



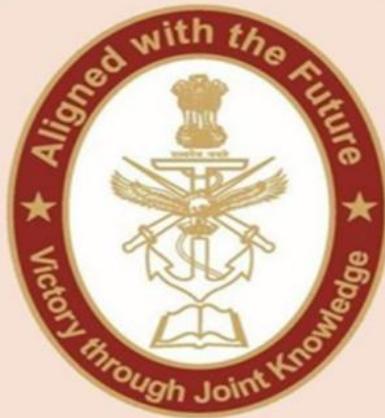
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GLOBAL INSIGHTS TO STRENGTHEN INDIA'S AMMUNITION ECO SYSTEM

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**GLOBAL INSIGHTS TO
STRENGTHEN INDIA'S
AMMUNITION ECO SYSTEM**



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Introduction

India's ammunition ecology system is a critical pillar of national security, operational readiness and logistics. It encompasses the full life cycle of munitions — planning, design and development, manufacturing, quality control, user trials, procurement, storage, distribution, operational deployment, monitoring and demilitarization of all ammunition related to the Indian Defence Forces. The growing complexity of security threats in the region, changing world dynamics and the threat of supply line choking by major ammunition manufacturing nations make it imperative to reduce reliance on imports and enhance our own ammunition logistics system to become more robust, self-sustaining and responsive. Systemized study of global best practices by the world armies, relevant in-depth analysis and suitable incorporation into our strategic logistic plan will help catalyze this transformation facilitate establishment of a resilient mechanism.

Historical Chronology of Ammunition Development in India

India's organized ammunition production dates back to the British colonial era with the establishment of the Gun Carriage Factory in 1801 followed by other key Ordnance Factoriesⁱ. There have been various government mechanisms to monitor these factories and ensure their integration in the national plan. In 1979, these were grouped under the Ordnance Factory Board (OFB), which for decades remained the sole government entity responsible for manufacturing munitions.

The various wars and skirmishes along the volatile borders have constantly highlighted the drawbacks in our preparedness on many aspects including ammunition management. Production capabilities, quality of indigenous production, elongated logistic lines etc have been noted and regular reforms incorporated to improve upon these. Modernization drives for improved products, better storage, accounting and increased competition in the sector by diversified sources have been introduced.

In 2006, the Long-Term Integrated Perspective Plan (LTIPP) emphasized the need for capacity expansion and modernization. More recently, the corporatization of the OFB into seven Defence Public Sector Undertakings (DPSUs) in 2021 marked a structural shift aimed at boosting efficiency and competitiveness. Private sector participation was minimal until the early 2000s when defense procurement policies began to shift. The 2016 Strategic Partnership model and subsequent Defense Acquisition Procedures (DAP) opened doors to private manufacturers in select ammunition categories, paving the way for joint ventures and foreign technology infusion.

Current Ammunition Ecology Structure in India

Ammunition supply and management in the Indian Defence Forces is service specific, tailor made multi agency system layered across institutions under the Ministry of Defence (MoD), which is responsible for the overall defence logistics. It lays down the policies, allocates the budget and approves all procurements through the Defence Acquisition Council. The Department of Defence Production (DDP) and Directorate of Quality Assurance (DGQA) responsible for indigenous production and quality control also function under the MoDⁱⁱ.

The newly corporatized DPSUs—like Munitions India Limited (MIL), Bharat Dynamics Ltd (BDL) and Advanced Weapons and Equipment India Ltd— handle bulk of the indigenous production related to munitions. DRDO is responsible for R&D and advanced systems. These entities now operate with financial autonomy, but their integration with modern inventory practices and market-driven efficiencies remains a work in progress. Private players have entered ammunition production under Make In India and IDDM categories post the Defence Procurement Policy (DPP) 2016 and DAP 2020ⁱⁱⁱ. Their presence is more visible in modern systems like smart munitions, fuses, and niche technologies while conventional ammunition production continues to be dominated by MIL, riding on the advantage of experience and existing infra. Import dependency still exists for specialized hi-tech munitions.

Quality control is enforced by the Directorate General of Quality Assurance (DGQA), which conducts inspection and testing during all stages of ammunition life cycle management. DGQA is transforming to overcome challenges like outdated testing infrastructure, cumbersome archival documentation and slow certification turnaround. The need for reevaluating existing test procedures and concepts has been accepted and reforms underway.

Procurement of munitions is guided by Long Term Integrated Perspective Plan (LTIPP), Annual Acquisition Plan (AAP) and facilitated further by certain Emergency Procurement Powers^{iv}.

The three services (Indian Army, Indian Navy and Indian Air Force) have their own independent task specific logistics branch responsible for ammunition management and planning. Master General of Sustenance (MGS) through the Director General of Ordnance Services (DGOS) oversees the logistics of ammunition within the Army. Maintenance Command is responsible for the IAF, while the Naval Armament Inspectorate advises the IN on all ammunition logistics matters. Ammunition storage is managed in the three services through a network of depots, designed for redundancy and secure dispersal^v. The Field Ammunition Depots/Companies/Platoons for the Army, Base Depots and Weapon Storage Areas for the Air Force and Naval Armament Depots for the Navy constitute this framework. These operationally sited ammunition storage facilities are a balanced mix of

hinterland based depots and fwd stocking echelons for immediate ammunition logistic support.

Inventory management is dominated by shelf-life monitoring and criticality. Digitalization in logistics is limited with compartmentalized legacy systems lacking real time tracking and decision support systems, hindering real-time coordination. Inter-service coordination is in a nascent stage and the three services often procure and manage similar munitions through separate channels, leading to redundancy and inefficiencies. A detailed policy on holding of reserves exists endeavored to maintain appropriate war fighting potential.

Global Insights: Best Practices and Lessons Learned

Leading ammunition-producing nations have consistently prioritized integration, innovation and strategic autonomy. All major powers demonstrate how institutional synergy and technological foresight can transform ammunition eco systems. A study of some of the nations who have been regularly been involved in conflicts or global deployments has been done to understand the nuances of ammunition management adopted and lessons derived from the experience.

The **Joint Munitions Command (JMC)**, which operates under the US Army Materiel Command manages the life cycle of conventional ammunition of all U S military services (i.e) Army, Navy, Air Force, Marines and Special Forces through the SMCA (Single Manager for Conventional Ammunition). The role includes production, storage, worldwide distribution and demilitarization. It oversees 14 production plants and 10 storage depots which include both government-owned contractor-operated (GOCO) and government-owned government-operated (GOGO) plants and ensuring consistent capacity for wartime surge production. Inventory management tools like the ERP based Logistics Modernization Program (LMP) and the Global Combat Support System (GCSS) are effectively employed along with RFIDs and bar coding for effective SCM by end-to-end tracking and delivery, real time asset visibility and demand forecasting based on AI-driven predictive analytic^{vis}. Its partnership with the Defense Logistics Agency (DLA) ensures safety and reliability through strict QA/QC protocols and continuous shelf life monitoring.

The **United Kingdom Armed Forces** follow a sophisticated, centralized, and technology-driven ammunition management system, focused on efficiency, safety, sustainability, and rapid response. The UK Ministry of Defence (MOD) is responsible for policy, budgeting, procurement and defining stock levels. The DE&S (Defence Equipment and Support) under MOD manages supply chain and lifecycle support of all munitions. Procurement is based on a Munitions Acquisition Strategy. Shared munitions standards are followed across all services and ensure interoperability. Ammunition stockpiles are stored in Defence Munitions (DM) sites and managed by the Joint Asset Management and Engineering Solutions (JAMES) system. This system allows tracking stock levels, batch tracing, compatibility group monitoring, condition, location and shelf life monitoring including expiry alerts. The joint supply chain integration is coordinated through the Strategic Command and managed by the Defence Support Chain Operations and Movement (DSCOM) and uses both military and civil logistics assets for movement. Explosives Safety Management System for safe storage and Electronic Munitions Management System for depot level stock handling are being used to increase efficiency and ensure safety.

The **French** also emphasize on a inter service coordinated, highly automated centralized system ably complemented by civil industrial and logistic support. The strategic guidelines, budget and oversight is ensured by the Ministere des Armees (MoD) and Dierctor Generale de l'Armement (DGA) oversees the nation's defense R&D, procurement and lifecycle management. Procurement follows EU and NATO standards for commonality. The Service Interarmees des Munitions (SIMu) or the Joint Munitions Service was created in 2011 to centralize and streamline complete ammunition management for the Army, Navy and Air & Space Force with branches in each military zone. This agency handles stockpiles, transportation, storage, supply and disposal storing ammunition stocks in national and regional depots conforming to NATO safety protocols. Multi modal transport means are employed for movement of munitions with mobile ammunition units deployed during military exercises and combat deployments for rapid support to FASPs (Forward Ammo Supply Points). ERP systems and SILIS (System ed Information Logistique Integer et Simplifie) are used for unified ammunition tracking and inventory management. Logistics Functional Area Service (LOGFAS), a NATO adopted system is used for operational logistics in multinational deployments.

Russia follows a centralized, military industrial complex based Soviet era system with emphasis on mass production, strategic stockpiling and logistical depth. While Russia has made some efforts to modernize its logistics and munitions management in the post-Soviet era, significant challenges remain. The GRAU (Missile and Artillery Directorate) is the core agency managing development, acquisition, distribution and accounting of all conventional munitions including missiles and rocket artillery. It also coordinates with the military industrial complexes like Rostec, Kalashnikov Concern etc. Ammunition Depots are managed by GRAU and located in remote locations with strategic reserves distributed throughout military districts. It has a rigid supply system with employment of Mobile Field Depots for support to combat operations. There is limited technology infusion and digitization in the supply chain management. Though efforts are on to include automated systems for inventory management, but remain low on priority.

Chinese People's Liberation Army (PLA) logistic philosophy is driven by China's doctrine of "fight and win wars in the information era" and is an industrially integrated system emphasizing indigenous production, strategic reserves, and technologically enabled logistics. Most of the information has limited open-source visibility and assessments tend to be speculative. It is largely accepted to be deeply centralized in control by the state as is the national culture. The Central Military Commission (CMC) is the apex policy making body on all military matters including logistics with the Logistics Support Department (LSD) responsible for ammunition management. A massive state owned industrial base supports the requirement of all types of munitions with the ability of surge production when required. The inventory is being modernized with emphasis on smart munitions, loitering platforms and network enabled systems. Stockpiles are stored in dispersed depots at national and theatre levels with pre positioned forward caches in key border areas. Mobile containerized systems are used for operational deployment. Joint Logistics Support Force (JLSF) established in 2016 manages theatre level coordination and support to all services.

Israel's success stems from a doctrine of rapid innovation cycles. Companies like Rafael and Elbit Systems co-develop advanced munitions alongside operational users. The Israeli Defense Forces (IDF) is deeply embedded in R&D processes, providing real-time battlefield feedback to engineers and scientists. This agility allows for rapid incorporation of combat lessons into product design.

Ukraine's system reflects a blend of wartime urgency, international support integration, and rapid adaptation. Ammunition supply and management are primarily handled by the Materiel Support Directorate under the General Staff with service branches (Army, Air Force, Navy, Territorial Defense) having their own logistics units coordinating ammo demand and distribution. Coordination with international donors and allied military logistics teams is integral. Ukraine leverages international logistics support systems from NATO partners with increasing adoption of RFID/barcoding and utilizing NATO based software platforms for demand forecasting and stockpile management. Implementation of digital inventory systems is still emerging.

The broad concept does appear repetitive but necessary with the government maintaining control over the policies and procurement, infusion of state backed industry and private manufacturers monitored by strict audit agencies. Multi service synergy is ensured by single nodal logistics agency employing technology and modern decision support management tools for asset monitoring and last point delivery. Across these models, several key lessons emerge: the importance of digital eco systems, public-private co-design mechanisms, modular manufacturing for scalability, and real-time quality assurance systems. Most importantly, these countries show that clear feedback loops, strong policy backing, and dedicated innovation budgets are essential to modern ammunition eco systems. Storage and transportation of ammunition stocks with countries having limited geographical depth assumes greater importance and reliance on hardened shelters, underground storage and dispersion by caches or mobile platforms is widely adopted.

Recommendations Based on Global Insights

India must tailor international best practices to its domestic context through a blend of restructuring, policy reforms, technological modernization and industrial collaboration. At the policy level, India must consider establishing a National Logistics Commission with a vertical catering for munitions to oversee production, planning, and innovation. This body can ensure synergy across Services, R&D institutions and industry.

Ammunition Research Development and Innovation Hubs. Establishment of these hubs should bring together DRDO labs, academic institutions, DPSUs, and private sector R&D under a shared innovation mandate. They could work on long term problems such as insensitive munitions, biodegradable packaging, high-performance propellants and even development of software for monitoring, quality control and predictive analysis.

Private Sector Inclusion. Participation of private industry and partnership with domestic and international manufacturers for steady supply and innovation should be encouraged. Indigenous development for critical ammo types and components should be promoted and supported. A formal User-Industry Interface Body should be established, involving representatives from Services, procurement divisions and major ammunition producers. This will ensure built in feedback mechanism during various stages of design, development and upgradation. Public-Private Partnerships (PPPs) in ammo production, storage, and disposal, like GOCO model plants should be encouraged. Legislative support for indigenous ammunition manufacturing and R&D tax breaks can incentivize participation from smaller and medium-scale enterprises. Flexible production lines and national munitions reserves to be planned with supply chain resilience via multiple qualified vendors for extended conflicts with surge production capacities.

Performance Based Incentives. DPSUs and private firms must be rewarded for meeting production targets with low rejection rates, early deliveries, and process innovations. At the same time, penalties must be enforced for delays or quality lapses to ensure discipline. Licensing and quality certification processes must be streamlined. International quality certifications like NATO's AQAP standards can also help Indian products enter global markets^{vii}.

Global Collaboration. India should actively seek co-development opportunities with friendly nations and leverage offset clauses in large defense deals to secure critical technologies. International technology transfer must be pursued through offset obligations and joint ventures with nations excelling in specific domains such as guidance systems, propellants, smart fuses etc. while pursuing in house talent to develop own systems to reduce reliance on foreign governments or vendors^{viii}.

Procurement and Stocking Norms. Procurement procedures have been modified and made more transparent. These need to be regularly revisited to ensure healthy and profitable competition. Instead of focusing only on upfront costs, India should adopt Total Ownership Cost models. These models factor in maintenance, shelf-life, disposal costs, and long-term storage conditions.

Life Cycle Management. Set up centralized ammunition health monitoring centers using AI/ML to track performance and reduce wastage. Streamline audit systems and automate

inventory reconciliation to minimize pilferage and misreporting. Strategically, India must invest in AI-based quality inspection systems, smart sensors for inventory tracking, and modular ammunition designs to allow faster upgrades.

Digital Supply Chain Integration. India should create a National Ammunition Digital Grid— a real – time dashboard and implement a pan-defence Munitions Management System (MMS) connecting all stakeholders, from manufacturing units and depots to frontline units. ERP systems need to be integrated with RFID/barcode tagging for real-time, location-level inventory visibility right down to the forward echelons. ‘Block chain’ could be used to ensure traceability, facilitate rapid audits, reduce pilferage, and minimize stock obsolescence. AI-based predictive logistics can flag replenishment needs and suggest dynamic adjustment of stock levels based on evolving threat and operational tempo^{ix}.

Joint Command Structure. Though it would be prudent to recommend a joint munitions structure but the same may not be too relevant in our context owing to the limited commonality of critical level munitions systems. The same may be considered as a single, tri-service agency or command responsible for all ammunition logistics (e.g., US Joint Munitions Command, France’s SIMu) enabling unified policy, streamlined inventory control, and inter-service coordination, but will continue to be governed by service specific existing inventory and storage infra. The factors of commonality like procurement processes, quality control parameters, repair, maintenance and disposal can be clubbed under a central monitoring agency but will continue to remain theatre specific and locally controlled during operations. Limited cross storage is possible and required and can be coordinated on case to case basis. Interoperability at ground level should be encouraged where beneficial.

Lastly, regular war-gaming exercises and simulation-based testing of ammunition positioning and resupply chains integrated closely with operational and tactical plans are essential to validate India’s preparedness and highlight operational gaps.

Conclusion

Strengthening India’s ammunition ecology system demands a multi-pronged approach involving structural reforms, innovation-driven production, stream lined logistics and robust user-industry feedback mechanisms. By embracing global best practices and integrating them into India’s unique security and industrial context, the country can build a resilient, responsive and future-ready ammunition framework. Such a transformation is vital not only

for operational readiness but also for achieving true defense self-reliance under the *Atmanirbhar Bharat* vision.

Disclaimer

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