircraft, the 2,900-pound missile can cruise up to one thousand miles (depending on the model) at a speed of five hundred miles per hour—roughly the speed of a typical airliner—before slamming into its target.

During the Cold War, Russia developed a *different* style of cruise missile designed to take out American aircraft carriers. These flew over the speed of sound to better evade the carrier’s defenses—which include air-to-air missiles fired by fighters, surface-to-air missiles and Gatling-cannon Close-in weapon systems, or CIWS. They were also larger to increase the likelihood of achieving a kill in one hit.

Ramjets were used to maintain high speeds over long distances. A ramjet uses incoming air at high speeds to achieve compression instead of using a compressor, saving on fuel. However, a ramjet needs a boost from another source to help it achieve that airflow in the first place. In the case of the BrahMos, a rocket provides the initial acceleration before the ramjet takes over.

The BrahMos is actually slightly faster at Mach 2.8 than the P-800. It also weighs *twice* as much as a Tomahawk, at six thousand pounds.

The combination of twice the weight and four times greater speed as a Tomahawk result in vastly more kinetic energy when striking the target. Despite having a smaller warhead, the effects on impact are devastating.

Even more importantly, the BrahMos’s ability to maintain supersonic speeds while skimming at low altitude makes it very difficult to detect and intercept. To cap it off, the BrahMos performs an evasive “S-maneuver” shortly before impact, making it difficult to shoot down at close range.

A modern ship targeted by the BrahMos could respond with layered defenses to shoot down the missiles: ripple-fired medium- and short-range anti-aircraft missiles and close-range CIWS. But an effective attack would involve firing multiple missiles in order to overwhelm these defensive countermeasures.

If the attack is launched within 120 kilometers of the target, it can skim at very low altitude the entire way to the target. While missiles can be detected earlier if benefiting from AWACs aircraft, a ship would likely detect a sea-skimming missile at range of only thirty kilometers, affording the vessel only a thirty second time window to respond. One intriguing analysis argues that a U.S. Arleigh Burke-class destroyer, with its layered air defenses, could not handle more than twelve BrahMos missiles at once and that an entire carrier battle group would be saturated by more than sixty-four.

Of course, though India has some unpleasant memories of an encounter with a U.S. carrier group in the past, they probably have a different foe in mind.

In any case, the BrahMos has a major limitation...

The Missile Technology Control Regime

The BrahMos has a relatively short range—only 190 miles (290 kilometers)—under half the range of the Russian Oniks missile. This means that BrahMos launch platforms need to be relatively close to their targets—potentially within ranges they may be detected and fired back at.

This was purposefully done in order to conform to the Missile Technology Control Regime (MTCR), a partnership of thirty-five countries which restricts the export of cruise missiles with ranges over three hundred kilometers. Russia is a member of the partnership—and just this June 28, India acceded into membership. And here we get into some interesting geopolitical strategy.

China is *not* a member of the regime, but would dearly appreciate the chance to deal in the market. India, on the other hand, would like to join the Nuclear Suppliers Group which regulates which nuclear technologies are permitted for trade. But China blocked its accession in June this year.

By adhering to the MTCR, India gained access to it—and now hopes to use that access as leverage versus China. Notionally, they could arrange a quid pro quo trading Indian NSG membership for Chinese admission to the MTCR. Whether it will work out that way remains to be seen.

Multiple Targets for Multiple Launchers

The BrahMos isn't just an antishipping weapon—it also can hit ground-based targets, and is ideal for precision attacks against fixed installations such as radars, command centers, airbases and enemy missile batteries. It can also potentially carry a 660-pound nuclear warhead, though that doesn't appear to be its primary intended use.

There are quite a few variants of the BrahMos missile designed to be used by the different platforms of the Indian military against either land or naval targets.

The Indian Navy's BrahMos missiles mostly use eight-cell Vertical Launch System launchers. Six of its frigates and two destroyers have a single BrahMos launcher, while three of its destroyers have twin launchers. More BrahMos equipped ships are under construction.

The Navy has also successfully tested in 2013 a submarine-launched version which is expected to enter service in future vessels. Submarine-launched BrahMos could potentially be launched fairly close to the target without being detected.

India has also developed the BrahMos-A, designed to be launched from its Su-30MKI strike fighters. Finding a way to mount such a heavy missile on a fighter plane has taken years of work—in the end, the Su-30s had to be specially modified for the task. The first test flight was carried out in June this year. India has already requisitioned two hundred BrahMos-As, and plans to convert forty Su-30MKIs to carry them. This offers yet another flexible means to deliver the missiles close enough to their intended targets.

Finally, there are ground-launched Mobile Autonomous Launcher systems mounted on twelve-wheeler trucks. These are organized in regiments of five launchers with over 100 missiles. India is deploying a fourth missile regiment to Arunachal Pradesh, reportedly at cost of over 4,300 crore (over \$640 million dollars.)

These are what have spooked the Chinese military, particularly since the new Block III missiles are designed to steep dive at seventy-degree angles to hit targets on the rear slopes of mountains. This has obvious application against the heavily militarized Himalayan border with China.

that India is pressing ahead with the development of even deadlier BrahMos variants. To begin with, some reports imply India tested in 2012 a version with a new satellite guidance system and a range of five hundred kilometers. Some argue that even the regular BrahMos may be capable of going further than its claimed 290-kilometer range.

India will also soon introduce the next-generation BrahMos-NG, which is smaller (only three thousand pounds,) faster (Mach 3.5,) and stealthier (smaller Radar-Cross Section.) It should be deployable from land, sea and air systems, including multiple missiles carried on fourth-generation fighters.

Additionally, India will soon be testing a scramjet-powered *hypersonic* BrahMos II missile capable of zipping along at Mach 7. Needless to say, these would be even harder to detect and shoot down and afford defending ships just seconds to react. The U.S. military has only just begun development a hypersonic missile of its own.

Russia, for its part, has appreciated the BrahMos's commercial success, but seems to have only limited intention of fielding it: it may potentially deploy the system to Gorshkov-class frigates. It has more capable Zircon missiles (believed to be the model for the BrahMos II) in development and longer-range Oniks missiles already in service.

Showdown Over the Himalayas—and the South China Sea?

The BrahMos is a new game piece in India's tense relationship with China. Chinese troops invaded India's Himalayan border in a 1962 war that is still bitterly remembered in India. In the last decade, the Chinese border garrisons began to rapidly increase in size, leading to similar escalation on the Indian side. China's close relationship with India's historical enemy, Pakistan, and its development of military base in Gwadar, Pakistan—seen as an attempt to encircle India—are another source of tension.

In the fall of 2014, Chinese President Xi Jinping visited India in order to improve relations. However, a group of Chinese border troops appeared to have disregarded the civilian leadership and launched an embarrassing (though fortunately nonviolent) standoff that cast a shadow on any progress made.

The BrahMos cannot reach very far into Chinese. Although China is upset about the BrahMos missile's presence on its border, it probably should be more worried that India is announcing it is close to a deal for selling the weapon to Vietnam.

Suffice to say, relations between China and Vietnam have a very long and complicated history, including a war in 1979. They recently have chilled over Chinese claims to the South China Sea. A particularly low point came with a Chinese oil expedition in 2014 that began drilling in Vietnamese-claimed waters, causing violent protests and a naval confrontation.

The Vietnamese Navy isn't going to match China's rapidly expanding flotilla any time soon. But small Vietnamese ships with BrahMos missiles could pose a major threat to China's larger military vessel. Thus, if Vietnam does acquire the weapon, this would affect the balance of power in the Pacific.

Therefore, India may attempt to cultivate an alliance with Vietnam in order to counterbalance China.

Other countries interested in the BrahMos include Malaysia, Brazil, Chile, Venezuela, South Africa and Indonesia.

Reading the Cruise Missile Tea Leaves

The politics of the BrahMos system also highlights the limited potential of a Chinese-Russian alliance. Russia historically has strong ties with both India and Vietnam. It's relationship with China has been more *complicated* (notice how that word keeps showing up?) After an energy agreement in 2014, there has been much speculation of a Chinese–Russian alliance based on shared authoritarian ideology and a desire to counterbalance the United States. However, the sale of the BrahMos missile to India and Vietnam illustrates that while Russia wishes to remain on good terms with all three countries, it is not yet committed to an alliance with China the expense of its economic interests or its own concerns with its powerful neighbor.

What can China do in response to the threat posed by the BrahMos missile?

Simple! It can de-escalate the conflict with India. India is a democracy with all the messy internal political deliberations that implies—it's not about to launch a massive surprise invasion of the Himalayas. A well-managed de-escalation wouldn't have to carry a huge political cost. The average Chinese citizen likely doesn't have strong feelings on the precise boundaries of the McMahon line.

Disputes over lightly populated Himalayan mountains *shouldn't* constitute a truly substantive conflict of interest between the two countries—but they have been allowed to flourish into full blown military competition. It is obvious the two Asian powers are wary of each other. But both would be better served by reciprocated détente, allowing billions spent fortifying the border to be redirected to the economic needs of the two countries.

<https://nationalinterest.org/blog/buzz/china-hates-indias-fast-and-sneaky-brahmos-missiles-130472>



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Is India's missile defense making war with Pakistan more likely?

India should have kept it quiet

By Michael Peck

- **Key point: India and Pakistan are already in an arms race for all intents and purposes.**

India says it has successfully tested an interceptor capable of shooting down ballistic missiles.

But could this trigger a nuclear war with Pakistan?

On August 2, the Defense Research Development Organization (DRDO) -- India's equivalent of the Pentagon's DARPA research agency -- launched an Advanced Area Defense (AAD) missile from Abdul Kalam island off India's eastern coast.

"The endo-atmospheric missile, capable of intercepting incoming targets at an altitude of 15 to 25 kilometers [9 to 16 miles] was launched against multiple simulated targets of 1,500 kilometer [932 mile]-class ballistic missiles," according to the DRDO announcement.

"One target among simultaneously incoming multiple targets was selected on real time, the weapon system radars tracked the target and the missile locked on to it and intercepted the target with a high degree of accuracy. The complete event including the engagement and interception was tracked by a number of electro-optical tracking systems, radars and telemetry stations. All the mission objectives were successfully met."

India's missile defense program is a two-tiered system: the Prithvi missile (derived from the Prithvi tactical ballistic missile) for exo-atmospheric intercepts in outer space, before they near the target, and the Advanced Area Defense missile for endo-atmospheric intercepts within the Earth's atmosphere, in the terminal phase when the target warhead is making its final descent.

In that sense, it is similar to the 1960s U.S. Anti-Ballistic Missile System, which used Safeguard and Sprint missiles, or any integrated air defense system. A long-range interceptor to take out the incoming missile far from the target, and a short-range point defense weapon to destroy any missile that penetrates the long-range screen.

Previous tests of Indian interceptors targeted short-range Prithvi ballistic missiles on a trajectory that mimicked medium-range missiles. The Diplomat magazine suggests that the dummy target this time could have been an Agni, an intermediate-range missile capable of carrying nuclear warheads.

Indian press trumpeted that India's missile defense is a homegrown program developed by India, rather than imported from Russia and America as are so many Indian weapons such as jet fighters and tanks. That's no small point of pride for the world's second most-populous nation, once the poster child for poverty, and now the world's sixth-largest economy.

Interestingly, while India boasts of developing its own missile defense system, it is also buying Russian S-400 air defense missiles capable of intercepting missiles as well as aircraft.

"The S-400 acquisition, which has some utility for missile defense, suggests that India is interested in the capability and not merely letting DRDO have a science project," Christopher Clary, a professor of international relations at State University of New York Albany, told *The National Interest*.

But there is another danger with Indian missile defense, as history shows. When America and the Soviet Union developed anti-missile systems in the 1960s, the opposing superpower either built more missiles, or increased the number of warheads on existing missiles, to saturate enemy defenses.

So what will Pakistan do?

India and Pakistan "are already in an arms race for all intents and purposes and have been so for some time," Georgetown University professor C. Christine Fair, who has written on the Pakistani military, told *The National Interest*.

"There is, of course more nuance: Pakistan has the world's fast growing nuclear weapons program. India has chosen not to reciprocate in growing its stockpiles. Pakistan has and is trying to acquire tactical nuclear weapons while India has demurred."

"Pakistan will field more warheads on more delivery vehicles than it would in the absence of BMD [ballistic missile defense], Clary says.

"Pakistan could develop multiple warheads for its current ballistic missiles, or develop short-range tactical nuclear weapons and cruise missiles that are harder to intercept."

In turn, a Pakistani buildup might prompt an India buildup, sparking a vicious cycle reminiscent of the Cold War.

Ironically, India is notorious for developing home-grown weapons, such as aircraft and tanks, that take much longer to develop than expected, and are plagued with problems when they are fielded. But as always with nuclear weapons and missile defense, perception is everything.

"The biggest problem from India's side is that it all too frequently announced that it has a capability which mobilizes Pakistan to innovate when in fact India is a long way from achieving the stated capability but Pakistan has already developed a counter measure," Fair warns.

<https://nationalinterest.org/blog/buzz/indias-missile-defense-making-war-pakistan-more-likely-129967>