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EVOLUTION OF INDIA'S AMMUNITION LANDSCAPE

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Introduction

India's ammunition history is deeply intertwined with its British colonial past and subsequent efforts to develop indigenous defense capabilities. The British East India Company recognized the importance of military hardware and established the Board of Ordnance in 1775. A gun powder factory at Isha pore was established in 1787, followed by a Gun Carriage Agency at Cossi pore in 1801. These institutions laid the foundation framework for the domestic defense industry. Other localized initiatives for infrastructure development to enhance self-reliance and reduce dependency on the elongated supply lines followed. After independence, India focused on building its own ammunition manufacturing capabilities, leading to the establishment of the Ordnance Factory Board responsible for establishing and managing various factories involved in manufacture of military hardware. Today, India is aiming for self-sufficiency in various fields including ammunition production through the "Make in India" (MII) initiative. This article traces the journey of ammunition production in India from its rudimentary origins to its increasingly autonomous and intelligent future with a focus on indigenous capacity development.

Evolution of Ammunition Around the World

The evolution of ammunition has been driven by advancements in firearms, propulsion systems and the need for more effective projectiles and accurate delivery means. Ammunition, the lifeblood of firearms, has a rich and fascinating history spanning centuries from the humble beginnings of stones and arrows to the precision guided and loiter munitions of today. The evolution of ammunition mirrors the progression the way wars have been fought and how human civilization has developed overtime. The journey from the traditional relatively simple early ammunition designs to the present complex systems in vogue has transitioned progressively in sync with other war fighting mechanisms.

The discovery of gunpowder during the 9th century AD marked a pivotal moment in ammunition history, revolutionizing warfare by propelling projectiles with explosive force to longer distances which were otherwise beyond imagination. This newfound power led to the creation of early firearms, including cannons and muskets, which reshaped the battlefield. Further employment of enhanced principles of ballistics aided the evolution of firearms and necessitated development of ammunition to complement the advantages accrued to increase potency at the target end.

Industrialization. The Industrial Revolution brought about mass production capabilities, which were fully leveraged during the World Wars. Ammunition diversified rapidly: armor-piercing rounds, high-explosive shells, tracer bullets, and aerial bombs became standard. Strategic bombing campaigns and artillery barrages demonstrated the vitality of ammunition in modern conflict. During the Cold War, the focus shifted to WMDs, intercontinental ballistic missiles (ICBMs), and precision-guided munitions (PGMs). While large-scale warfare was deterred by the threat of mutually assured destruction, regional conflicts around the world showcased the need for both conventional as well as ‘deterrent arsenals’ to maintain sovereignty and influence political, diplomatic or commercial agendas.

Transformation of India's Ammunition Landscape

India's engagement with manufacture of weapons and ammunition stretches back several centuries, evolving alongside global advancements in firearm mechanisms. It was primarily limited to small arms domain and explosives until the 20th century. From early matchlocks to modern automatic rifles, each phase reflects changing military needs and industrial capabilities. The earliest firearms used in India were **matchlocks**, introduced by the Portuguese and later adopted by the Mughals and regional kingdoms. These suffered from certain drawbacks like slow rate of fire and were unreliable in rain or wind. The **flintlock,** using a piece of flint striking steel to create sparks and ignite the priming powder replaced the matchlock in the 17th century. By the early 1800s, **percussion caps** replaced flintlocks. These were more weatherproof and easier to use.

Pre Independence Capabilities

Following the 1857 revolt, British authorities grew increasingly aware of the strategic risks posed by reliance on overseas arms supplies. This realization led to greater investments in domestic ordnance production. Ammunition Factory Kirkee was established in 1869 to produce gun powder-based cartridges for Snider and Henry Martin Rifles. Factories like Isha pore Rifle Factory were established in existing location of Gun Powder factory in1904 for local production of weapons like the British infantry breech-loading Snider–Enfield rifles, followed by bolt-action rifles such as the Lee–Enfield Mk III which were the standard issue during the World Wars era. By the early 20th century, India had begun limited production of some key ammunition categories as well. This included localized manufacturing of .303 British cartridges for the Lee–Enfield rifles, as well as artillery shell fillings. 1904 saw the establishment of Cordite Factory Arvankadu for the manufacture of propellants. However, India's ordnance production remained insufficient for large-scale conflicts, and during times of war, imports from Britain continued to supply the majority of military needs. In 1906 the administration of Indian Ordnance Factories came under 'IG of Ordnance Factories'.

India played a critical role in supporting the British Empire during World War I (1914–1918), contributing over 1.3 million soldiers across various theatres, including Europe, the Middle East, and Africa. These troops were primarily equipped with Lee Enfield Rifles, Vickers & Lewis Machine Guns, Hand Grenades and artillery weapons like the 18 Pounder and 4.5-inch Howitzers. Most of the ammunition for these weapons was supplied by Britain. However, Indian ordnance factories, particularly those in **Kirkee** and **Cossi pore** played a

supportive role by producing small arms ammunition and carrying out shell filling operations. These munitions were transported by sea through major ports such as **Karachi** and **Bombay**, from where they were shipped to war fronts. The ordnance factories were charged to DG of Ordnance Factories from 1933 onwards. In 1935 Indian Ordnance Services (IOS) was established to administer the complete defence production industry of India. The IOS was renamed as Indian Ordnance Factories Service (IOFS) in 1954.

India's contribution to the Allied war effort grew substantially during World War II (1939–1945). The country not only provided over **2.5 million troops**, but also became a major logistical and manufacturing hub. During this period, India underwent a significant transformation in its industrial capacity. Wartime demands prompted a rapid scaling up of domestic production. New factories like the dedicated explosive plants at Ammunition Factory Khamariya and High Explosives Factory at Kirkee were established. By 1943–44, India had achieved near self-sufficiency in small arms ammunition and even began exporting munitions to other British colonies and Commonwealth forces. While certain advanced munitions and high-volume requirements continued to be supplemented by UK and Allied imports, India had clearly emerged as a key production base within the Empire's military-industrial network.

Post-Independence Industrial Growth and Modernization

Following independence in 1947, India inherited a modest yet strategic industrial base in ammunition manufacturing. India retained the centralized defence production system established during British rule. At the point of independence India had 18 functional ordnance factories focussing on supplying arms, ammunition and military equipment. Their development was limited by the strategic needs of colonial rulers, rather than by innovation or strategic national concerns, leaving considerable room or modernisation post-independence. After independence, the Ordnance factories were brought under control of the Indian government (Ministry of Defence). The government prioritised strengthening the indigenous defence capability and added 23 more factories. Department of Defence Production was set up in 1962. Facilities located in Khadki and Khamaria played pivotal roles in India's logistics during the 1962 Sino Indian conflict. Ordnance Factory Bhandara and Varangaon were commissioned in mid 1960s and added to the production capacity playing a vital role in the Indo-Pak wars of 1965 and 1971. Ordnance Factory Itarsi was added in 1969 or propellant manufacture and Ordnance factory Chandrapur was established in 1970 for medium and high calibre ammunition.

The entire network was consolidated in 1979, culminating in the formation of the Ordnance Factory Board (OFB) which became the backbone of independent India's defence production to meet India’s growing defence requirements. Establishment of OFB was aimed at centralising management, improving efficiency and promoting self-sufficiency in defence manufacturing. The High Energy Projectile Factory for kinetic projectiles was set up in 1980 followed by establishment of Ordnance Factory Dehu Road for pyrotechnic stores in 1984. In the same year foundation stone was laid at Bolangir for a state-of-the-art ammunition plant. This factory called Ordnance Factory Badmal was established with collaboration with firms from USA, Germany, Switzerland and Bulgaria, commencing operations in 1989. Nalanda was home to a factory responsible for high calibre charge systems consequent to inauguration of Ordnance factory Nalanda in 2001.

At its peak, the OFB managed 41 factories, training institutes, regional safety controllers and marketing centres with over 80,000 employees making it amongst the largest and most diverse government owned defence production setups in the world. OFB was producing a diverse range of military hardware, including more than 200 types of ammunition to include small arms rounds, medium calibre ammunition, high-calibre artillery shells, tank and anti-tank munitions, mines, explosives, naval guns ammunition and air-dropped bombs.

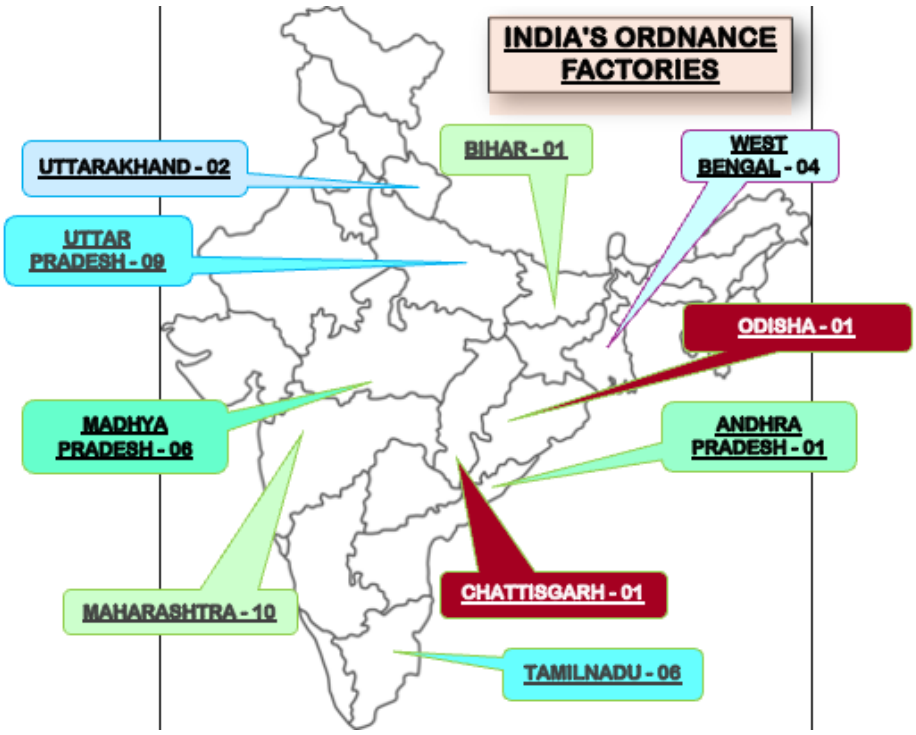

Figure 1: 41 Factories under OFB

Despite its scale, over time the OFB became plagued with systematic inefficiencies. Production delays, shortfall in production targets, exorbitant costs, lack of innovation and poor-quality control severely undermined its efficacy. Monopoly in the defence sector and a captive clientele led to lack of competitive incentive and poor production record. The high cost of orders placed and delayed delivery timelines resulted in critical cascading effect on combat effectiveness of the armed forces, increasing dependency on imports even for standard calibre munitions. Concerns from the Armed Forces emphasised urgent need to modernise, ensure accountability and increase competitiveness. The stage was set for a transformational reform process, leading to corporatisation and restructuring.

The OFB was corporatized in 2021 into 7 PSUs with an aim to improve autonomy, accountability, and efficiency in ordnance supplies. This transformation targeted to create a more flexible and modern organization with faster decision-making capabilities to lead to better product quality, expanded markets, and enhanced defence exports. The 12 ammunition manufacturing components of erstwhile OFB are now clubbed under Munitions India Limited (MIL).

Entry of Private Sector and Technological Leap

Private industry had made small forays in the defence sector in the early 90s by ways of supplying important components or various munitions even when the defence sector remained largely under government control. For instance, the development and production of semi combustible cart cases (SCC) for tank ammunition was undertaken by government agencies in collaboration with SM Group. The High Energy Projectile factory along with DRDO was focusing production of tungsten based heavy alloy penetrators for FSAPDS rounds. A significant policy shift came in the early 2000s and gained momentum after 2016 with the Make In India and *Atmanirbhar Bharat* (Self-Reliant India) initiatives, which aimed at indigenization of military platforms, increased domestic production, support for MSMEs and startups.

The policy involves liberalizing FDI, streamlining procurement processes, and encouraging private sector participation in defence manufacturing. The government aims to nearly quadruple India's annual defence output to 3 lakh crores by 2028-29 as also depicted in Figure 2 sourced from IISS Database (2023). These policies have allowed the private sector to formally enter ammunition and explosives manufacturing, previously monopolized by state-run entities. Few of the private players in the ammunition manufacturing transformation are elaborated in subsequent paragraphs.

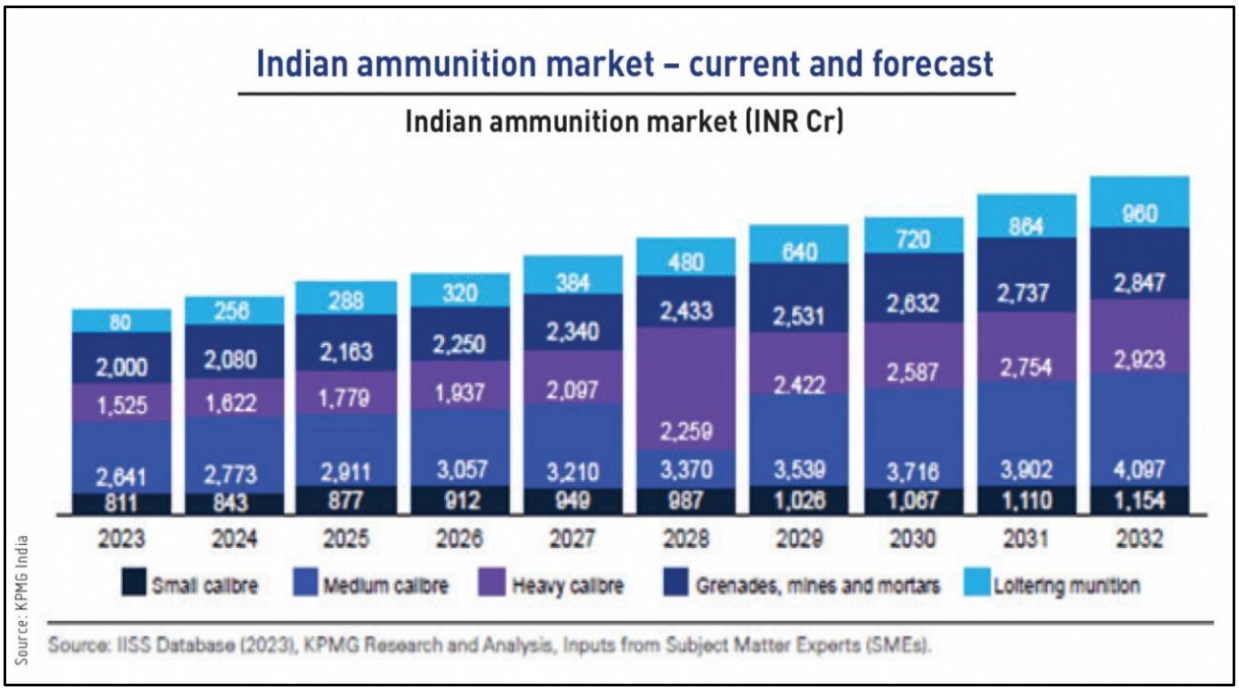

Figure 2: Growth of ammunition production with forecast

Munitions India Ltd (MIL). Formerly part of OFB, MIL continues producing core ammunition, now functioning under a corporate PSU model for greater efficiency and accountability. MIL, recognized as India's largest and most prominent manufacturer in its field, specializes in the production, testing, research & development and marketing of a comprehensive range of ammunition and explosives for the Army, Navy, Air Force and Para-Military Forces. Headquartered in Pune, MIL operates 12 advanced manufacturing units across the country, employing a skilled workforce of approximately 23,000 individuals. These facilities serve as an integrated hub for the production of small, medium, and high-calibre ammunition, mortars, rockets, hand grenades, and more. MIL also carries out in-house manufacturing of initiatory compositions, propellants, and high explosives, building on over 150 years of expertise.

The budget allocated for MIL has seen an increase in the 2020s. The defence PSU was allocated a budget of Rs 577 crore in FY2023, Rs 580 crore in FY2024 (RE), and Rs 745.45 crore in FY2025, the highest among the seven defence PSUs (ex OFB). This is a part of the infrastructure modernisation plan, and to increase the war reserves of the Indian Armed Forces to sustain long-drawn wars. The sum is to be invested in modernising equipment, increasing production capacity, and including new manufacturing lines for ammunition. MIL's products are trusted by customers across North America, South America, Europe, Africa, and Asia.

Solar Industries India Ltd (Nagpur). Solar Industries India Limited is an Indian-based integrated global explosives company. The company primarily produces industrial explosives and explosive-initiating devices. Its industrial explosives line includes packaged emulsion explosives, bulk explosives, and explosive initiating systems. The company's journey began in 1984, focusing on trading explosives and accessories. By 1985, they expanded operations by finding Economic Explosives Ltd (EEL) in Solapur. These ventures laid the groundwork for a robust trading network, making Solar Industries one of the largest dealers of detonators and explosives by 1991. EEL, a subsidiary of Solar Group manufactures fuzes, rockets, air bombs. It is also producing loitering munitions, warheads, and solid propellants for missiles.

Solar Industries Ltd is a domestic manufacturer of bulk and cartridge explosives, detonators, detonating cords, and other components. The company's defense products include high-energy materials like HMX, RDX, and TNT, as well as composite propellants for Pinaka,

Akash, Brahmos, PSOMXL, and Skyroot. Ammunition such as 30 mm ammunition, multi-mode hand grenades, mines, warheads, a bund blasting device; artillery fuzes, ASW fuzes, Pyros, and igniters; chaff payloads; loitering munition; rocket integration; and explosive ammunition filling. It is a key player in manufacturing Pinaka Multi-Barrel Rocket Launcher (MBRL) rockets, in collaboration with DRDO.

During the financial year 2024–2025, Solar Industries Nagpur achieved several significant milestones. The company crossed a market capitalization of ₹1,00,000 cr, marking a major financial landmark. It secured its highest-ever order for PINAKA rockets, with the order valued at over ₹6,000 cr. In terms of technological advancements, Solar Industries made notable progress in defence innovations. The Counter Drone System, named Bhargavastra and a micro missile system both underwent successful initial trials. Additionally, the company successfully delivered the loitering munition system NAGASTRA-1 to the Indian Army, demonstrating its growing contribution to national defence capabilities.

Premier Explosives Limited. Based in India, this company manufactures high-energy materials and related products for the defense, space, mining, and infrastructure industries. Its primary mission is to develop and manufacture solid propellants for rockets and strap-on motors used in satellite launch vehicles. Ammunition, chaff, infrared flares, explosive bolts, pyro devices, smoke markers, cable cutters, tear gas grenades, pyrogen igniters, and Blazer Plates are among the company’s diverse product offerings for defense and space applications.

The company operates two defense and explosive manufacturing facilities in Peddakundukur and Katepally, both in Telangana. In addition, it operates six bulk explosive manufacturing facilities in Madhya Pradesh, Maharashtra, Telangana, and Tamil Nadu. They have been producing solid propellants since 2003. The company has successfully contributed to the production of solid propellants for a variety of tactical missiles including Astra, Akash, and LRSAM, as well as rockets such as Pinaka. They are expanding the product portfolio to include rocket motor hardware, warheads, ammonium perchlorate, HTPB and CL20.

Bharat Forge Ltd (Kalyani Group). Established in 1961 in Pune focusing on automotive components, it has diversified into defence manufacturing. Additionally, Bharat Forge has ventured into advanced defence technologies, unveiling India's first indigenous UAV engine

at Aero India 2025. It has a key role in developing smart munitions, APFSDS tank rounds, and precision-guided artillery ammunition. **Kalyani Strategic Systems Ltd. (KSSL)**, a fully-owned subsidiary of Bharat Forge Limited, was established as a flagship company to spearhead defence sector initiatives. Backed by the Kalyani Group's extensive legacy in design, engineering, metallurgy, and manufacturing—spanning over five decades—KSSL has emerged as a major player in India's defence landscape. Its rise is supported by the robust and specialized capabilities of various group entities located at strategic sites across the country. The Kalyani Group operates cutting-edge manufacturing and electronics facilities dedicated to the development of advanced defence technologies. These include systems such as artillery platforms, protected vehicles, armoured vehicle upgrades, ammunition, air defence systems, small arms, marine applications, and defence electronics. The Group's internal research and development ecosystem, featuring the Kalyani Centre for Technology & Innovation (KCTI) and the Kalyani Centre for Manufacturing Innovation (KCMI)—plays a crucial role in delivering solution-driven, differentiated technologies.

Hughes Precision. A subsidiary of Deep Group, this company was incorporated in 2016 for the manufacture of defense equipment. The company is known for its small-caliber ammunition manufacturing, including sniper rifle ammunition, and was the first private company in India to receive a license for manufacturing military-grade ammunition in 2018. Hughes Precision's facility in Goa has an in-house test facility and range and can produce 80 million rounds per year, meeting NATO military standards. Hughes Precision is a significant player in India's "Make in India" initiative, aiming to reduce reliance on imported defense products. The company's work on indigenous sniper ammunition has been highly appreciated and it is also involved in the development and manufacturing of other small caliber ammunition.

SSS Defense. Founded in 2017, the company is involved in driving the agenda for Make in India and also breed in innovations for meeting specific requirements of Armed Forces, Law enforcement Agencies and their unique theatre of operations. SSS Defence is among a rare league of companies in India to have the industrial license for operating in the realm of small arms and ammunition. It sets out to envision a new future of defence technology that incorporates deep design thinking, precision engineering and operational excellence.

Adani Group. Adani Defence & Aerospace, a subsidiary of Adani Enterprises established in 2015, has quickly grown into a major player in India's defence manufacturing sector. It is

manufacturing Unmanned aerial vehicles (UAV), advance missile system like RUDRAM and 70mm rockets in partnership with Thales, Belgium playing a pivotal role in establishing India as a hub for advanced defence and aerospace manufacturing. This effort aligns with the MII initiative, promoting self-reliant industrial growth. The company focuses on raising India's defence capabilities to international standards and to strengthen local expertise and advance the domestic defence sector, it is making targeted investments in innovative technologies and products by collaborating with Indian MSMEs (Micro, Small, and Medium Enterprises) and start-ups.

Bharat Dynamics Ltd (BDL). India's first SSM Prithvi, ballistic missile Agni, MRSAM, Akash, AAM Astra and in service ATGMs are all development/license projects of BDL. Established on July 16, 1970, and headquartered in Hyderabad, BDL is a key Public Sector Undertaking under the Ministry of Defence, Government of India. It was founded to serve as the primary production hub for guided missile systems and related equipment for the Indian Armed Forces. Since its inception, BDL has worked closely with the Defence Research and Development Organisation (DRDO) and international Original Equipment Manufacturers (OEMs) to manufacture and supply a variety of missile systems and associated equipment. The company operates four manufacturing units: three in Telangana (located at Hyderabad, Bhanur, and Ibrahimpatnam) and one in Andhra Pradesh (Visakhapatnam).

BDL's significant role in India's **Integrated Guided Missile Development Programme (IGMDP)** marked a major turning point. Identified as the Prime Production Agency under the program, BDL was instrumental in the nation's push to develop indigenous, advanced missile systems. Over the years, BDL has emerged as a global leader with cutting-edge capabilities in the production and supply of guided missiles, underwater weapons, airborne products, and related defence equipment. In addition to manufacturing, BDL also provides **Product Life Cycle Support**, including the refurbishment and life extension of vintage missiles. From its roots as a missile manufacturer, BDL has evolved into a comprehensive **Weapon System Integrator**, offering end-to-end solutions to meet the defence needs of the Indian Armed Forces.

BAPL. Brahmos Aerospace was established in 1998 as a JV between Russia and India for development and manufacture of a supersonic cruise missile, the need for which was felt post the Gulf War. The company has been a success model with the missile achieving highest standards of accuracy and lethality, meeting all mission goals. The speed of

development of the missile system and the ease of collaboration between the two parties has been the hallmark of the project.

Though initially planned as a ship and surface launched missile it was subsequently developed for submarine and aircraft launch versions. All variants have met strapping success. The range has already been increased and a Brahmos NG variant is in the offing. The missile has given a major boost to the defence potential of the armed forces and bagged lucrative export orders. The $375 million deal with Philippines marked a significant milestone in exports for the Indian defence industry and BAPL itself.

Defence Corridors. In addition to the aforementioned private sector companies, the MII Initiative together with policy of Atmanirbhar Bharat has given a substantive push to the public sector in the defence manufacturing landscape of India. In addition to the policy initiatives of promoting MSMEs and new entrants in the sector, the government has also gone on to create infrastructure and allied facilities by creating dedicated defence corridors in the country. At the services level, a major focus has been given towards facilitating and supporting the indigenous manufactures by enhanced formal and informal interactions, formulating achievable SQRs and assurance of minimum order to successful bidders.

DRDO's Role in Ammunition and Rocket Systems

DRDO has always been the backbone of research and development for the Indian defence sector. The DRDO was established in 1958 by combining the Defence Science Organisation and some of the technical development establishments. A separate Department of Defence Research and Development was formed in 1980, which later administered DRDO and its almost 30 laboratories and establishments (there were almost 52 labs before merging). The DRDO plays a key role in design, development and initial prototyping of advanced ammunition and rocket systems. While it doesn't produce weapons at scale, it continues to be the backbone of major defence research and development**.** Other advancements researched and introduced by the DRDO include improved metallurgy, better-quality propellants, and system automations. Ammunition changing the defence landscape of India's defence capabilities developed by DRDO are as under: -

- IGMDP – Prithvi, Agni, Akash missiles
- Brahmos missile system
- **Pinaka Multi-Barrel Rocket Launcher (MBRL)** system

- **Anti-Tank Guided Missiles (ATGMs)** like Nag
- **Loiter munitions and Drones**
- **Smart munitions** like Precision-Guided Kits for artillery shells
- **High-energy propellants** and **insensitive munitions**

Conclusion

The evolution of ammunition reflects the broader history of warfare — from primitive stones to advanced, networked systems. Modern battlefields now emphasize not just firepower, but its precise, intelligent, and sustainable delivery. The ongoing Russia-Ukraine conflict has further highlighted the integration of drones and smart weaponry, reshaping global military strategies.

India's ammunition manufacturing sector has transitioned from colonial-era dependence to a diversified and innovation-driven ecosystem. The synergy between restructured public sector entities and agile private firms has created a robust framework capable of advancing national defence objectives and global ambitions. With continued investment in privatisation, indigenous R&D, procurement streamlining, and international partnerships, India is well-positioned to emerge as a global defence manufacturing hub of the future where ammunition development will be dominated by AI, robotics, and precision-guided technologies.

Disclaimer

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References

1. Khan, Iqtidar Alam. *Gunpowder and Firearms: Warfare in Medieval India*. New Delhi: Oxford University Press, 2004.
2. Carman, W. Y. *A History of Firearms: From Earliest Times to 1914*. London: Routledge & Kegan Paul, 1955.
3. Marks, Edward C. R. *The Evolution of Modern Small Arms and Ammunition*. London: Sampson Low, Marston and Company, 1898.
4. Ordnance Factory Board – Directorate of Ordnance (Coordination & Services). *Details on the Structure and History of Indian Ordnance Production*. Accessed October 7, 2025. [No direct URL provided].
5. Defence Research and Development Organisation (DRDO). *Pinaka Multi-Barrel Rocket Launcher – Development Project*. [Technical report/document, if available; otherwise, use institutional source]. Accessed October 7, 2025.
6. "Nagpur Company Delivering Indigenous Boosters for BrahMos Missiles." *Times of India*, February 2024. https://timesofindia.indiatimes.com/city/nagpur/nagpur-co-delivering-indigenous-boosters-for-brahmos-missiles/articleshow/121120784.cms
7. "Solar Group's Economic Explosives Ltd Creates History With 100% Indigenous 30mm HE Ammo." *Indian Aerospace Defence Bulletin*, August 2022.
8. India Foundation. "Make in India and the Defence Sector: Progress and Challenges." *India Foundation Journal*. Accessed October 7, 2025. [Include volume/issue if available].
9. Ministry of Defence, Government of India. *Annual Reports and Publications*. Accessed October 7, 2025. https://mod.gov.in.
10. Centre for Land Warfare Studies (CLAWS). *Performance Evaluation of Ordnance Factories: Their Relevance in Future and Way Ahead*. New Delhi: CLAWS. Accessed October 7, 2025.