# 3. Technology Perspective and Capability Roadmap - S & T

India has released a 15-year military modernization plan, TPCR-2025, to boost its nuclear deterrence, drone, and cyber warfare capabilities. The roadmap aims to achieve self-reliance in defence manufacturing and prepare for multi-domain conflict, enhancing its strategic posture in the region.

## Introduction to TPCR-2025

The Ministry of Defence has recently released the Technology Perspective and Capability Roadmap (TPCR-2025). This document outlines a comprehensive 15-year strategy aimed at significantly enhancing India's nuclear deterrence and drone warfare capabilities. The core objective is to maintain a credible nuclear deterrent while preparing the armed forces for future conflict scenarios.

### Strategic Themes of the Roadmap

**Integrated Deterrence** - TPCR-2025 promotes a unified defence strategy that combines nuclear resilience, unmanned strike platforms, electronic warfare, and AI-enabled systems into a single, cohesive framework.

**Policy Alignment** - The roadmap is closely aligned with the Atmanirbhar Bharat (self-reliant India) initiative, emphasizing indigenous research, development, and production to reduce dependence on foreign military imports.

**Multi-Domain Readiness** - It is designed to equip India's military for effective operations across all five domains of warfare - land, sea, air, cyber, and space, positioning the nation as a technologically advanced and self-reliant power.

**Industry Engagement** - The plan sets clear priorities and provides a strategic direction for the domestic defence industry, including MSMEs and start-ups, to focus their R&D, manufacturing, and innovation efforts.

**Future-Ready Forces** - A central theme is to ensure that the Indian armed forces remain technologically competitive, resilient, and fully capable of addressing emerging and future security threats.

### Key Features of TPCR-2025

**Nuclear Deterrence Measures** -

1. Strengthening nuclear command-and-control systems.
2. Enhancing survivability infrastructure to protect nuclear assets.
3. Deploying advanced radiation detection tools and mobile decontamination units.
4. Utilizing unmanned CBRN (Chemical, Biological, Radiological, and Nuclear) reconnaissance vehicles to guarantee a credible second-strike capability.

**Drones & Unmanned Systems** -

1. Induction of stealth drones with a range of 1,500 km and an operational altitude of 60,000 ft.
2. Development of AI-enabled loitering munitions for high-precision strikes.
3. Deployment of anti-drone electronic warfare systems to counter hostile UAV swarms.
4. Use of High-Altitude Pseudo-Satellites (HAPS) and stratospheric airships for persistent ISR (Intelligence, Surveillance, and Reconnaissance) and communication.

**Electronic & Cyber Warfare** - Equipping forces with advanced jammers, electronic warfare payloads, and information dominance systems. Utilizing AI-enabled tools to protect manoeuvre forces, enhance operational decision-making, and secure command networks. Strengthening national cyber defence capabilities and protecting space-based assets.

**Service-Specific Modernisation** -

**Army** - Introduction of Future Ready Combat Vehicles (FRCVs), light tanks for high-altitude operations, UAV-launched precision-guided munitions (PGMs), and cyber-hardened communication systems.

**Navy** - Induction of next-generation destroyers, corvettes, and mine countermeasure vessels. Development of 10 nuclear propulsion systems for aircraft carriers and a third aircraft carrier equipped with an indigenous Electromagnetic Aircraft Launch System (EMALS).

**Air Force** - Deployment of stratospheric airships, long-range cruise missiles, tactical high-energy laser systems, and hardened PGMs.
**Information & Electronic Warfare Enhancements** - Implementing AI-enabled emitter detection and adaptive jammers. Developing deepfake detection tools to safeguard the integrity of operational decision-making and improve battlefield situational awareness.

## Geopolitical & Strategic Implications

**Multi-Domain Readiness** - The roadmap prepares India for complex, high-intensity conflict scenarios involving simultaneous operations across multiple domains.
**Regional Deterrence** - It significantly enhances India's deterrence posture, particularly concerning regional adversaries China and Pakistan.
**Naval Strength** - The plan bolsters India's blue-water naval capabilities and its ability to conduct surveillance over the critical Indian Ocean Region (IOR).
**Technological Edge** - It aims to position India among the world's advanced military powers through the development of AI-enabled and autonomous combat capabilities.

## Challenges and Concerns

**Advanced Technology Development** - Successfully developing cutting-edge systems like hypersonic missiles, scramjets, AI platforms, directed-energy weapons, and quantum communication requires massive investment and sustained R&D efforts.
**Operational Costs & Integration** - The high costs of procurement and long-term maintenance, coupled with the challenges of ensuring seamless inter-service integration and training, are significant hurdles.
**Cyber & Space Vulnerabilities** - Increased reliance on networked platforms, satellites, and AI systems makes them prime targets for cyberattacks and space-based threats.
**Strategic Stability** - India must ensure that its modern strike capabilities do not compromise its No First Use nuclear doctrine or destabilize regional security dynamics.
**Ethical & Legal Compliance** - The use of autonomous and AI-enabled weapon systems must strictly adhere to international humanitarian law to prevent misuse or unintended escalation

## Way Forward

**Indigenisation & Self-Reliance** - Continue to prioritize domestic R&D and empower MSMEs and start-ups to build a robust homegrown defence industrial base.
**Multi-Domain Readiness** - Focus on integrated operational capability through regular joint exercises and the development of interoperable systems across the Army, Navy, and Air Force.
**Emerging Technology Investment** - Strategically invest in future-defining technologies like AI, drones, hypersonics, directed-energy weapons, cybersecurity, and space assets.
**Cyber & Space Defence** - Proactively strengthen infrastructure to protect critical networked platforms, satellites, and command-and-control systems from attack.
**Strategic Stability** - Carefully balance the development of modern strike capabilities with India's long-standing commitment to its No First Use nuclear doctrine and international norms.

## Conclusion

TPCR-2025 is a long-term, integrated vision for India's defence modernization. By focusing on indigenisation, technological superiority, and joint operational readiness, the roadmap aims to establish India as a self-reliant, technologically advanced, and credible military power prepared for the security challenges of the coming decades.
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