Research Article

Indian Navy's Submarine Development Programme: A Critical Assessment

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Abstract

In the twenty-first century, undersea warfare is changing. The role of submarines and ASW is also adapting to the new maritime environment in the Indo-Pacific region. The Submarine arm of the Indian Navy plays a crucial role in this region. Except for the four recently inducted Scorpene submarines, the other conventional submarines are more than two decades old. India's ageing submarine fleet calls for greater focus on submarine acquisition. The 30-year (2000–2030) submarine building plan drawn up in 1998 envisaged the development of two parallel lines of six conventional submarines, to be constructed in India over twelve years. This is to be followed by 12 submarines of indigenous design based on the learning curve of the two lines to be constructed over the next twelve years. But, as of now, Project 75 has been planned for six submarines (with French design) in 2006, of which five are on active duty and the last one is undergoing sea trials. Project 75I has been sanctioned to build six submarines but with a new model involving two Indian firms, with the introduction of a strategic partner from the private sector to encourage their participation in the 'Make in India' policy. Despite India's capability to design, develop, build and operate strategic submarines with very high indigenous content, India's lack of capability to design conventional submarines raises the following questions, which this paper has tried to address: Is it related to inadequacies in capability or policy decision-making? Are there inconsistencies in defence procurement policy/procedure? Is there a need to evaluate the Strategic Partnership model before implementation? Is there a lack of access to technology?

Keywords

Indian Navy, Advanced Technology Vessel (ATV) Project, Project 75I, Make in India

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Introduction

Submarines are game changers and a boon for any navy possessing them. During World War Two, diesel-electric submarines sank more tonnage than warships in the Atlantic and Pacific (Lautenschlager, 1986–1987). Submarines are a crucial element in ensuring Sea Denial. The sheer presence of submarines can cause major military and diplomatic tension between nations. In the Falklands War, the sinking of the Belgrano by HMS Conqueror and her continued presence in the area kept the entire Argentine Fleet within the harbour (Harper, 2014). In 1954, a miniature nuclear plant powered the Nautilus, and by 1958, the Soviet Union had three different lines of nuclear-powered submarines with an intent to counter the aircraft carriers of the USA. Nuclear submarines have evolved, and today's SSNs and SSBNs are a force to reckon with. They are versatile, fast and more manoeuvrable, suitable for long-range patrols and capable of launching nuclear strikes. However, conventional platforms, by virtue of size and design, albeit slow, are capable of operating in shallow waters. Conventional platforms with AIP, like the Gotland Class, are known for having improved stealth features. Therefore, for a nation like India with a complex geographical location with a long coastline, vast ocean resources, large EEZ and a spread of littoral territories, the Indian Navy adopted a combination of conventional and nuclear submarines to protect maritime interests.

Over the past 40 years, the Indian Navy has indicated the envisaged force level requirement of 24 conventional submarines to carry out its duties effectively. Also, with the changing scenario in the Indian Ocean region and the increase in submarine force levels of nations in the region, the need to have a complement of nuclear attack submarines (SSNs) has gained ground. The latest development involves amending the 30-year submarine plan to convert the 12 submarines from phase 2 into six conventional and six nuclear submarines (SSNs). Although the Indian Navy has clear requirements for 24 conventional submarines and proven competence in designing indigenous equipment and systems for nuclear submarines, the actual force levels have always fallen short of the target. Currently, only 15 conventional submarines are in the inventory, with one submarine undergoing trials and expected to be commissioned by 2024.

Despite an approved 30-year submarine plan for the construction of 24 submarines, the required numbers have not been achieved as of date. Therefore, it is important to analyse the Indian naval submarine programme in detail. In this article, we will trace the roadmap of the Indian submarine programme since its inception, and the various facets involving the submarines, ranging from policy and plans, acquisition, operation and maintenance, modernisation, design/development, and manufacture of submarines over the years. The progress of the Indian conventional submarine programme will be examined in conjunction with the nuclear submarine programme to identify challenges that impact the availability of desired force levels for the navy.

Background

In pre-independence India, the Royal Indian Navy was only trained in anti-submarine warfare (ASW) to a very limited extent. One British submarine was deployed once a year for the Commonwealth exercises. This opportunity was used to conduct training. The Vice Admiral Godfrey, Commander-in-Chief of the Royal Indian Navy, proposed to the Chiefs of Staff Committee in a report of 1944 on the size and composition of the post-war forces in India to replace old ships with modern destroyers and frigates (Hiranandani, 2000). In phase-II, Vice Admiral Godfrey envisaged the acquisition of aircraft carriers and submarines. The Committee for Planning the Requirement of Armed Forces, 1945, also reiterated the importance of submarines for defending Indian Coastal Shipping in the event of an attack from the United States, China or the Soviet Union till the Imperial forces moved in for defence (Madsen, 2015).

Even though the Indian Navy realised the importance of the role of submarines in future wars, newly independent India faced three major challenges which significantly delayed the procurement of submarines. First, the India–Pakistan War of 1947 over the Kashmir issue shifted New Delhi's focus towards protecting the newly established border areas. The threat perception from Pakistan caused the priorities to lean towards the Army and Air Force. Moreover, the financial constraints and priority to focus on the nation's development significantly affected the navy's aspiration to grow as a major force in the region. In 1947, the Outline Plan for re-organisation and development of the Indian Navy was proposed, including the acquisition of four submarines (Hiranandani, 2000). But by 1951, budgetary constraints all but dropped the submarine plan itself. Second, the political establishment was not conducive to the idea of buying submarines. India's first Prime Minister Nehru, an idealist, adopted the non-alignment policy as India's foreign policy and saw the submarine as a means for offensive warfare. The land border with Pakistan and China was seen as the biggest challenge to India's national security. The maritime domain had not gained much interest in the national discourse. Third, the British did not concede to providing a submarine to India due to geopolitical reasons. Britain believed that providing submarines to India would tip the balance in favour of New Delhi and push Pakistan into the communist bloc. Moreover, the Britishers thought it would be difficult for the Indian Navy to operate and maintain submarines.

However, the Indian Navy continued to show interest in procuring submarines for its fleet. Admiral A. K. Chatterji, in his book *Indian Navy's Submarine Arm*, stated that in 1959 a paper put up by the Indian Navy suggested the procurement of three operational submarines, which would also act as the target submarines for ASW ships (Chari, 1983). Despite protracted discussions with the government, this did not work out. The need to set up training facilities and train officers and sailors in the operations of submarines would be a prerequisite for procuring submarines. In 1962, the first group of trainees was sent to HMS Dolphin in Britain for submarine training. This marked the beginning of training in the submarine arm of the Indian Navy. During the commonwealth exercises, the non-availability of the submarine as targets for the training of ASW ships caused a

concern which triggered the political establishment to take up the issue with the British.

More particularly, the changing threat scenario resulted in a change in the government policy to procure submarines. First, the India–China War of 1962 was a big surprise to India, and the growing threat from China in the border areas and maritime domain posed a major threat to India. In the 1960s, China's People Liberation of Army–Navy (PLA–Navy) maintained a small but effective coastal–naval force with about 21 submarines, which could be deployed for operations on the east coast of India. Second, Pakistan inducted its first submarine, PN Ghazi, in 1964, and its subsequent role in the 1965 War laid emphasis on the submarine role in future India–Pakistan conflicts. After the war, the Navy insisted there was a role for submarines against the Chinese and Pakistan threats. Moreover, Indonesia's cosying up ties with Pakistan and China called for great concern (Arora, 2016). The Soviet Union's support to Indonesia with naval equipment, systems and platforms was likely to have played a role in the decision-making for the purchase of submarines for the Indian Navy (Muraviev & Brown, 2008).

G. Keith Jacobs claims that after India's effort to source submarines from the UK and USA failed, New Delhi decided to purchase four 'Foxtrot' (Type 641) class diesel-attack submarines directly from the Soviet Union in 1965 (Jacobs, 1982). Despite pressure from the United States and United Kingdom, India was able to negotiate with the Soviet Union for expert assistance to set up a naval dockyard on the east coast at Visakhapatnam as part of the package (Singh, 1955). This led to the creation of Indian Navy submarine arm on 8 December 1967, when the first Indian submarine, INS Kalveri was commissioned at Riga. By 1970, the other three submarines (called the Kalveri Class) were commissioned into the Navy. The procurement of four more foxtrot submarines was initiated in 1971. These submarines (called the Vela class, the first boat being INS Vela), arrived between 1973 and 1975 and were based in Mumbai.

The procurement process of submarines made India consider the need to develop indigenous submarine technology in stages. Particularly, after the 1971 war with Pakistan, the Soviet Union's deployment of nuclear submarines to counter the US seventh fleet in the Indian Ocean clearly emphasised the nature and role that submarines play in strengthening the defences of the nation (Jacobs, 1982). The ability of nuclear submarines to be rapidly deployed to distant locations and the impact of their presence in the area of interest has resulted in the political establishment taking note and supporting efforts to harness such capability. Admiral Vishnu Bhagwat writes that Prime Minister Indira Gandhi, having understood the importance of the submarine programme, formally initiated Advanced Technology Vessel (ATV) on a priority basis (Bhagwat, 2020). However, India, at that time, did not possess the industrial capabilities to build submarines, which are highly complex, involves specific niche technologies and materials, and are inherently difficult to maintain. Even carrying out major overhauls or modernisation would become possible only after years of experience in exploitation and repairs, absorbing the technology, or having the necessary technical documentation and wherewithal. Given the emerging threat perception, India's decision to build a nuclear submarine indigenously with the support of the Soviet

Union was a major strategic decision taken at the highest level. However, India continued to acquire conventional submarines from Russia and other European countries. No major plans for the indigenous production of conventional submarines were envisaged during this period.

India's Nuclear Submarine Capability

The Indian Nuclear Submarine Programme that took shape has the hallmark of any good project with a clear intent or dream defined very early. The Indian government created a separate division for the programme and the funding processes were kept insulated to provide continuity. The programme has culminated in the successful delivery of nuclear submarines to the nation and has a clear follow-on plan. The indigenous content of these platforms is progressively increasing and the target for the future platforms is reaching a level of 95% by cost (ANI, 2021).

The naval leadership of the 1960s had a vision and a perception that these technologies are hard to come by and need to be nurtured over time. In the 1950s, naval constructors, and engineering and electrical officers were sent to pursue post-graduation studies at reputed institutes in India and abroad. Admiral (retd) AP Revi says that the technical officers of the Indian Navy were sent to reputed institutes of technologies such as the Indian Institute of Technology, Indian Institute of Science and Homi Bhabha Institute at the Bhabha Atomic Research Centre (BARC) to undergo courses in system design, nuclear engineering and technologies, and so on (Revi, 2016). In the late 1960s, the officers who completed the course were deputed to BARC as part of the project teams to carry out a feasibility study on nuclear propulsion. Such initiatives have ensured that officers from different streams reach a level of competence in designing and developing systems and technologies related to nuclear submarines. In Jan 1976, the Cabinet Committee for Political Affairs accorded approval for the nuclear propulsion project (Revi, 2016).

Given the technical and financial constraints, India adopted a three-pronged approach in the construction of nuclear submarines: First was the focus on three crucial areas of development—the nuclear propulsion, the submarine as a weapons platform, and the Submarine Launched Ballistic Missiles. Second, India began negotiations with the Soviet Union in the nuclear domain. The discussion focused on achieving operation and maintenance experience, handling the nuclear reactor at sea, and creating infrastructure and safety systems in India. Third, leasing the first INS Chakra from the Soviet Union provided training and familiarisation of operating the nuclear submarine by the Indian Navy (Bhagwat, 2017).

In 1984, the ATV Programme was initiated to design and develop indigenous nuclear submarines with technical collaboration and consultation for design and validation with the Soviet Union. The personnel trained at Ingenieur Kontor Lübeck (IKL), Germany, on submarine design as part of the contract with Howaldtswerke-Deutsche Werft (HDW) in 1981 were posted to the Submarine Design Group and tasked with working on the twin hull design for a nuclear

submarine. There were co-operation agreements with the Soviet Union/Russia for interaction and joint work towards the realisation of the design and construction of the nuclear submarine. The design efforts progressed through the 1980s, and development requirements for equipment and systems were identified. Prior to 1992, the Indian industry was in a nascent stage in concerned technological areas. Various industrial linkages were established to meet the stringent standards in manufacturing.

There are three major factors that attributed to the success of ATV programme which are as follows:

Long-term Approach for Indigenous Construction

For any nuclear submarine project to start *ab initio*, with no prior experience in submarine building, the time envisaged to get through all stages of the design would take 15–20 years, subject to the capabilities of the design teams. Design and development of associated equipment and systems must be concurrently undertaken. After the design phase, the construction of the vessels and commissioning will take up to seven more years. The follow-ons are subject to when the construction is initiated, and lead times for procurement of material will define the time frame. Since both the Government and the Navy understood the long-gestation period for starting the ATV programme in the 1980s, they provided a clear direction and long-term commitment towards building indigenous nuclear submarines as the third leg of the triad for its nuclear weapon programme. In 1992, there was a shift in policy towards a free market economy, leading to a major impetus for private industry. Adequate qualified industrial participation in the development of equipment and systems was forthcoming. The actual commencement of production of the submarine was started in 1998 (Express Web Desk, 2018).

Thereafter, the first indigenous nuclear submarine, Arihant, was launched in July 2009. Being first of class, the submarine went on to complete all tests and trials, and was finally commissioned into the Navy in August 2016 (Express Web Desk). The programme has follow-on vessels under construction. The second vessel, Arighat, is undergoing trials. The third vessel, Aridhaman has also been launched and is due for sea trials (Bhattacharjee, 2022). The success of the programme has provided the framework and competence to undertake nuclear submarine designs to meet future requirements indigenously. The Government has approved the design and development of six SSNs for the Indian Navy. Work is in progress towards the design of these platforms. As the technical capability matures, the gestation times for the manufacture of equipment and systems for nuclear submarines will reduce, and construction lead times thereof can be shorter.

Indo-Russian Co-operation

India–Russia co-operation was one of the important pillars of the ATV Project. Since the first Russian submarine Foxtrot, Moscow's support has been unwavering

in setting up infrastructure in India to maintain these assets over the next several decades. This background and years of joint work have been instrumental in taking the co-operation forward, resulting in collaboration towards indigenous nuclear submarine design and construction by India. A lease agreement was negotiated, and the first INS Chakra, a Charlie class submarine, was brought on lease from the Soviet Union in 1987 and retained in India for three years to gain operational and maintenance experience. Based on the developments in nuclear submarine construction, India inducted an Akula II class SSN from Russia on a ten-year lease (Pandit, 2014). The submarine was handed over to the Indian Navy on 23 January 2012. The submarine was returned to Russia in 2021. In 2019, India signed a deal for a 10-year lease of another Akula II submarine from Russia, likely to be inducted in 2024/2025 (Pubby, 2019).

Indian Industry

Any indigenous effort is only as good as industry can support. Industry capability dictates whether the programme can succeed from the smallest part to the most complex of systems. The country had to rely heavily on the Defence Research and Development Organisation (DRDO) for the development of technologies. The industry was limited to the Public Sector Undertakings established as industrial hubs in the nation to fuel development. Most industries, such as Iron and Steel, Power plants and all heavy industries, were either state-owned or owned by a few business houses. The political and economic reforms of the 1990s initiated by the then Prime Minister, PV Narasimha Rao, with Dr Manmohan Singh as the Finance Minister, led to tremendous growth in private industry, which greatly benefited the ATV programme. During this period, the Government also enabled identifying private industries that could qualify to participate in the nuclear submarine programme, in addition to the state-owned enterprises. A host of such manufacturers have contributed towards the platform. The industry has expanded in various domains in the last two decades and has a good competitive environment. There are bigger private industries that are competent in taking on bigger responsibilities for equipment and systems. M/s Larsen & Toubro (L&T), Tata Group and many more Medium, Small and Micro Industries (MSME) are involved in the submarine programme.

The nuclear submarine programme was successful because it was not targeted with stiff timelines linked to force-level requirements. Since no nation would offer nuclear submarines or associated technologies for procurement, it provided an impetus to start an indigenous nuclear submarine-building programme. This resulted in the creation of a submarine design group and a competent design team for the nuclear submarine programme. But, the conventional submarine programme was not able to replicate the success of the nuclear submarine programme. Operational imperatives and maintenance of minimum force levels were key drivers in shaping conventional submarine procurement policies until the 1990s. The next section will discuss acquiring and modernising India's conventional submarine programme.

India's Conventional Submarine Programme: From Import Model to 30-year Submarine Building Plan

The Indian Navy inducted the first batch of Foxtrot-Class (Kalvari Class) that proved effective in deep water operations. But a need was felt to have submarines that were capable of operating in shallow waters. The submarines were expected to have lower noise levels, improved sensors and systems, and good shallow water capability. India approached the Soviet Union with the new specifications. 'The erstwhile Soviet Union indicated that they did not have anything in their design inventory in that size range to offer', says Chacko (2018) in his book *Foxtrot to Arihant: The Story of Indian Navy's Submarine Arm*.

India then turned to the West for solutions and discussed with six potential suppliers. The Kockums and HDW were shortlisted (Menon, 2006). The requirement included the transfer of design know-how. Finally, the agreements were signed with HDW in 1981 for two Type 209 boats to be built in Germany, including training of Indian personnel, and two to be built in India by transfer of technology (ToT). The first two submarines, INS Shishumar and INS Shankush, built at HDW in Kiel, Germany, were commissioned in 1986 (Indian Navy, n.d.). The third and fourth submarines, INS Shalki and INS Shankul, were constructed at the Mazagon Dock Limited, Mumbai. The submarines were commissioned in 1992 and 1994, respectively. These four submarines were part of the Shishumar Class (named after the first of class). In 1987, an allegation of payment of commission by HDW to secure the contract surfaced and was being investigated by the government. Hence, the option for constructing two more submarines at M/s Mazagon Dock Ltd (MDL), as follow-ons, did not materialise.

During discussions with the erstwhile Soviet Union in 1983, the Indian Navy was given the opportunity to evaluate the conventional submarine of Project 877 of the Soviet Union. During this period, there were challenges in maintaining the Kalveri Class, particularly regarding medium and long refits. These boats were aging and a replacement for the same was considered necessary. The decrease in force levels due to difficulties in refits was to be mitigated. The Navy acquired eight Kilo Class submarines designated Type 877EKM from the Soviet Union. The contracts for these submarines were placed in 1984 for six boats, and two more boats in 1987/1988. The eight platforms were delivered between 1986 and 1991 (Chacko 2018). On being commissioned into the Indian Navy, these submarines were nomenclated as the Sindhughosh class of submarines.

By the end of the 1990s, the Indian Navy had the experience of operating and maintaining both Soviet-origin and Western-origin submarines. The dockyards were well augmented in phases to undertake refits and repair and maintain the equipment and systems of these submarines. As part of the contract with HDW, personnel were trained at IKL, the submarine design bureau of Germany. Mazagon Dock Limited (presently Mazagon Dock Shipbuilders Limited, or MDL), with experience in the construction of two submarines (INS Shalki and INS Shankul), is capable of handling refits for Shishumar Class submarines. Laboratories of the DRDO developed certain sensor and communication systems indigenously that were fitted on the Sindhughosh class submarines. Progressively, many indigenous

systems/equipment were fitted on the Kalveri, Sindhughosh, and Shishumar Class submarines. Notably, there was no policy initiative to set up a design bureau for designing, developing and constructing conventional submarines. To maintain submarine force levels, the government and navy preferred importing state-of-the-art conventional submarines from submarine-building nations such as Russia, France and Germany with possible ToT and technical assistance. The technical assistance and training of manpower helped India in two primary ways. First, it strengthened the knowledge base to venture into submarine design. Second, this enabled enhancing the maintenance and refit capability in respect of these submarines.

Design Capability of Conventional Submarines

India has created a pool of officers who could contribute to developing platforms and systems. In the contract for four SSK submarines from Germany, the transfer of design know-how was part of the defence deal (Chawla, 2022). As part of this clause, a multi-disciplinary design team of about 25 Indian specialists received design training under Prof Gabler's team at the Ingenieur Kontor Luebeck (IKL), Germany (Rai, 2022). IKL is the design bureau that designed the Type 209 submarines. To complete the course, the team had to design a submarine concept based on the qualitative requirements provided and submit a preliminary design. This team had the competence to take up modification work on the platform and was skilled in designing a single-hull submarine ab initio. They have also specialised in noise reduction (Revi, 2016). Consequently, when the submarine design group was formed to take up the design of the indigenous nuclear submarine, these officers were posted with the strategic project. They had to adapt to the double hull design. The design of the nuclear submarine went ahead. However, having a design initiated for conventional submarines was left on the back burner.

Towards the end of the construction of the two Types 209 submarines in India, with the commissioning of INS Shankul in 1994, there were no more orders for these platforms on MDL, Mumbai. This initiated a thought of having trained designers working on the design of two follow-on boats for manufacture at MDL. This feasibility was examined in 1993 and 1997 (Bhagwat, 2020). However, these efforts did not fructify. In order to maintain force levels, an order for two more EKM submarines was placed in November 1997; INS Sindhurakshak and INS Sindhushastra were commissioned into service in 1998 and 2000, respectively.

At this juncture, it would have been of immense value to have taken a critical decision from the long-term perspective. A design group for conventional submarines could have been set up to augment skills and take a parallel path without impeding the procurement process of conventional submarines aimed at meeting force-level requirements. The group could have worked on designing and developing a conventional submarine, the qualification requirements the Navy could have provided. Given the long gestation times for design and development, such an initiative may have led the nation to build conventional submarines indigenously, at least by the mid-2010s.

Maintenance and Refits

The maintenance of submarines involves periodic refits based on the operation-cum-refit cycle (OCR) of the class of platform. Generally, these are assisted maintenance periods for level 1 and 2 maintenance and refits such as Short Refits (for about 3–4 months after approximately 18 months of operations), Normal Refits (for about 6–8 months, once every five to six years), Medium Refit (for a period of up to 1–2 years depending on the work package, once in ten to twelve years), a Long Refit or one which is used for major modifications or one where the residual life of submarine is assessed. Generally, there would be one long refit in the life of a submarine. These durations vary to some extent from class to class.

Notwithstanding the OCR, the timelines for this maintenance depend on operational requirements, availability of dock slots, spares and support, repairs that vary from platform to platform, and skill levels in the yards. India has two naval dockyards where submarines are maintained, each on the west and east coast. The shipyards, Mazagaon Docks Limited, in Mumbai, having built two of the Shishumar Class (Type 209s), is equipped to handle all levels of maintenance of these platforms. The naval dockyards are capable of handling refits up to normal refits for the submarines. Hindustan Shipyard Limited (HSL), Visakhapatnam, can undertake medium refits of Russian-origin submarines.

Considering the obsolescence cycle for technologies progressively shrinking, there is a need to constantly upgrade systems and equipment related to sensors, navigation, weapon systems and others. This leads to a need for modernisation programmes. Generally, these are clubbed with the refit cycle of the platforms to minimise downtime. Availability of spares plays a major role in ensuring timely completion of maintenance or refits and operational availability. The process of skill development, ranging from welding of submarine grade materials to in-depth knowledge to repair and operationalise sensors, power systems, control and weapon systems, testing and tuning, is long-drawn and involves continuous skill upgradation.

There has been a cost involved in this aspect. Chacko (2018) claims INS Khursura was under refit with the naval dockyard at Visakhapatnam from 1978 to 1991, a period of thirteen years. This was the result of having to cannibalise equipment or systems to keep other platforms operational and to augment the skills required in undertaking deeper levels of repairs and maintenance. HSL undertook the Medium Refit of INS Vagli from 1997 to 2005. This, again, was due to the learning curve involved and also certain issues related to the availability of spares or support for such old platforms (Submarine Division, n.d.).

HSL took up the refit cum modernisation of INS Sindhukirti in 2006 (Comptroller and Auditor General of India, 2014). The Navy aimed to attempt to undertake a refit within the country but with the assistance of the original equipment manufacturers (OEMs) in critical areas of the modernisation programme. This refit had its share of cost and time overruns and the refit was completed in 2015. The cost of the refit was escalated from US$142 million in 2005 to US$ 186 million in 2013, with additional liabilities of US$ 15.234 million still being claimed by the yard, claims Controller Auditor General Report of 2014 (Comptroller and Auditor General of India, 2014). Other than these protracted

refits, most of the short and normal refits have been undertaken on a regular basis. Most refits have exceeded the planned time frames. Though there are reasons for such delays, from the overall perspective, this is an area that needs to be addressed to improve the operational availability of platforms. These initiatives have strengthened the respective yards' capability and skills to meet future requirements within the country.

It is crucial to understand that the maintenance and upkeep of submarines are a complex set of activities that need high levels of skills and meticulous planning and positioning of spares well in advance. Given the timelines of procurement of new equipment and systems and the gestation of their manufacture, the planning process starts years before modernisation and upgrades conjoined with refits are commenced. The naval dockyards and the two shipyards, one each in the west and east, have reached a level of competence to handle repairs, refits and upgradation over time.

To balance the need to enhance indigenous capability and the availability of submarines to meet force-level requirements, many modernisation-cum-refits of EKMs have been undertaken at Russian shipyards. The refits in Russia have been completed in the contractual time frames agreed upon. The quality of refits is also found to be better at OEM facilities. Also, upgradation or modernisation that included the fitment of indigenous equipment and systems was undertaken during this period. As of date, eight refit cum modernisation packages have been undertaken for EKM submarines in Russia. Notably, the refit duration in Russia is two and a half years, while that attempt in India for the first time was extended to 09 years (Table 1).

For a nation progressing towards self-reliance, it is critical to nurture capabilities and augment skill sets to meet such requirements. Therefore, all refits and modernisation of Shishumar Class are being undertaken in India. Also, the plan for life extension or modernisation of the EKMs as a second upgrade is likely to be undertaken in India. India can undertake refits and repairs of Western-origin and Russian-origin submarines. The Indian industry is also geared up to provide alternate indigenous solutions for equipment and systems. The experience in maintenance and refit has enhanced the Indian shipyard's capabilities and skills, gearing them up for handling submarine construction projects.

Subsequently, India also realised the need for indigenous design and development of submarines. Over a period of time, Western nations have made significant

Table 1. Timeline of Modernisation-cum-refits of EKMs in Russia.

Class of Submarine	Year
INS Sindhuraj	1999–2001
INS Sindhukesari	1999–2001
INS Sindhuratna	2000–2002
INS Sindhughosh	2002–2005
INS Sindhuvijay	2005–2008
INS Sindhurakshak	2010–2013
INS Sindhukesari	2016–2018
INS Sindhuraj	2017–2019

Source: Compiled by authors from various sources.

progress in submarine technologies. They can build conventional submarines with advanced capabilities with developments in areas such as Air Independent Propulsion, Fuel Cell Technologies, Lithium-Ion batteries and others. India wanted to leverage its technology strength and find solutions to augment conventional submarines' force levels, which led to the drafting of the 30-year submarine-building plan.

Features of 30-year Submarine Building Plan

The building plan for conventional submarines called the 'Project for Series Construction of Submarines for the Indian Navy and Acquisition of National Competence in Submarine Building', also popularly known as the 30-year submarine building plan, was formulated in 1998. Chacko (2018) says that in the 1960s, Vice Admiral A. K. Chattterji had presented a paper for a force level of 24 submarines to meet the requirements of the Indian Navy. In 1998, the force level had depleted significantly. INS Khanderi had been decommissioned in 1989, and INS Kalveri was decommissioned in 1996. INS Khursura, after close to 30 years in service, was to be positioned as a museum at Visakhapatnam; the boat was beached in 2001 and decommissioned. INS Karanj was converted into a trial platform for several DRDO-developed technologies. Of the Vela class, INS Vagsheer was decommissioned in 1997 and INS Vagir was due to be decommissioned in 2001. The force levels were drastically low. INS Vela and INS Vagli were the only two submarines in the Foxtrot class. The 09 EKM boats, with the tenth one due to be delivered in 2000, and four of the Shishumar Class (Type 209) were the mainstay of the submarine arm. Most of these submarines were getting close to their midlife of 15 years and would need to be replaced within the next decade.

The other factors leading to the 30-year submarine plan included:

1. The impending phasing out of the EKMs and SSKs at the end of their life cycle and yet being able to maintain a force level of 24 submarines was a daunting task.
2. The non-continuance of the construction programme for further platforms at MDL resulted in the erosion of skill sets in the workforce.
3. The design capability carefully built as part of the HDW deal was diverted to meet the nuclear programme requirements. New talent was not nurtured to take the conventional design capability further. If the route of design, development and production of submarines were initiated, it is likely to take more than ten years for the first class to come up for manufacturing. This would not meet the force-level requirements.
4. Need to gain experience through new lines of submarines, whose production is to be within India, preferably, two parallel lines given the time constraint, and preferably one line from western nations and one from Russia.
5. Commencement of design efforts for the future platforms during the construction of the two lines with the transfer of design know-how and know why as was done with IKL during the HDW programme.

6. At the end of this effort, the production of submarines with their design can be commenced at the earliest.
7. The Indian Industry would get a boost and this long lead project will encourage private industry participation in the manufacture of various components, equipment and systems resulting in a vibrant ecosystem for the construction of submarines.

The Cabinet Committee of Security of the Government of India approved the plan in Jul 1999. The aim of seeking approval was to have a commitment that would enable the inclusion of these projects into the five-year plans accordingly. According to the proposed plan, two parallel lines of six submarines, each of two different designs, preferably one Western origin and one Russian origin line, were to be constructed in India in the first phase. Thereafter, twelve submarines were to be produced using an indigenous design that has evolved using the experience and learning attained through the two lines. At the end of 30 years, by 2030, 24 submarines would have been built in the nation and the requirements of the Navy would have been fulfilled.

The plan, if implemented as desired, would yield the following benefits:

1. The Indian Navy will have a judicious mix of new and potent submarines with state-of-the-art equipment and systems.
2. The indigenous design, development and production of submarines will kick off.
3. The design capability will become robust and can be sustained in the future.
4. The continuity that it would provide to the yards will enhance the skill sets and retention of a competent workforce to improve the processes and reduce timelines for construction.
5. Having two lines of construction in parallel would involve two yards, and hence splitting a load of production between the two yards during the phase of manufacturing based on the indigenous design will also reduce the timelines.

The P-75 Project was the first step in the implementation of the 30-year plan. This formed the first part of the parallel approach for two lines of manufacture using the ToT from two different OEMs. The second leg of this approach is still under consideration at the request for proposal (RFP) stage, called the P75I. The timelines were that on conclusion of the contract for six submarines. The first submarine would be built at MDL in India within the first six years. One submarine per year will be delivered to complete the project in 12 years. The agreement contained clauses that aimed to promote collaboration with Indian businesses and facilitate the ToT for producing equipment and systems in India.

Project P-75

The approval to negotiate with Thales, France, for the Scorpene submarine, was accorded in 2001. During the discussions, the first submarine of this class was yet

to be tested. The assessment of the performance was based on simulation studies done by France. This aspect was pointed out by the Auditor General's Report. However, the Defence Procurement Procedure (DPP) 2002 provided for such an option. The trials could be conducted in Indian waters, or simulation studies can be used for the evaluation. The process of negotiation, which started in 2001, went on till 2005. On completion of the negotiation in 2005, the contract between MDL and Armaris (SPV floated by Thales for this Project). The submarine was jointly realised by DCN, France, and Novantia, Spain. Thales merged with DCNS retaining a 25% stake, and subsequently, as of date, the Naval Group, France is the holding company in France. The construction work was started in 2006. Due to the delays and changes in equipment and system costs, the project cost also increased. Suffice to say that the first of the Scorpene submarines, INS Kalvari, was commissioned on 14 December 2017. The fifth of the series, INS Vagir, was commissioned in January 2023, and the last of the series, INS Vagsheer, was launched in April 2022, likely to come up for commissioning in 2024.

The Project was envisioned to start in 2001 and finish by 2012, and in case of delays, at least by 2015. However, as per the 30-year plan, it is likely to complete only in 2024. The effective time post-contract to last delivery is approximately 19 years against 12 years as envisaged. From approval to negotiation to completion of one line of six submarines takes 24 years. Here, the time taken to finalise specifications, identify OEMs, go through request for information (RFI) and then reach a stage of RFP, issue the same and get responses and shortlist the technically qualified companies before getting a clearance for negotiation needs to be assessed and factored in the planning process.

The second line that was to have started in parallel with P75, now called P75I, was initially envisaged as a 'Make in India' platform that would form the second line along with Scorpene but to be constructed at a different yard. The project has been discussed in fits and starts. The initial discussions with the Russian side for the Amur 1650 that can meet the requirements were between 2002 and 2004 (Kumar, 2022). Later, the discussions were set aside as the Scorpene submarine contract was yet to be signed. Thereafter, with the developments in technologies, India decided that the platform should have improved capabilities such as having an AIP section and land attack capability. Progressively, a larger content of indigenous equipment was also to be fitted onboard these platforms. To date, only the RFP for P75I has been issued. This is 22 years after the 30-year plan was initiated. This inordinate delay has skewed the whole 30-year plan and has resulted in the second phase of the plan for twelve indigenous conventional submarines yet to take shape.

Project P-75I: 'Make in India' Initiative

The P-75I was envisaged as the second line of six submarines to be constructed parallel to the P-75 during the first phase of the 30-year submarine building plan. The submarines were to be constructed in India in collaboration with the selected OEM. Frequent policy shifts and decisions have resulted in inordinate

delays in finalising the order for this Project. In 2008, an RFI was issued for six submarines with AIP and land attack capability to be built in India (Chand, 2012). In July 2010, the Defence Acquisition Council (DAC) of the Ministry of Defence decided that two submarines would be imported and the balance four would be manufactured in India (three at MDL and one at HSL) (Pandit, 2010). Based on approval by DAC, the RFI was reissued in Sep 2010. In October 2014, DAC decided that six submarines were to be constructed in India (PTI, 2014). Five identified Indian shipyards were allowed to bid after finalising collaboration with any of the foreign shipyards meeting the requirements. In 2017, another RFI was issued to Naval Group, RoE, ThyssenKrupp Marine Systems, Saab Kockums, Navantia and Mitsubishi Heavy Industries to confirm their willingness to participate (*The Hindu*, 2018).

A 'Strategic Partnership Policy' was promulgated on 21 May 2017 by the Government of India for the defence sector. Chapter VII of DPP 2016 as 'Revitalising Defence Industrial Ecosystem through Strategic Partnerships' (Ministry of Defence, Government of India, 2017). In June 2017, it was brought out that a contract for the construction of submarines would be awarded under the 'Strategic Partnership Policy' (Ministry of Defence, Government of India). In January 2019, DAC renewed the approval for project 75I (Pandit, 2019).

In Apr 2019, an Expression of Interest was issued for six submarines manufactured in India to identify potential strategic partners (Ministry of Defence, Government of India, 2019). On 21 January 2020, the Government of India indicated that MDL and L&T were the two shortlisted Indian firms for P75-I (Unnithan, 2020). They also shortlisted TKMS, Germany; Rubin Design Bureau, Russia; Navanta, Spain; Naval Group, France; and DSME, South Korea, as foreign OEMs (Tiwari, 2022). On 20 Jul 2021, the MoD issued RFP for six submarines at US$600 million under the Strategic Partnership model (Ministry of Defence, Government of India, 2021). The two shortlisted shipyards—MDL and L&T, were to finalise the partnership with the foreign companies and respond to the RFP. The response deadline for Nov 2021 has since been shifted thrice to August 2023.

On the basis of the RFP, MDL issued RFI to the five foreign companies seeking partners with functional AIP that have been tested on an operational submarine. France, Germany, Russia and Spain withdrew as they may not be able to adhere to such severe technical conditions (Thapar, 2021). In 2022, Russia and France Naval Group withdrew due to the inability to comply with the AIP query. Russia claims that the Indian Navy's requirements, such as stealth technology and state-of-the-art submarines to be equipped with powerful missiles, are unrealistic (Siddiqui, 2022). According to Russia, there is no prototype of such a submarine in the world (Siddiqui). On finalisation, the two Indian entities will finalise with the OEM to respond to the RFP. Thereafter, the process of evaluation of technical bids, the price negotiations and then order placement needs to be completed before the commencement of construction. Considering the skewed nature of the outcome of the plan, phase II of the 30-year submarine building plan, where the indigenous design was to be implemented and 12 submarines manufactured accordingly, is yet to be initiated. The delay in Project 75I in inducting new

submarines has led to a situation to find solutions that would cater for immediate requirements. There has been an offer for the modernisation and life extension for the 877 EKM submarines by the Russian side, along with the offer to provide three more refurbished EKMs from the Russian inventory to enable maintain force levels (Gady, 2020).

Analysis of 30-year Submarine Building Plan

The plan elucidates the higher intent of the nation, which is to meet the requirement of having a force level of 24 submarines in the next 30 years. To that end, the aim of getting an understanding of the design philosophies and processes of two lines of submarines, each line based on a different design, and ploughing the best of both lines back into their design for the next line of 12 indigenous submarines is debatable. India has been one of the few countries operating submarines of both Western and Russian origin for a long time.

At the same time, it is important to note that India did not procure submarines from any specific nation based on a need for alignment with that nation or concept of submarine design. Instead, India sourced submarines from nations willing to meet Indian Navy's requirements. Procuring submarines from the Soviet Union/ Russia, Germany, or France occurred more by default than by design, despite the major differences in design philosophy. Moreover, India's experience in operating different types of submarines provide a unique understanding of the design philosophy of different class of submarine. This has contributed immensely towards defining future requirements and associating with industry and laboratories in finding indigenous solutions.

The experience in understanding the knowhow of the two designs will help solve hurdles in indigenous design. But one must make major choices such as single hull or double hull boat ab initio. A crucial takeaway from the plan towards the construction of 12 indigenous submarines in phase 2 is that the indigenous design must be ready in all respects prior to the commencement of construction. This implies that the specifications must be finalised, a design group put in place with the necessary skill sets, and all stages of submarine design are to be completed. Equipment designed, developed and prototypes tested; and necessary augmentation of production yards to meet design requirements put in place by the end of the 12 years of phase I of the plan. Only then can the submarine's series production begin in time to provide 12 platforms by the end of the 30th year of the plan.

The timelines of the plan involving two lines of construction of a series of six submarines, each in parallel with both lines from different designs or sources within a span of 12–15 years, is quite ambitious. Given how P75 progressed, with approval for negotiations with Thales coming as early as 2001, it is evident that the finalisation process had commenced much in advance. Hence, the possibility of commencement of construction to meet the envisaged schedule may have been assumed to be viable. For the second parallel line of submarines to be constructed based on a different design (initially envisaged to be of Russian design), the

discussions with the Russian side and the possibility of the Amur 1650 submarine being considered for procurement may have enabled the assessment.

The procurement of submarines is cost-intensive. Resource limitations have played a role in the delay of discussions for the second construction line, as the contract for the Scorpenes had not yet been signed in 2005.

There are three significant factors to consider. First, the procurement must be done on a global tender basis. In that case, it is essential to take into account the time required for drawing specifications, sending out RFI, shortlisting and issuance of RFP, and conducting technical and financial negotiations before finalising the order. This process sometimes takes up to four years or more, and each stage requires approval. Second, it is important to finalise the shipyard and infrastructure needed to construct the second line of submarines and to ensure that skilled manpower is in place. The timelines for these activities are critical and need to be taken into account. The progress of Project 75I, which pertains to the second line of submarines, indicates that the option of taking the nomination route has not been chosen. And, third, the procurement procedures or policies need to be stable and consistent during the process of procurement from initiation to order placement.

P75I is yet in the RFP stage even after two decades. When time delays of a high order occur, it will inevitably lead to amendments in the requirement specifications. New technologies and enhanced capabilities that emerge may need to be factored in to ensure that platform systems are current and will not face obsolescence issues before a reasonable period of exploitation. In the case of P75I, delays have been there and frequent changes in policy or requirements from 2008 onwards have precipitated further delays. In such projects, there is a gestation for shipyards and OEMs to arrive at a feasible collaboration option and work out the details towards responding to proposals. However, if the policy changes are more frequent, it will create an atmosphere of uncertainty resulting in further delays in responses. The changing requirements and continuous need to realign with changing policies are likely to put the project in jeopardy. After all the changes, two shipyards from India have been nominated and cleared to collaborate with any of the selected five foreign OEMs, but with a qualification requirement for AIP specified in such a way that at least three of the five OEMs would not qualify. This has led to an inability to respond to the RFP in the time frame specified. The deadlines have since been revised to Aug 2023. The manner in which P75I has progressed is a cause for concern, when such a cascade happens, it is more prudent to stop, take stock and review the requirements before taking the issue further.

The Strategic Partnership Initiative and current limitations outlined in the RFP for P 75 I do not identify how shipyards will benefit from the directives. The Indian Navy and the Government of India should resolve this dilemma to find a way to finalise the contracts for the second line of the submarine-building.

One of the critical areas of the vision behind the 30-year submarine building plan has been the need to have an indigenous design in place and have 12 submarines manufactured based on this design. Given that this is a 30-year plan, this provided a 12–15-year lead time for setting up the design group and augmenting their skill sets and capabilities, commencing the design and development of

indigenous submarines, learning from the two lines of submarine construction envisaged in phase I and be sufficiently prepared to commence construction of 12 indigenous submarines in the next 15 years.

If implemented, this time frame with a commitment to the approved plan would have resulted in India being one of the leading submarine-building nations. As of date, there is no information available regarding the steps taken or progress made in this regard. Now that the two lines have become sequential instead of parallel, and the P75I programme does not directly affect the P75 programme, this can be considered two independent sourcing requirements. The phase 2 of the 30-year programme may also be reconciled and redefined to provide thrust in the appropriate areas to enable progress towards the indigenous line of conventional submarines.

It is also understood that the case for modifying the 30-year plan to break phase 2 into two parts, six indigenous conventional submarines and six SSNs in light of the fast-changing geopolitical scenario and increased threat perception due to the escalation in deployments by the Chinese in the region. We need to determine the necessary force levels and promptly come up with solutions to address any gaps. In India, the procurement or building process through the ToT route has encountered various challenges and hurdles. Additionally, some issues need to be addressed to move forward with designing conventional submarines indigenously, especially since the country has already built its indigenous SSBNs.

To bridge the gap between the necessary force level and its availability, it is imperative to establish a clear and effective policy for the timely placement of orders for conventional submarine construction. This should include providing directives and resources for the commencement of indigenous conventional submarine design through collaboration or the formation of a consortium within the country. Additionally, a time-bound plan for the implementation of phase 2 of the approved 30-year submarine building plan should be established. Priority should be given to approving and commencing work on the indigenous construction of one line of six SSNs.

Conclusions and the Way Forward

Since its inception, the Indian Navy has wanted to have a fleet of submarines. After continued efforts to convince the political leadership and identify potential suppliers, India procured eight submarines from the erstwhile Soviet Union that were commissioned into the Indian Navy between 1967 and 1975. The need for submarines with shallow water capability was felt and the Shishumar Class (Type 209) submarines were procured, followed by the Sindhughosh Class(877EKM). India wanted to have a submarine design capability. A team was trained at IKL, Germany, for this purpose. With the nuclear submarine programme put in place, these designers were moved to the design group for nuclear submarines, hence leaving a void in respect of conventional platforms. Since procurement was an option for conventional submarines, the design aspects were not pursued at that point. A sound design bureau and a competent design team were the fundamental requirements to start any indigenous submarine-building programme. In this case,

the team trained and skills honed had to be transferred to manage the nuclear programme designs.

The factors that ensured the success of the indigenous programme for the construction of nuclear submarines included the long-term approach to indigenous construction with the creation of a robust design group, Indo-Russian Co-operation and the growth of Indian Industry that resulted in meeting the stringent requirements for the development of equipment and systems. As conventional platforms were being made by many countries and OEMs were willing to compete to supply, the needs could be met through procurement or production in India through the ToT route, as was done for the Shishumar class, which was a distinct possibility.

After the 30-year submarine building plan was approved, the need to set up a design bureau or add the tasking for the design of conventional submarines to the Submarine Design Group was very evident. If this had been initiated between 2000 and 2005, the Navy would have been better positioned to successfully produce an indigenous design. Since the way ahead for P75I is still not finalised, a design bureau or group can be created at the earliest to commence design work for indigenous conventional submarines. This allows for sufficient gestation to design and develop critical equipment and systems within India.

Submarine construction being a niche area, the creation of expertise and, more so, retention of expertise is of great concern. Therefore, considering the levels of quality required and the complex skilling requirements, most nations do not have more than one or two primary shipyards involved in submarine building. They may, in turn, get some manufacturing done through other yards or involve them in specific areas where their expertise is necessary. It is crucial to designate and establish two yards for the construction of submarines that have been identified and selected. For all submarine construction requirements, the two shipyards, namely MDL and L&T, may be fixed by regulation. If two government shipyards are envisaged, HSL being a Defence Shipyard may also be considered.

The industry plays a major role in providing all equipment and systems to shipyards based on the specifications of the designer. Most companies that have a niche capability to provide for submarine applications also have some design and development capability. This goes a long way in improving designs and providing support to the submarines during the exploitation phase. The critical industry elements can be taken as partners by the shipyard after the due qualification process and regular audits for compliance. These would result in a consortium construction model for submarine building. The ancillary industry, the MSME and other support industries continue to be in the ecosystem as any regular business model.

The key to submarine building is always to have some orders to fulfil. If the shipyard, MDL, does not get any orders for prolonged periods, they will lose out on skilled manpower, as it happened with M/s MDL after the commissioning of INS Shankul in 1994. The next order for the Scorpenes was in 2006. This can be avoided if the cycle is planned efficiently. The operation cum refit cycle will automatically provide an opportunity to work on the maintenance cycles of the platforms. When the manufacturing yard and OEMs are present within the country, the refits and life cycle maintenance must be given to these yards. This will keep the cycle going and will yield optimal results.

A host of critical technologies are developed within the country. Therefore, there is a great opportunity to compete in the export market. The strength of the designer bureau will make a huge difference in the ability to modify and customise designs to meet customer requirements better. In the interim, it may be prudent to resolve the P75I dilemma at the earliest to maintain adequate force levels. The efforts to undertake modernisation and life extension certification are a good way to ensure the operational availability of platforms. Considering the depleting force levels due to delays in the construction programme, one way to reduce the time frame for procurement is to opt for a follow-on series of the Kalveri class (Scorpene submarines) with necessary updates or additions/ modifications. The yard with the experience of manufacturing the first six may be able to compress timeframes for construction and delivery of the follow-ons. India, undoubtedly, has the potential to become a submarine-building state. There is a need to draw out a clear framework; reassess the way ahead for the 30-year submarine building plan; implement the same without losing the momentum of progress made in enhancing capabilities towards design, development of systems and competence in indigenous submarine construction.

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