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Peering Down the Hatch: A Quick Peek at India's Submarine-world

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In July of 2020, Indian troops forcefully reminded their Chinese counterparts in eastern Ladakh on the trans-Himalayan border that the resolve of the present government and the people of India was a far cry from the political naivete that led to the debacle of 1962. Over the past six months, the regional geopolitical landscape has been undergoing remarkable roiling and churning. The vicious trade war between the USA and China, the political upheaval in the USA as the Trump administration reluctantly and truculently handed the reins of government to that of President Joe Biden, China's uncompromising aggressiveness in the South China Sea and the East China Sea, and, Beijing's deployment of increasing numbers of the PLA's naval elements beyond the western Pacific and into the Indian Ocean, its consolidation of naval facilities in Djibouti and in the Turbat-Jiwani-Gwadar-Pasni triangle, are only a few of the several manifestations of this oceanic churn. There is a discernible buzz from defence, security, and strategic analysts from around the world, over the possibility of armed conventional conflict involving, in one or another fashion, countries such as those comprising what some are already calling the 'QUAD-Plus' (India, Australia, Japan, the US, and France — and possibly Vietnam) on the one hand, and a collusive and collaborative axis of China and Pakistan (with Russia and Turkey being the wild card) on the other. On New Delhi's Raisina Hill, there is a growing realisation that trans-Himalayan face-offs are likely to grind down into land-centric attrition, but, the Indian Navy might well hold the key to India gaining an asymmetric advantage over the Sino-Pakistan combine. Consequently, there is renewed urgency in the upgrading of naval capacity and capability in all dimensions of possible maritime conflict, not limited to the physical dimensions of surface, subsurface, and airborne conflict, but also including space — both, outer-space and inner-space (the latter also being commonly referred-to as 'cyberspace') — and relatively new domains and dimensions, such as those involving 'lawfare' and 'grey-zone' forces.

Subsurface warfare, involving capacity (e.g., submarines and antisubmarine platforms, weapon-sensor suites, equipment, etc.) and capability (human skills honed by training, organisational structures, legal frameworks operational philosophies, etc.) is of particular interest and relevance. While anti-submarine capacities and capabilities demand a separate discussion, this article seeks to provide some the reader with a few fundamentals of Indian submarine capacities and capabilities, which are necessary to generate and sustain 'informed' debate.

With commissioning, on the 10th of March this year, of the INS *Karanj* — in her new avatar as India's third Scorpène Class submarine — this might an appropriate moment in which to present some of these fundamentals to the lay reader.

Ever since they were first developed and deployed in combat (this was as long ago as 1776 during the American War of Independence) submarines have principally been used to counter surface ships. It is in this anti-shipping role that they enjoy the greatest advantage, because lurking as they do within the complex underwater domain, their very presence is, more often than not, unknown to their adversaries. Within the underwater medium, electromagnetic waves (such as those emitted by radars) prove quite inadequate for echo-ranging as they suffer very significant attenuation. On the other hand, sound waves travel very well through the water with far less attenuation. Therefore, within the underwater domain, devices that can generate directed sound energy for echo-ranging are much sought after for navigation as well as for combat-purposes. These devices are generically known as 'sonars'. However, the underwater medium is far more complex than the medium of the air. Sound beams behave quite a lot like light beams and they tend to 'bend' or refract when moving from portions of the sea that are denser to ones that are rarer, and vice versa. Density of water varies with the temperature. As the sun heats the oceans on an hourly, daily, or seasonal basis, it changes the density of the underwater column. So, a sound wave that is generated underwater does not travel continuously in the direction in which it was sent out. It bends upward or downwards depending upon the temperature and density of the water through which it passes. Since echo-ranging is basically a function of measuring the time that a sound wave takes to echo off an object and return to the source that generated it, for this method to be accurate, the speed of sound is taken to be a fixed value. However, the speed of sound varies with salinity and is different in fresh water than in salt water. Thus, by varying its depth at will, a submarine tries to benefit from the conditions of temperature, density, and salinity that prevail in the area in which it is operating. This ability to vary depth, gives a submarine an asymmetric advantage over a surface ship. Moreover, the performance of the ship's own sonars is invariably degraded by the noise that the ship itself is making in the close proximity of its sonar array, because the ship's propulsion plant, being diesel, or gas-turbine or steam-turbine driven, is much noisier than that of a submarine, especially one that is being propelled by electricity generated from its onboard batteries. Such diesel-electric submarines (also known as conventionally-powered submarines) go by the generic NATO acronym, 'SSK'. Other complications are caused by the plethora of natural underwater noises generated by fish, mammals, underwater currents, geothermal activity, seaborne craft and vessels other than those of interest, etc. The challenges of separating the returning echo (the 'signal') from other sounds ('noise') is common (but not necessarily equal) in both, submarines and ships.

Offsetting these advantages of an SSK is the fact that onboard batteries can drain very quickly, particularly if the submarine is trying to proceed at high underwater speeds. The need to maximise battery-endurance demands that SSKs travel at very low speed compared to a ship. Even then, the batteries need to be charged periodically and the submarine must draw in oxygen from the atmosphere to run its diesel generators that will charge its batteries. This usually entails the submarine raising some sort of hollow tube (typically called a snorkel or snort-mast) that breaks the surface of the water and consequently renders the submarine more vulnerable to

detection. The desire to enhance underwater endurance has led to the development of a variety of air-independent propulsion (AIP) systems. The Indian DRDO has very recently unveiled an indigenous AIP system that holds out very substantial promise. Although an AIP system does enhance underwater endurance to some extent, it does not enhance underwater speed. Nuclear propulsion, on the other hand, maximises underwater speed and endurance, but is noisier than battery-powered propulsion. This is mostly because such submarines are propelled by steam turbines, the steam itself is produced by heating water. The heat required to convert water into steam water is generated by a nuclear fission reactor. The fitment of a nuclear-powered steam propulsion plant requires a much larger submarine hull and this, in turn, severely constrains the submarine's ability to operate in the relatively shallow waters found in most narrow straits and also in sea areas that are close to the coast.

Weapons employed by submarines are typically anti-ship torpedoes and/or anti-ship cruise (i.e., non-ballistic) missiles, but could also include cruise or ballistic missiles that are optimised against targets located on the land. Naturally, the need to carry large, long-range ballistic missiles, once again significantly increases the size of the submarine hull itself. This, in turn, dictates a much larger overall 'volume' of water that the submarine requires for safe operations (which is another reason why large submarines cannot use relatively shallow straits for underwater transits).

Quieter submarines are sometimes used to operate against other, less quiet ones. In such cases, both opponents are now within the same (underwater) medium and the advantages of varying depth must now be shared more equally than was the case against surface-ships. Since submarines, too, generate underwater sound in a large number of frequencies, the factor determining surprise is 'relative noisiness' — more usually called 'stealth'. Even amongst nuclear powered submarines, stealth varies widely. Large, long-range, nuclear-tipped ballistic-missile-carrying submarines (SSBNs) are inherently noisier than are smaller ones (SSNs) that carry cruise-missiles and torpedoes as their principal weapons. Consequently, if one has SSNs in one's inventory, these are often deployed to detect and then continuously shadow an enemy's SSBNs. Likewise, modern diesel-electric submarines (SSKs) are often far quieter than an SSN and are designed to shadow/track and, where necessary, attack, not just surface ships but also SSNs — or even other, relatively-noisier diesel-electric submarines.

With the above very brief and very basic summary providing a backdrop, let us consider the Indian case, wherein the Indian Navy's Submarine Arm is now running its 55th year and provides a well-established, mature, and well-honed combat capability upon which India may repose its fullest confidence. India's submarine story actually began in 1959 when the young Indian Navy made its first serious bid to convince the government that the country needed a submarine arm. It was proposed to acquire four *Oberon* Class submarines from the British Royal Navy. It took the Navy three years of stubborn battle with the Indian bureaucracy — a battle that was significantly shaped by the grudging realisation that the militarily-inept politico-bureaucratic leadership of the late-1950s and early-1960s had led to disaster in the India-China armed conflict of 1962 — before the government finally agreed to the training of nine Indian officers, in the UK. This training with a mature navy that possessed decades of experience in the operation and maintenance of submarines proved invaluable. However, although the actual

acquisition of the four submarines was eventually approved by the Government of India in 1963, the British turned out to be obdurate, typically condescending, and grossly unreasonable, in their negotiations, which eventually failed. The very next year (1964), the Soviet Union, seeing a major opportunity to draw India into its fold, offered four of its very successful and contemporary 'Type-641' submarines (whose NATO designation was the 'FOXTROT' Class). New Delhi, still smarting from the demeaning attitude of the British, viewed the Soviet offer as a godsend and accepted with alacrity. Indeed, in the early- and mid-1960s, the proliferation of warships, including submarines, being 'gifted' to Asian countries by the erstwhile Soviet Union was marked. An early beneficiary of Soviet naval largesse was Indonesia. Between 1959 and 1962, Indonesia, acquired 12 to 14 ex-Soviet submarines pf the *Whiskey* Class.[1] In the India-Pakistan conflict of 1965, reportedly colluding with Pakistan, Jakarta even despatched one of these Whiskey Class submarines to threaten the Nicobar group of the Andaman & Nicobar Islands! Of course, much water has flowed under that bridge and the Indonesia that one knows today is a far cry from the Surkarno and Suharto dictatorships of that time. This demonstration, howsoever minimalist, of the alarm that could be engendered by submarines, lent impetus to India's own acquisition plans. In December of 1967, INS *Kalvari* became the first submarine to fly India's flag.[2] As India's submarine fraternity gained expertise with these Soviet (and later, Russian) submarines and became familiar and comfortable with the logistic supply-chain upon which their maintenance depended, India's dependence-upon and preference-for Soviet/Russian submarines became increasingly evident. Despite this, it was the Indian Navy, rather than the Government of India, that recognised that the only way for India to break away from this potentially-crippling dependence was for the country build submarines indigenously.

Accordingly, as early as 1969, barely two years after the commissioning of the *Kalvari*, the Indian Navy submitted its proposal for an indigenous submarine-construction programme. It took an incredible eight years of bureaucratic delay before the Government would accord even its 'preliminary approval' and another two years for an 'in principle' approval to be accorded[3] for an indigenisation programme that so many now extol and wish to take credit for. In the interim, of course, Indian tactical and technical ingenuity had already garnered both credit and respect in terms of the operation and routine maintenance of these submarines.

The answer to the oft-repeated question of why, even allowing for such a grossly delayed start, and in spite of its proven ability to build far more complex SSBNs of the *Arihant* Class, India has not been able to effect series production of SSKs India has been establish an indigenous series production of SSKs is to be found in the politics and prevalent economic condition of India in the 1980s.

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[1] "Indonesia Submarine Capabilities", Nuclear Threat Initiative (NTI), 18 February 2021, https://www.nti.org/analysis/articles/indonesia-submarine-capabilities/
See also:
"Indonesia Navy - Living Dangerously Under Sukarno", GlobalSecurity.org website, https://www.globalsecurity.org/military/world/indonesia/alri-sukarno.htm

[2] Commodore Lalit Kapur, "India's Conventional Submarine Saga" in *"India's Silent Hunters"*, Geopolitics, NewsEye Media Pvt Ltd, New Delhi, September 2017

[3] *Ibid,* p. 49

Submarine-building in India began in 1981, with contracts being signed between the Government of India and Messrs Howaldstwerk-Deurschewerft AG (HDW) of Germany for the acquisition of four 'western' advanced SSKs. The first two submarines were to be constructed in Germany so as to minimise any delay in acquisition while Mazagon Docks Ltd (MDL) was being provided with the shipyard machinery and material that was necessary for submarine-construction in India. The third and fourth submarine would be built by the MDL. It is pertinent to mention that the Navy was in favour of entering into a contract with Messrs Kockums of Sweden, but the government eventually opted for HDW. Construction of INS *Shalki* and INS *Shankul*, the two indigenously-built SSKs, began in 1984, two years after construction of the first one had commenced in Germany. While the German submarines took some four years to be ready for commissioning, the MDL took more than twice as long (eight years for the *Shalki* and ten years for the *Shankul*). And then, just as the MDL was settling down for series production of these submarines, the massive depreciation of the Indian Rupee[4] effectively removed from the table the original intention of building another two submarines under the 'option clause' of the original agreements of 1981. Amongst the difficulties reportedly cited in 1987 by the German officials involved in the price negotiations for the exercise of the option clause was a payment of 7% commission to Indian agents of HDW. When this was brought to the notice of Mr VP Singh, the then Raksha Mantri, he launched an inquiry by the CBI and resigned three days later. This on-again-off-again CBI inquiry eventually came to naught, but in its wake, all the investment made in capacity-development in MDL and, more importantly, all the investment in capability-development by way of skilled shipyard workers and technicians, was lost. In fact, many of these highly skilled and intensively trained workers migrated to Australia and helped that country build its own submarines of the *Collins* Class. This is why India lost not one but two decades of time, both largely due to gross inadequacies in its bureaucratic structure. This is where and why China irretrievably overtook India.

In the meanwhile, in the early-1980s, even as negotiations for the indigenous SSK-project were in progress, the Government of India approached the Soviets for replacements for the FOXTROT/*Kalvari* Class submarines with ones equipped with tube-launched missiles (i.e., missiles that could be launched from the submarine's torpedo tubes themselves). This led to the acquisition by India of the KILO/*Sindhughosh* Class submarines, whose stealth characteristics were outstanding. The first of the Class, INS *Sindhughosh*, was commissioned in 1986 as part of a contract for six submarines. Deliveries were swift and in a matter of three years, that is, by 1989, the Indian Navy was able to deploy the *Sindhughosh*, the *Sindhudhvaj*, the *Sindhuraj*, the *Sindhuvir*, the *Sindhuratna*, and the *Sindhukesari*. Four additional submarines were contracted-for over the next few years and by the commencement of the current millennium, the *Sindhukirti* and the *Sindhuvijay*, the *Sindhurakshak*, and the *Sindhushastra* had been added to the Indian Navy's submarine holdings, making for a total of ten submarines of the *Sindhughosh* Class. This number has been reduced by two, as the *Sindhurakshak* was tragically lost due to an explosion in 2013, while the *Sindhuvir* has been leased to Myanmar (where it has been renamed the UMS *Minye Theinkhathu*). The total technical service life of each of these submarines is 35 years and, at or around the 13th year of service, each undergoes what is known as a 'Medium Refit' (MR). This

[4] India Rupee Inflation, InflationTool Online Calculator, 2021, https://www.inflationtool.com/indian-rupee?amount=100&year1=1980&year2=1987

takes two-to-three years, during which time, major upgrades are effected and the submarine is made ready to operate in the contemporary environment for another decade-plus. Then, around the 26th year of service, each boat undergoes a 27-month Service Life Extension Programme (SLEP), which enables it to be materially and operationally viable — once again within the prevailing contemporary environment — for the next 9-10 years. This notwithstanding, the end of service-life of four of these submarines will come to pass in the next 18 to 24 months.

And that brings us back to the question of indigenous construction of SSK submarines. India is now inching painfully back onto track, trying to once again imbibe cutting-edge technical, technological, industrial capacity and capability, this time in partnership with France. The MDL and Naval Group collaboration seems to be finally picking-up pace, with three of the six submarines of the *Scorpène* Class now being in commission, and another two expected to be handed over to the Indian Navy over the next twelve months or so.

The tragedy, of course, is that the agonizingly slow, suspicion-ridden process of governmental bureaucratic decision-making remains firmly in place. We are still awaiting a decision of which foreign shipyard will partner which Indian shipyard for the next six SSK submarines under 'Project *75-India*'. Even with years of delay having already occurred, the project, which is under the Strategic Partnership (SP) route is yet to get meaningfully underway. One or both of the two shortlisted Strategic Partners (SP), the MDL and Messrs Larsen & Toubro (L&T) will construct the submarines, while technical collaboration will with one of four of the world's major submarine-building companies, namely, **(1)** Naval Group of France (should it be selected, this will aid in series production since this company is, as has already been mentioned) involved in the production of the six *Scorpène* Class submarines under 'Project 75'; **(2)** Navantia of Spain (which has offered the S-80, a.k.a. the *Issac Peral* Class); **(3)** ThyssenKrupp Marine Systems (TKMS) of Germany (which has offered Issacs the 'Type 218', a.k.a., the *Invincible* Class); and **(4)** Rosboronexport of Russia (whose *Amur* Class is on offer). A 'wild card' remains South Korea's Daewoo Shipbuilding & Marine Engineering, which had, in response to the Expression of Interest offered its 'KSS-3' submarine.[5] However, the devil lies in the details and there are a host of complexities that still need to be resolved by the MoD.

Turning briefly to submarines powered by nuclear propulsion (SSNs and SSBNs), India currently builds SSBNs (e.g., the *Arihant*, the *Arighat*, and its follow-on variants), and has leased an SSNs (the *Chakra*) from Russia. In February 2015, the Modi government accorded political approval for six SSNs, makes a training and manpower upgrade for the Navy a critical objective over the next decade.

At the other end of the spectrum of manned underwater craft are 'midget' submarines. These submarines are typically craft of less than 150 displacement-tonnes, operated by a minimal crew numbering from two to seven, and, are mostly used for special operations. They normally work with mother ships, from which they are launched and recovered, and, which provide living

[5] Huma Siddiqui, "The Wait for More Submarines Gets Longer! Project 75 I Gets Delayed Further", Financial Express, March 9, 2021. https://www.financialexpress.com/defence/the-wait-for-more-submarines-gets-longer-project-75-i-gets-delayed-further/2209149/

accommodation for the crew and support staff. They are used for shallow-water surveillance as well as to attack the enemy's coastal installations and high-value targets such as ships in harbour. In India, they are sometimes known as 'SDVs' or 'Swimmer Delivery Vehicles'. This term, which is derived from the USA's SEAL Delivery Vehicles, includes two-man chariots — craft with whose early variants the Indian Navy has long-proven familiarity and skill — which provide marine commandos with access to close-to-shore areas that other submarines cannot reach due to shallow waters. They are also known as 'Strategic Operation Vessels' (SOVs), which term includes hybrid low-observable, submersible-cum-surface vessels that combine the benefits of stealth and high speed from a combination of SDV and high-speed Surface vessels.[6] At the high-end of 'midget' submarines are what are sometimes called 'Coastal submarines', which are much smaller than an SSK but larger than SDVs, and, exemplified by North Korea's *Sang-O* Class, the Former Yugoslavia's *R-3E* Class, Croatia's *Drakon-220,* and Iran's *Fateh* Class.[7] These are capable of carrying smaller craft used for clandestine naval operations, such as Chariot-type SDVs, and underwater-scooters.

Whatever be the descriptive term that is used, midget submarines certainly are a critical and long-overdue component of our marine commando (MARCO) capacity. The design and construction of midget submarines is a specialist function and needs a shipyard that has at least worked on basic submarine design. In 2012, the MoD, ignoring the impressive performance of Indian private shipyards and despite the extremely poor record and clear lack of competence of the struggling defence-PSU, Hindustan Shipyard Ltd (HSL), nominated HSL to build two midget submarines.[8] Nine years later, we are at a familiar impasse, but the bureaucrats of the MoD have moved on and are no longer accountable.

The Indian saga of indigenous submarine construction continues to be one, of unrealised potential, in a system burdened by political intrigue, bureaucratic incompetence and unaccountability, and an obsession with grossly inefficient public sector undertakings (PSUs). As former Chief of the Naval Staff, Admiral DK Joshi, had bluntly and publicly lamented, *"The root cause is this dysfunctional and inefficient business model that we have … While professional competence, accountability and responsibility is with the service, this is not the case with authority… Where there is authority, there is no accountability. And where there is responsibility, there is no authority."*[9]

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[6] "SDV 1000W", VOGO Ltd, South Korea, Product Brochure, http://www.vogoeng.com/bbs/board.php?bo_table=product01_e&wr_id=2

[7] HI Sutton, "Covert Shores", http://www.hisutton.com/Indian-Navy-Coastal-Submarine.html
See also: http://www.hisutton.com/Yugo_X-Craft.html

[8] Vivek Raghuvanshi, "India's HSL May Seek Foreign Help to Build Midget Subs", Defense News, 24 August 2016, https://www.defensenews.com/global/asia-pacific/2016/08/24/india-s-hsl-may-seek-foreign-help-to-build-midget-subs/

[9] Ramananda Sengupta, "The Sad Decline of India's Submarine Fleet and How the Navy is Rebuilding it", *quoting Admiral DK Joshi's TV Interview of October 2014 by the NDTV news channel*, Swarajya Magazine, 01 November 2015, https://swarajyamag.com/politics/the-sad-decline-of-indias-submarine-fleet-and-how-the-navy-is-rebuilding-it

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