Atmanirbhar Bharat and Pinaka Multi-Barrel Rocket System

Implications for India in National Security and Strategic Autonomy

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The recent past has witnessed a paradigm shift in the way 'modern wars' are prosecuted. In today's era, conflicts are swift, intense, tech-driven, indigenous, low-cost and high-impact. There are also no permanent enemies, friends and allies. India's exposure to a hostile neighbourhood, along both western and northern borders, makes it mandatory for the country to possess indigenous weapon systems in its inventory to meet any eventuality that might occur. Pinaka Multi-Barrel Rocket System (MBRS) is a step in this direction, to make India, particularly the Indian Army, self-reliant in the field of rocket systems. An effort has been made in the article to study the development of the rocket system since inception, analyse current challenges being faced and suggest measures for India to capitalise on existing opportunities to achieve favourable strategic autonomy and national security.

Keywords: *Pinaka Multi-Barrel Rocket System, Indian Army, Atmanirbharta, Self-Reliance*

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Introduction

Rocket systems in the Indian Armed Forces were mostly procured from foreign vendors, or sometimes developed in-house with collaboration among government and private research and development (R&D) agencies, defence public sector undertakings (DPSUs), academia and industry. Indigenisation is vital to realise the true sense of national security and strategic autonomy in the field of operational and strategic rocket systems.

The Pinaka multi-barrel rocket system (MBRS) was specifically manufactured by the Defence Research and Development Organisation (DRDO) in India for the exclusive use of the Indian Army. The indigenous rocket system was named after the bow of the Hindu deity, Lord Shiva, and was originally developed in the 1980s. This rocket system possesses the capacity to deploy a salvo of 12 high-explosive rockets in a span of 44 seconds. The project entails the involvement of private sector entities, such as Larsen & Toubro (L&T), Tata Defence SED and Economic Explosives Limited (EEL). Presently, production lines for the Pinaka system have been established, which are currently providing supplies to the Indian Army.[1]

Historical Context of India's Defence Reliance on Imports

Post Independence

After India gained independence in 1947 and until the early 1960s when the Sino-India and Indo-Pakistan wars occurred, India did not have a domestic industrial and technological base. As a result, the country had to rely heavily on importing critical equipment for its armed forces. The majority of such equipment was predominantly obtained from readily available sources and technologically advanced nations, such as the United Kingdom (UK), France and Sweden. Since then, the trend has continued, with the exception of a few contracts after 1971 with the former Soviet Union, which allowed indigenous manufacture under licenced production agreements. During this period, the scope of technology transfer was limited and did not encompass the elements of design and development.

The 1990s

After the Indian economy was opened up in 1991, private enterprises sought to enter the defence sector by working as sub-contractors in the supporting industries. India liberalised its defence sector by granting access to private domestic companies and permitting limited foreign involvement, capped

at 26 per cent, in defence joint ventures. However, most foreign original equipment manufacturers were reluctant to share their proprietary technology because they had very little ownership interest.

Early 2000s

In 2001, the production and research agencies were merged to meet the requirements of the three services. This was achieved by creating a 'Production Board' and an 'R&D Board', each headed by their respective secretaries. Additionally, Long Term Perspective Plans (LTPPs) for each of the services were developed starting from 2002. Offset measures too were put into effect for projects of significant magnitude from 2005.

Post 2011

In 2011, the government introduced the Defence Production Policy, which recognised the importance of achieving self-sufficiency in defence manufacturing. In 2020, the government introduced two crucial documents that would establish the direction for the next 10–15 years. The Draft Defence Production and Export Promotion Policy was made public on 3 August 2020 and the Defence Acquisition Procedure (DAP) was disclosed on 28 September 2020.

Stockholm International Peace Research Institute (SIPRI) Report 2023

The majority of the platforms and armaments currently in use are of foreign origin, predominantly sourced from Russia. Most of India's tanks, ships and fighter planes are of Soviet origin.[2] According to the 2023 SIPRI report, India's arms imports are mostly driven by its conflicts with Pakistan and China. India experienced a 4.7 per cent growth in arms imports from 2014–18 to 2019–23, solidifying its position as the largest arms importer in the world for the period 2019–23, with a 9.8 per cent share. Russia continues to be India's primary source of armaments. However, the proportion of Indian arms imports from Russia has declined from 76 per cent in 2009–13 to 36 per cent in 2019–23.[3]

Overview of the Atmanirbhar Bharat Initiative

The aim of this initiative is to establish a self-reliant India or 'Atmanirbhar Bharat'. The five essential pillars of Atmanirbhar Bharat encompass economy, infrastructure, system, vibrant demography and demand. The defence industry is widely acknowledged as a critical sector that offers ample

potential for achieving self-reliance and holds significant importance in the Indian economy.

The Indian government has liberalised the defence manufacturing industry, allowing domestic private enterprises to participate. Further, the government is actively promoting their involvement by encouraging these companies to engage in technology development, research and manufacturing, in collaboration with DRDO, domestic public firms and foreign suppliers. The goal is to jointly produce military equipment in India for the Indian military and for export. The government is also supporting and promoting the establishment of defence start-ups by domestic private players.[4]

Inception of Pinaka MBRS

1. *Pre-1994 era*: In 1981, the Ministry of Defence (MoD), Government of India, sanctioned two confidence-building projects to fulfil the Indian Army's need for a long-range artillery system. The army implemented its General Staff Qualitative Requirements (GSQRs) for the system in July 1983, with the goal of adding one regiment every year beginning in 1994.
2. *1994–2006*: The Armament Research and Development Establishment (ARDE) was tasked with the responsibility of making an indigenous rocket system for the Indian Army. The demonstration of the launcher's performance and firing capability was done in June 1996. The effectiveness of Pinaka multi-barrel rocket launchers (MBRLs) combat capabilities was evaluated during the Kargil conflict in June 1999. The first Pinaka MBRL regiment was raised in February 2000. In March 2006, the Indian Army granted a US$ 45 million contract to Tata Power SED and L&T to provide 40 Pinaka MBRLs.
3. *2006 onwards*: In August 2020, the Indian government signed a contract valued at Rs 25.8 billion (US$ 353.5 million) with Tata Power Company, L&T and Bharat Earth Movers Limited (BEML). The contract was for the supply of six regiments of Pinaka Mk-I MBRL systems to the Indian Army. It is expected that the supply of these systems would be completed by 2024.[5]

Key Developmental Aspects

1. *Pinaka Mk-I*: The Pinaka MBRS was developed for the Indian Army by the ARDE. This version is the most basic MBRS being used in the Indian

Army till date. First manufactured in 1994, it consists of a free-flight artillery rocket with a maximum range of approximately 40 kilometres (km). It also includes various types of warheads and fuzes, as well as a multi-tube launcher vehicle, a replenishment-cum-loader vehicle, a replenishment vehicle (RV) and a command post vehicle.[6]

2. *Pinaka Mk-II*: On 12 January and 24 January 2017, trials of Pinaka Mk-II ammunition were successfully conducted at Balasore. The ARDE successfully produced Pinaka Mk-II rocket with an extended range of around 60 kms, in response to the army's need for a long-endurance free-flight rocket. The new rocket can be fired using the current launch vehicle and ground equipment of Pinaka MBRS, with only minimal alterations.
3. *Pinaka Mk-I (Enhanced)*: On 4 November 2020, the ARDE, in collaboration with High Energy Materials Research Laboratory, conducted testing of the enhanced version of Pinaka Mk-I rockets.[7] An important achievement of the Pinaka Mk-I (Enhanced) is the augmentation of its range (around 45 kms) in comparison to the previous version and reduction in length of the rockets. By increasing the maximum range of its rockets, the system is able to effectively target and attack enemy positions at longer distances, hence enhancing its operational capabilities and effectiveness in combat.
4. *Guided Pinaka*: Recently, the EEL, in partnership with the ARDE, transformed Pinaka rocket into a highly accurate guided missile by the utilisation of the guidance, navigation and control (GNC) kit developed by Research Centre Imarat (RCI). An improved range of around 75 kms and enhanced precision striking capabilities have become possible by the indigenously developed GNC kit.[8]

Key Stakeholders

1. DPSUs:
   (i) Yantra India Limited
   (ii) DRDO
   (iii) BEML
   (iv) ARDE
   (v) RCI, Hyderabad
   (vi) Defence Research and Development Laboratory (DRDL)

(vii) Proof and Experimental Establishment (PXE)
(viii) Munitions India Limited (MIL)

2. Private industries:
   (i) TATA Power SED
   (ii) L&T Heavy Engineering Division
   (iii) Solar Industries
3. Users:
   (i) Indian Army, Corps of Artillery
   (ii) Armenian Ground Forces (since July 2023)

Role of Users in Development

The Indian Army, from time to time, provides critical operational insights and requirements to the various stakeholders in the form of regular feedback sessions, trials, user evaluations, discussions, technical innovation symposiums and conferences. The rich frontline experiences and in-depth understanding of modern battlefield dynamics acquired by the army help in shaping the capabilities and performance parameters of the rocket system.

One of the noteworthy contributions of the Indian Army in the development of modern rocket systems is its role in validating the rocket system in real-world battlefield scenarios. This real-time 'hands-on' approach provides scope for product refinement and enhancing system reliability, thereby improving the efficacy of this potent weapon platform. This facilitates seamless integration of modern rocket systems and their effective deployment in alignment with real-world battlefield scenarios.

DRDO–Industry–Indian Army Synergy

The seamless collaboration between the DPSUs, Indian private industries and the Indian Army in developing the 214 millimetre (mm) Pinaka MBRS highlights a strategic alignment aimed at strengthening India's indigenous defence capabilities. This engagement helps in harnessing the DRDO's cutting-edge technological prowess, modern manufacturing capabilities of the Indian industry and operational expertise combined with frontline experience of the Indian Army to develop and deploy a potent military asset. This bolsters India's national security and strategic autonomy in maintaining a lively and versatile defence ecosystem.

Technological Aspects

Configuration

The 214 mm Pinaka MBRS is an extremely versatile and potent weapon system, with each battery consisting of a wide range of specialised vehicles in order to perform various operational roles across multiple domains and ranges.[9]

A typical Pinaka battery comprises six launchers, six loader-cum-replenishment (LCR) vehicles, three RVs, two battery command post (BCPs) vehicles and one DigiCORA meteorological (met) radar.

Tactical Aspects of Pinaka MBRS

1. *Area denial and saturation*: The primary role of Pinaka MBRS is delivery of massed firepower over a likely target area, such as enemy formation, logistics, high-value targets and troops in open.
2. *Precision engagement*: With guided extended range (GER) rockets, Pinaka MBRS is capable of accurate and precision strikes, making it a formidable long-range precision strike-capable weapon system. This reduces the requirement of firing large number of rockets to destroy a likely target area, thereby enhancing single-shot kill probability to a large extent.
3. *Integrated operations*: Pinaka MBRS, integrated with Project Shakti, the Artillery Combat Command and Control System (ACCCS), facilitates seamless integration and passage of data between all artillery systems. This, in turn, enables delivery of coordinated fire support for advancing ground forces during operations.
4. *Psychological impact*: The overwhelming firepower of a Pinaka salvo can never be underestimated. The delivery of a Pinaka battery salvo can significantly demoralise enemy troops, cause fear, lead to large-scale destruction and disrupt operational effectiveness of the enemy.

Integration of Indigenous Systems in Pinaka MBRS

The Pinaka MBRS is a very potent weapon system, but it can be optimised with the use of domestic technologies and innovations to increase its operational capabilities and reduce reliance on foreign imports. Some of the indigenous technologies that may be incorporated into the weapon system are mentioned next:

1. *Indigenous rocket propellants and warheads*: Incorporation of advanced indigenous solid rocket propellants, rocket design and research in improvement of propellant grain geometry for obtaining optimum range, accuracy and lethality of Pinaka MBRS is required. Design and fabrication of advanced indigenous warheads, such as pre-fragmented high-explosive ammunition, area denial munitions and cluster and GER ammunition, is the need of the hour.
2. *Navigation and guidance system*: Inclusion of indigenous Global Positioning System (GPS) systems, such as Indian Regional Navigation Satellite System (IRNSS) and NavIC, into Pinaka MBRS for trajectory guidance and control of rockets during flight is needed. The inertial navigation system may also be made part of the guidance kit to facilitate rocket guidance in the event of GPS jamming/degraded signals being present during hostile electronic warfare scenarios.
3. *Command and control systems*: Incorporation of indigenous battlefield surveillance systems, surveillance centres and software interfaces into the Pinaka data communication system will facilitate seamless real-time data sharing and better sensor–shooter linkages.
4. *Automation and artificial intelligence (AI) integration*: Use of indigenous AI and machine learning for performing advanced functions, such as automatic target acquisition, automated launch sequence procedures and threat detection techniques, should be considered. Usage of such systems has been validated in the ongoing Israel–Hamas conflict wherein the use of Gospel and Lavender AI-based systems was incorporated with artillery systems for automated target engagement and post-strike damage assessment.
5. *3D printing and material technology*: Indigenous fabrication and manufacturing of critical spare parts using different techniques, such as 3D printing, to ensure optimum equipment readiness during operations is essential. Research on low-cost improved composite materials to reduce certain material characteristics, such as weight, durability and tensile stress, is required to be carried out.

Transforming Defence Paradigm

Role of Pinaka MBRS in Reducing Foreign Defence Imports

1. *Increase in defence exports*: The indigenous Pinaka rocket system has gained international attention due to its export to Armenia during the

Armenia–Azerbaijan conflict. India clinched a deal with Armenia, valued at Rs 2,000 crore, to acquire four Pinaka batteries and additional defence equipment. The procurement also encompassed future deliveries of enhanced range and guided rockets for the Pinaka system. The order was delivered to Armenia in July 2023. The interest demonstrated by other nations, such as Indonesia and Nigeria, highlights the system's capacity for worldwide acceptance and strengthens India's role as a significant participant in the global armaments industry.[10]

2. *Indigenous innovation*: Private enterprises, such as TATA Power SED and L&T Defence, in collaboration with the DRDO, have helped immensely in the production of particular elements of the Pinaka system, such as rocket casings, guidance systems and propulsion units. Private enterprises, including micro, small and medium enterprises (MSMEs) and start-ups, have the potential to contribute specialised knowledge in various fields, like precision engineering, materials science or electronics, thereby improving the performance and capabilities of the Pinaka system.
3. *Cost-effectiveness*: India saves costs by utilising domestically manufactured Pinaka MBRS instead of procuring equivalent systems from foreign markets. This cost effectiveness not only conserves vital financial resources but also alleviates the burden on foreign exchange reserves.
4. *Technological self-reliance*: The development and manufacture of Pinaka MBRS has bolstered India's technological autonomy in the defence sector. This has, in turn, promoted the development of specialised knowledge in important fields, like rocket propulsion, guidance systems and artillery technology, thereby decreasing the reliance on foreign imports of these technologies.
5. *Tailored solutions*: The Pinaka MBRS can be tailored to fulfil the precise demands and operational circumstances encountered by the Indian Armed Forces. The level of customisation guarantees that the system is fine-tuned to address India's distinctive geographical, climatic and strategic obstacles, hence decreasing dependence on standardised solutions provided by international providers.

Economic Impetus

1. *Job creation and economic growth*: A proficient workforce is necessary for the research, development, production and maintenance of the Pinaka rocket system. This encompasses professionals, such as engineers, scientists, technicians and administrative personnel, who are employed by

different organisations, such as DRDO, public sector undertakings and private companies, engaged in defence production. The establishment of these highly qualified positions directly helps in the expansion of economy.

2. *Human resource development*: The defence industry has a substantial impact on the economy through a multiplier effect. The manufacture and deployment of the Pinaka rocket system generates demand for goods and services in many industries, resulting in the development of indirect employment opportunities and training of individuals in niche technologies. This encompasses job prospects in supply chains, logistics, transportation, raw materials and support services.
3. *Defence exports*: The weapon system is one of the first Indian military items that has been shared with foreign countries, including Armenia. The army too needs additional regiments of Pinaka MBRS as part of its efforts to enhance its artillery capabilities.

Role of Pinaka Rocket System in National Security

1. *Russia–Ukraine conflict*: This conflict has had a negative impact on India across multiple dimensions. Over the years, India has established strong diplomatic relations with both Russia and Ukraine to fulfil its military requirements. In addition to acquiring new equipment, the Indian military relies on Russia and Ukraine for essential spare parts for its existing arsenal, which includes GRAD, Smerch rocket systems, artillery guns, infantry combat vehicles, as well as T-72 and T-90 tanks.[11] The current conflict has made India dependant on foreign countries to provide spares for its existing inventory and has halted the acquisition of new technology and critical equipment. This has made India realise the importance of indigenous defence technology for its armed forces.
2. *Firepower*: The Pinaka rocket system equips the Indian Armed Forces with a formidable capability to deploy firepower and effectively neutralise hostile targets. The Pinaka system has the capability to launch multiple rockets at the same time, which allows it to cover a specific region with a large number of high-explosive warheads, fragmentation munitions or specialised payloads. This can effectively damage enemy formations, infrastructure and logistical capabilities.
3. *Strategic deterrence*: The Pinaka rocket system enhances India's strategic deterrence by demonstrating its indigenous technological prowess and

commitment to safeguarding its territorial integrity and national interests. The system's capabilities act as a deterrent to potential aggressors and enemies, thereby contributing to the preservation of regional stability and security.

4. *Operational flexibility*: The Pinaka system's operational flexibility enables its seamless integration into a wide range of military operations, encompassing conventional combat and counter-insurgency operations, including surgical strikes.

Present Challenges in Pinaka MBRS

1. *Incomplete indigenisation*: Few components and sub-assemblies, including navigation and positioning system (Sigma 30), are manufactured abroad for use with artillery rocket systems, including Pinaka MBRS.[12] This provides scope for the sub-systems to be indigenised and manufactured in India. Such components and assemblies present in Pinaka MBRS are still being procured from their manufacturers abroad due to the technology being non-existent/nascent in India.
2. *Precision firepower*: The accuracy of Pinaka Mk-I and Mk-II rocket systems is around < 1.5 per cent of the range.[13] There exists phenomenal scope for improvement in the accuracy and consistency of the weapon system in order to compete with well-known rocket systems, such as those developed by China, Russia and the United States.
3. *Range*: Currently, the Pinaka MBRS family has a wide range, from around 5 km to 75 km.[14] The full-fledged application of the weapon system across diverse ranges will be realised when the present ranges are enhanced further and are comparable to rocket systems capable of striking targets at ranges of about 300 km.
4. *DigiCORA meteorological system*: Accurate and precise engagement of targets is possible due to the meteorological system integrated with Pinaka MBRS. Currently, this system is being imported due to the technology not being readily available in India. Earnest efforts are required in this direction in order to increase the efficiency of the weapon system.[15]

Lessons for India

Defence and R&D Budget

Defence industrial capability of developed countries, such as China, is mostly ascribed to its constant and large increase in military expenditure, particularly

in procurement spending. In India, the projected budget for the MoD for the fiscal year 2024–25 is only Rs 621,540.85 crore, which accounts for a meagre 13.04 per cent of the overall union budget. The budgetary allocations for the MoD in the fiscal year 2024–25 have only increased marginally by 4.71 per cent, compared to the budget estimates for the fiscal year 2023–24.[16]

Asymmetric Competition

India must refrain from engaging in competition to acquire larger quantities of weapons with likely adversaries, such as China and Pakistan. Instead, it is essential to prioritise the development of technologically advanced capabilities that would offset the numerical advantage held by these rivals. Although technology holds significance, operational methods and organisational architecture are equally crucial in achieving advantages over adversaries with greater numbers.

Cost

India needs to strategically allocate its limited resources in order to rebalance the cost dynamics that currently give a significant advantage to its rivals. To attain sustainable self-sufficiency in defence industry, India must acquire defence technology at or above the prevailing worldwide market rates, even if it entails compromising on cost.[17] This is necessary to ensure technology transfers which are crucial for the country's objectives. In addition, ensuring a steady and uniform method for distributing funds and implementing minor modifications to the regulatory structure will augment the motivation for private sector investment in the Indian defence sector. As a result, this will promote the expansion of competition, reduce costs and encourage innovation.

Predicting Requirements

The primary duty for articulating their immediate, intermediate and long-term equipment requirements, taking into account technological superiority, costs and export potential, lies with the Indian Armed Forces. This logical and practical process for defence industrial planning may be initiated by the Integrated Defence Staff (IDS). Nevertheless, obtaining the support and approval of the MoD, Defence Planning Committee and the Cabinet Committee on Security will be necessary. Realistic GSQRs fielded by respective service headquarters will go a long way in helping the industry and academia in understanding the unique and critical requirements of the defence forces.

Planning Expenditure

In order to secure technology transfers which are necessary for the country, India will have limited options. However, it is crucial to acquire defensive technology at or above international market pricing, even if it means sacrificing cost in favour of prioritising time and quality.[18] Furthermore, maintaining a consistent approach to budget allocations and making small adjustments to the regulatory environment will enhance the incentives for private sector participation in the Indian defence industry.[19] Consequently, this will facilitate the enhancement of competition, reduction of expenses and stimulation of innovation.

Future-proof Rocket Systems

In the near future, we need to replace Russian-origin GRAD, Smerch and similar rocket systems in our inventory with indigenously developed Pinaka MBRS to achieve the true sense of 'Atmanirbhar Bharat' in rocket artillery systems. This will also ensure that indigenously developed equipment, spares and specialised manpower are available to the Indian Army in the foreseeable future. Commonality of equipment and weapon systems is of utmost importance, which otherwise leads to complex supply chain management linkages for spares, upgradation and maintenance.

Conclusion

India is compelled to enhance its defence capabilities in order to safeguard its national interests due to threats posed by the neighbouring states. There is an immediate necessity to thoroughly reassess the entire notion of indigenisation and self-reliance in rocket artillery systems. It is crucial to move beyond the limited perspective of viewing indigenisation solely as the replacement of imported components and sub-assemblies. India deserves to transition from being a country that imports defence items to becoming self-reliant, with the ultimate aim of becoming a net exporter to other friendly nations.

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