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# Role Of Science, Technology And Innovation In Low Intensity Conflicts Areas

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**ABSTRACT:** The Indian government has increasingly emphasized the importance of science, technology, and innovation (STI) in formulating its internal security strategies. Advanced weaponry and scientific innovations developed by the DRDO have been effectively utilized by security forces in counter-insurgency operations to maneuver through challenging terrains. Moreover, technologies such as satellites, drones, and skilled sniffer dogs have been deployed to locate Naxal hideouts and detect improvised explosive devices (IEDs) buried underground.

In low-intensity conflict (LIC) areas, significant loss of life, both among security forces and civilians, underscores the critical need for STI in developing innovative solutions to enhance the capabilities of security agencies. This involves investing in research and development, fostering public-private partnerships, and leveraging technological advancements to create a more resilient internal security apparatus.

Some regions remain inaccessible due to harsh environments and difficult terrains. Interestingly, science, technology, and innovation have also been adopted by Naxals in LIC areas, enabling them to survive for extended periods. This presents a challenge, as technology alone does not determine dominance in warfare. The indiscriminate use of lethal weapons and improvised explosive devices IEDs by Naxals makes it particularly difficult for security forces to achieve success in counter-insurgency operations.

To combat these challenges, counter-insurgency operations have increasingly relied on STI to enhance their effectiveness. Understanding the modus operandi of Naxals in LIC areas, along with the technologies they utilize, is essential. Equally important is recognizing the equipment and tools used by the military, paramilitary forces, and agencies such as the Central Armed Police Forces (CAPF) and state police during these operations. The role of STI is crucial in saving the lives of security forces and disrupting the insurgent activities carried out by Naxals.

Addressing this complexity necessitates a comprehensive understanding of the role of science, technology, and innovation in both insurgency and counter-insurgency doctrines. This paper focuses on the latest technologies adopted by Maoists in their warfare against the Indian state, as well as the advanced technologies employed by security forces in counter-insurgency operations, particularly in jungle warfare. It also highlights the efforts made by the Indian state to tackle the challenges posed by Maoist activities.

**Keywords:** Low-Intensity Conflicts, Counter-Insurgency, Science & Technology, Innovations.

## 1. Introduction

India has been faced with a series of low intensity internal conflicts of various shades and modes, including communal clashes, insurgencies, separatism, religious-ethnic violence, illegal migration across the land and territorial waters, domestic and trans-national terrorism, organised crimes and nexus with terror, drug trafficking and money laundering, increasing Naxalites' onslaughts in over a dozen Indian States, along with a number of non-traditional threats to Indian security, natural and man-made disasters, etc.In dealing with the dangers of internal security, India must utilize its scientific and technological competence as 'internal security force multiplier'. The trends and potency of scientific and technological sophistication acquired and manipulated by naxalites are also alarming. Detection, identification, prevention, and responses to them require the support of a broad range of technologies, cutting across various areas needed for internal security management. India needs to be adequately prepared to face these challenges and its internal security system be properly galvanized to integrate the broader perspectives of scientific and technological know-how and tools for public safety and security in the fast-changing and globalising world.

Low Intensity Conflicts (LIC) and high rate of crime present a deadly combination, one that constitutes a formidable challenge to the law enforcement authorities, and even to the Armed Forces, Central Armed Forces, and State Police of a country. These inject an element of political instability into the system of governance and are a serious concern to the country's law and order and public order. India has experienced Low Intensity Conflicts in different theatres and is now witnessing the emergence of high rate of crime by insurgents, terrorists, Naxalites and crime syndicates, as well as a complex pattern of co-operation and collusion between these. The scenario come to the fore the shift of modern warfare doctrine towards asymmetric warfare i.e. Low Intensity Conflicts.Conventional conflicts that dominated through history have largely lost importance, whereas *operations other than war* have become a rule.

## 2. Technology Shapes Warfare

Technology shapes the conduct of warfare, but it does not define war itself. War is an enduring and universal phenomenon, afflicting nearly every state in recorded history. It represents a state of conflict, whereas warfare refers to the organized actions of armed forces engaging in operations—whether through direct combat or strategic maneuvers. While other forms of collective violence, such as Naxalism or insurgencies, may exhibit similarities to warfare, they often rely on tools and techniques derived from military conflict. Understanding the technology of warfare, therefore, is key to comprehending much of organized violence throughout history.

Technology's primary influence on warfare lies in its ability to transform it. Throughout history, technological advancements have been at the heart of military innovation. The so-called "principles of war"—concepts like intelligence, surprise, maneuver, unity of command, and terrain—reflect the accumulated wisdom of successful commanders. Even the insights of great thinkers like Clausewitz, who articulated ideas such as chance, violence, and the "fog of war," had parallels in the experiences of earlier strategists like Alexander the Great or Sun Tzu.

Yet, these historical figures would be utterly lost on a modern battlefield dominated by technologies such as aircraft, missiles, tanks, drones, satellites, and advanced communication systems like GPS and trackers. While their strategic genius remains timeless, even a modern mid-ranking officer would outperform them in exploiting today's high-tech resources. In modern and postmodern warfare, technology increasingly defines the battlefield.

This transformation is not limited to the evolution of weaponry but also extends to its distribution. Throughout history, wars were often fought between states with similar arsenals, maintaining a kind of symmetry in their capabilities. However, as technology advances, disparities in military power—whether due to resources, innovation, or strategic adoption—have reshaped the dynamics of warfare, making technology an ever more crucial factor in determining outcomes.

### 3. Technology Does *Not* Determine Warfare

Technology can significantly influence warfare, it does not determine its conduct or outcomes. The idea of "technological determinism" is misleading, as human agency always allows for resistance to historical forces. Believing in determinism assumes an inevitability that ignores the unpredictability of human actions. Although past events may seem predetermined in hindsight, no aspect of human activity is ever entirely certain.

Throughout history, there are instances where technology seemed to dominate warfare. However, within a century, many out dated technology vanished as the primary military technology, marking a sudden and mysterious end to their dominance. Theories for this decline include the introduction of sophisticated weapons, changes in infantry tactics, state financial collapse due to costly arms races, or a combination of these factors.

moreover once-dominant technologies, from gunpowder weapons to Dreadnought battleships, strategic bombing, and modern concepts like the "revolution in military affairs," have risen to prominence only to fade over time. Each case demonstrates that no weapon or technology guarantees inevitable success. The perceived determinism of these innovations often dissolves under shifting historical, economic, and tactical conditions, emphasizing that warfare is ultimately shaped by human choices, strategies, and adaptability—not by technology alone.

### 4. The Open Door

Lynn White, Jr., in his study *Medieval Technology and Social Change* (1962), introduced the metaphor of the "open door" to describe the role of technology in shaping history, particularly in warfare. This model challenges the notion of technological determinism, emphasizing that technology creates possibilities, not inevitabilities. The "open door" metaphor underscores the importance of human agency in technological adoption. People must decide whether to embrace an innovation and adapt it to their needs. Historical examples, such as the development of strategic bombers in the U.S. and Britain versus the focus on fighter aircraft in continental Europe during the interwar years, illustrate how geography and strategy shaped technological applications.

White also highlighted a second layer of human agency: those who create and promote innovations. This relationship, exemplified by the modern military-industrial complex, shows how technology and its users interact in self-reinforcing systems. While technology itself is not deterministic, it can shape social structures and decision-making in ways that may lead to unforeseen consequences. Ultimately, White's "open door" concept demonstrates that technology's impact depends on the complex interplay of human decisions, societal conditions, and historical context, rather than being an autonomous force driving change.

### 5. Modern Military Technology Is Different

Modern military technology differs not in kind but in degree, evolving significantly during World War II when weapons developed at an unprecedented pace. Notable innovations included the atomic bomb, jet aircraft, guided missiles, radar, and the proximity fuse. This rapid advancement led to the belief, especially in the United States, that future wars would be won through military innovation rather than industrial production. Consequently, research and development became institutionalized, fostering a continuous arms race and creating what President Eisenhower termed the "military-industrial complex." This system prioritized perpetual innovation, irrespective of specific adversaries.

The modern era's accelerated technological advancements contrast with the static nature of premodern military tools, which commanders expected to use throughout their careers. In earlier times, armies relied on human capital and material resources rather than systematic science and technology. Innovations were the domain of skilled craftsmen, not scientists or engineers, and knowledge was passed through apprenticeships. Premodern engineers designed tools of war, such as catapults and fortifications, which often shaped or deterred conflicts.

The evolution of warfare tools highlights the shift from individual ingenuity to institutionalized innovation. However, attributing this solely to "technological determinism" overlooks critical questions about the human decisions and societal conditions driving technological adoption and secrecy, as exemplified by Kallinikos and Greek fire. The interplay between war and technology remains complex, dynamic, and central to military progress.

## 6. Research Methodology

Various studies revealed that Low Intensity Conflicts has contemporary challenges and it deals with holistic approach of Counterinsurgency Operations and civil operation of the government of India. The present paper aims to focus on the following issues as the latest technologies that Maoists are able to incorporate in the warfare against the Indian state as well as latest technologies used by security forces in counterinsurgency operations in jungle warfare; and what are the efforts made by the Indian state to tackle these challenges posed by the Maoist.

**Methodology Structure**

| | |
|---|---|
| **Objectives** | To identify role of science, technology and innovation in the Low Intensity Conflicts areas as Naxalites areas<br>How science, technology and innovation affect insurgent and counterinsurgency operations. |
| **Data** | The study is based on Secondary Data and Data has been collected from the Annual Report of Ministry of Home Affairs, PIB, South Asia Terrorism Portal, Newspapers etc |
| **Variables** | No. of Incidence, CION, Equipments used in COIN, latest innovations by the naxalite. |
| **Methodology And Tools** | Trend Line, Bar Diagram, Histogram, Maximum, Minimum and Range, etc |

## 7. Result and Discussion

### 7.1 Science, Technology and Innovation used by Naxals

#### 1. Use of very lethal weapons

The Naxals have developed some latest "very lethal" and crude ammunition like 'rambo arrows' and 'rocket bombs' as part of their new IED armoury to launch attacks and inflict casualty on security forces as the emerging trends in the LWE theatre. The arrow head carries low grade gun powder or fire cracker powder which explodes after hitting the target. The rambo arrows doesn't cause much damage but disorients the security personnel by generating intense heat and fog, thereby making it easy for the Maoists to inflict fatal battle injuries on the troops and helps them to loot their weapons intact.

Fig 1: arrow head grenade used by Naxals

**2. The technique of concealing the IED under animal excreta**

Naxals have devised a smart way of concealing crude bombs "in animal excreta to deceive sniffer dogs" of the security teams from detecting and alerting their masters. There were occasions in the first quarter of 2017, when sniffer dogs of security forces were killed or injured as pressure improvised explosive devices (IEDs) exploded while the canines were getting agitated because of the obnoxious smell (of the excreta) while trying to detect the hidden IEDs. The technique of concealing the IED under animal excreta is suspected to be the fatal explosions that claimed the lives of the canines, considered a vital tool to detect IEDs and save troops lives.

**3. Use of Improvised Mortars and Rockets**

The Maoists have also "developed" improvised mortars and rockets. In these rockets, a conical nose filled with explosives is welded to a tail section filled with low-explosive propellant fuel. The funnel-shaped nozzle at the tail produces thrust, while fins, loosely screwed to the tail, provide stability during flight. Once the rocket strikes, an explosion occurs, creating a devastating impact. Some projectiles are incendiary, designed to burn tents and other camp items using a combination of sulphuric acid and sugar chlorate, while others explode, emitting fatal iron rings to inflict injuries.

**4. Barrel Grenade Launchers (BGL)**

The Barrel Grenade Launchers (BGLs) are improvised explosives encased in iron. These projectiles are equipped with fins at the tail to enhance flight stability, enabling Maoists to target security forces with increased precision.

Fig 2: Arms recovered from encounter site in Chattisgarh

**5. Use of Drones**

The Naxals have reportedly employed drones, which emit a low whizzing sound that seen by camp guards. During one incident, the drones disappeared from the sky before they could be targeted, suggesting their use for reconnaissance or potential attacks on CRPF camps. This development highlights their evolving technological capabilities.

The increasing use of arrow bombs in ambushes is a matter of grave concern. These indigenous and fatal projectiles, filled with low explosives and aluminum powder, can cause grievous injuries and fatalities if they strike vital parts of the body. These advancements in technical expertise, particularly in IED mechanisms and projectiles, underline the Maoists' growing capability to enhance the ferocity and effectiveness of their ambushes.

The report concludes that the emergence of these new weapons highlights a significant advancement in the technical expertise of Naxals, making them a formidable threat in the LWE grid. Security forces must respond with equal technological innovation and adaptive strategies to counter this evolving menace effectively.

**7.2 Use of Science, Technology And Innovation by security forces**

1. **Equipping Internal Security Forces for Low Intensity Conflicts**

Low Intensity Conflict (LIC) has emerged as a serious threat to the internal security of India. For about four decades, India has been faced with the brow-brunt of insurgency, terrorism and Naxal threats. In such circumstances, our internal security forces are required to be confident about their weapons and other technical needs well in time. Technology and products which are immediately required can be made available by customisation of existing technologies. Future requirements have to be visualised. Today, when India is in the vortex of LIC in various shades and modes, it's Defence Research and Development Organization (DRDO) has geared up its endeavours to provide technology and different range of weapons and devices required by the forces which are deployed to fight in these conflicts. LIC requires superior quality, portable and accurate guns for close quarter combat. DRDO-developed modern submachine carbine is best suited for it. DRDO has also prepared a compendium of technology and products available to industry for the internal security forces.

| Sl. No. | DRDO developed items | Procured by CAPFs |
|---|---|---|
| i | • 100 Nos. Joint Venture Protective Carbine<br>• 100 Nos. Trichy Assault Rifle<br>• 3700 Nos. Multi Mode Hand Grenade | CRPF |
| ii | • 2375 Nos. Kerosene Bukhari | BSF |
| iii | • 09 Nos. of Mountain Foot Bridge with launching system (under process) | ITBP |
| iv | • 01 NETRA UAV<br>• 08 Micro UAV<br>• 2,000 Nos. Multi Mode Hand Grenades (under process) | NSG |

Fig 3: According to Annual Report of MHA 2022-23

**2. Detection of Explosives and Neutralisation of Bombs, Mines, etc.**

Detection of explosives is a highly technical and challenging task and is largely based on sensors. India has developed several important sensors and others are under development. Works are going on laser-centric technology for standoff detection from a distance of 20 meters or so to detect trace quantity of explosives. Presently, hard-wired buried explosives have emerged as a big hazard, as they are difficult to detect. India is now planning to use land penetrating radars, which are capable of generating large data base to quantify detection. As estimated by the DRDO sources, within 2 to 3 years, the system would be commercially

available for its use by the Indian security services. In addition to explosive detectors,India has to focus on the neutralisation of explosive bombs and mines, along with disruption detection equipment and devices. Remote Operated Vehicle developed by DRDO is going to play a crucial role during the employment of internal security forces in LICs. It can also be used for mine detection, once its sensors are developed and operationalised.

**3. Public Safety and Security and Protection of Physical Assets**

Going by the demographic data of 2011, India has reached the figure of 133 crore population. Due to growing dangers of selective and indiscriminate terrorist violence, diffusion of small arms, light weapons and other modern means of destruction readily available at the disposal of insurgents, Naxalites, criminals and saboteurs, India should pay special attention and utilize its technological competence and technically trained manpower for public safety and security, along with protection of physical assets anywhere and everywhere according to the exigency of the time.

India's internal security system requires the leverage and cautious utilization of technological support, like advanced ICT devices, CCTVs, alarm systems, electronic fence systems, bullet-proof jackets and bullet proof cars, detection of incendiary devices, advanced technical systems to neutralise electronically and radio-controlled explosive devices and so may rudimentary means of violence presently being used by terrorists, naxals, etc. Securing any economic installation or physical infrastructure needs case specific safety and security arrangements required.

**4. Police Service K9 (Police dog)**

Police K9 Cell was established under the PM Division with effect from 01.11.2019 with the mandate of ' Mainstreaming and Augmentation of Police Service K9 (PSK) Teams in the Country. Substantial progress has been made with in a short period of time by successfully achieving the modernization of the current K9 practices as per contemporary dog training techniques prevalent world over. A large number of SOP sand policy directives have been formulated and issued with an aim to bring in uniformity of best practices for PSKs amongst different CAPFs and to also achieve the vital interoperability amongst diverse police forces and law enforcement organizations.

**5. Drone Technology in Insurgency and Counter-Insurgency Operations**

Drones are revolutionising surveillance and reconnaissance, enabling real-time data for effective threat detection and monitoring of large areas. In recent years, drone technology has rapidly advanced, becoming a vital component of modern defence and aerospace operations. The partnership between innovative drone technology startups and government organisations strengthens internal security and defence capabilities while pioneering new technologies for superior nationwide safeguarding.Drone-tech startups are leading the way in developing advanced technologies that improve unmanned aerial vehicles (UAVs). These companies use the latest advancements in technology to create drones that are more capable, versatile, and reliable. Unlike larger, more established companies, startups can quickly experiment with new technologies and make rapid improvements, allowing them to address emerging threats and adapt to changing needs more effectively. These startups are producing advanced drones with advanced features like surveillance systems, autonomous navigation, and real-time data processing, providing detailed imagery and intelligence for security threat monitoring and response. These drones are often delivered at lower costs, facilitating the integration of new technologies into law enforcement agencies' operations.

Government organisations are supporting the drone technology startup ecosystem by providing funding, regulatory frameworks, and strategic partnerships. These organisations offer grants and funding programs to enable drone-tech startups to conduct research, expand operations, and introduce new market innovations. Additionally, they establish regulations to ensure the safe and efficient operation of drones. These regulations help startups navigate the complexities of deploying drones and integrating their technology into existing defence systems. Furthermore, Governments are partnering with startups for joint development projects, testing, and operational deployments, leveraging their technological expertise to accelerate the development of new capabilities, thereby enhancing the speed and efficiency of innovation.

## 8. Key Finding

- Science,Technology and Innovation has vital role in enhancing the internal securty in naxals areas, various technology and innovation use in counterinsurgency operations that lead to smooth apprehension, Strike, Raids, CASO, SADO, etc, resulted into less no of security forces martyred.

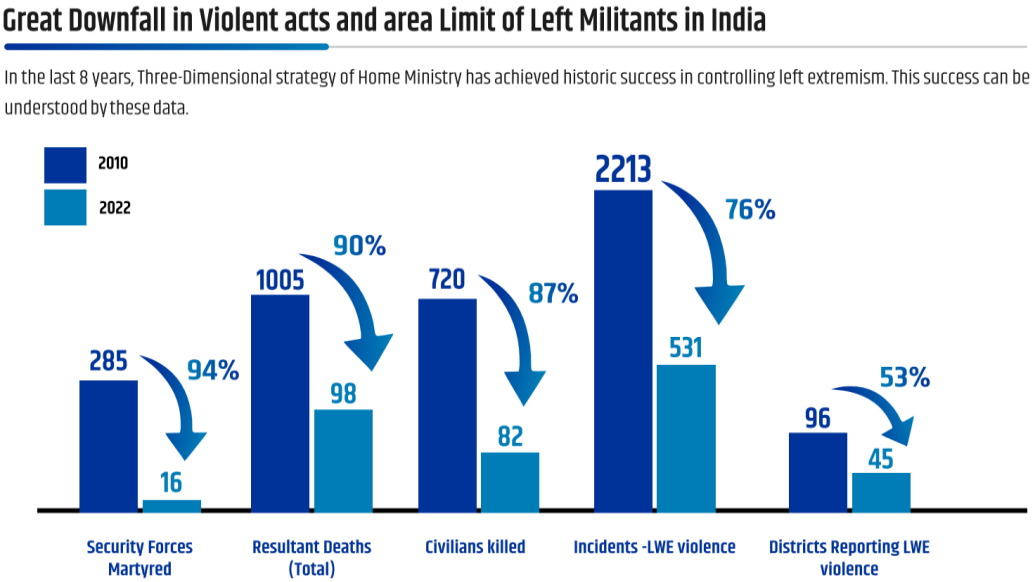


Fig 4: Draft of government achievement last 9 years from 2010 to 2022

- Number of fatalities of security forces became low due to induction of Drone Technology and Police Service K9.
- Hard Core Naxals take hideout in the core areas where use of Drone cut the supply chain of food and ammunition/weaponry.
- The Science, Technology, and Innovation (STI) plays a pivotal role in integrating new technologies into internal security frameworks in India. This integration is essential for enhancing the capabilities of law enforcement and security agencies to address emerging threats and challenges effectively.

## 9. Conclusions

The role of science, technology, and innovation (STI) in addressing low-intensity conflicts is transformative, offering tools that enhance strategic capabilities and operational efficiency. India's integration of STI, particularly drone technology, into its internal security framework exemplifies the potential of modern advancements in counter-insurgency efforts. However, this progress underscores the importance of addressing challenges such as regulatory barriers, skill gaps, and the need for localized, terrain-specific innovations.

Unlike the sporadic innovations of premodern societies, modern military technology is rooted in systematic research and development, driven by the collaboration of science, engineering, and strategic foresight. This institutionalized approach has not only accelerated technological advancements but also reshaped the landscape of internal security, offering solutions that are both proactive and adaptive.

To fully leverage the potential of STI, India must invest in indigenous technology, enhance personnel training programs, and foster international collaboration. By aligning technological progress with societal and strategic priorities, India can create a resilient internal security framework that addresses both current challenges and emerging threats. This balance between innovation and its ethical application will be key to navigating the complexities of modern low-intensity conflicts while safeguarding national security and sovereignty.

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