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# Role of Science and Technology to Achieve Viksit Bharat@2047

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**Abstract**

India's vision of Viksit Bharat 2047 envisions a technologically advanced, self-reliant, and inclusive developed nation. For any country, Science and technology (S&T) are the fundamental enablers of this transformation. Advancement in science, technology development in a country, positively influences every sector of national growth. This paper explores the multidimensional role of S&T in realizing this vision, emphasizing its contribution to economic development, industrial modernization, and innovation ecosystems. Paper highlights advancements in precision agriculture, biotechnology, renewable energy, health science advancements, space technology, and defiance technologies that collectively strengthen India's global position. Furthermore, it underscores the importance of digital education, skill development, and sustainable urban planning driven by data and artificial intelligence. Integration of modern research with indigenous knowledge systems of India can ensure inclusive growth and environmental sustainability. The study concludes that strategic investment in science, research, and technological innovation will be the cornerstone for achieving the goal of Viksit Bharat, fostering a future that is resilient, sustainable, and globally competitive.

**Keywords:** *Viksit Bharat; Science and Technology; Innovation; Sustainable Development; Digital Transformation; Self-Reliance*

## 1. Introduction

The vision of Viksit Bharat 2047, "achieving a developed India by the 100th year of independence," reflects the nation's aspiration to emerge as a global leader in innovation, manufacturing, and sustainable development[1] (NITI Aayog, 2023). The cornerstone of this vision lies in the effective utilization of science and technology (S&T) for inclusive growth and nation building. This is the timely perspective planning of India in the present volatile world and emerging multipolar world from present unipolar hegemony.

## 2. Economic Growth through Science and Technology

Science and technology are crucial to a nation's economic success, with advancements leading to increased efficiency, higher output, and stronger competitive advantages in world market.

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In India, S&T contributes to growth by:

- **Encouraging innovation**

A thriving S&T ecosystem connects diverse experts from universities, research institutions, startups, and government to develop new solutions and accelerate research outcomes. India's position has improved to 39th in the Global Innovation Index for 2024.[2]

- **Enhancing skills**

S&T drives training and capacity building, preparing the workforce for future challenges and increasing job creation. The Future Skills Prime initiative, in partnership with NASSCOM, provides upskilling in emerging technologies like AI, IoT, and cloud computing.

- **Promoting sustainable technology**

Science and Technology focuses improve resource efficiency and reduce environmental impact, such as those related to renewable energy, water conservation, and waste management.

Transforming the industrial and digital landscape Make in India and Digital India initiatives have acted as key drivers of S&T, ushering in an era of industrial and digital transformation. It has fostered domestic production of semi-high-speed Vande Bharat trains and the indigenous aircraft carrier INS Vikrant. The electronics sector grew to $155 billion in FY23, making India the world's second-largest mobile manufacturer. Revitalizing manufacturing through schemes like the Production-Linked Incentive (PLI), the initiative has attracted significant investment to key sectors, enhancing India's manufacturing competitiveness. Digital technologies are using to enhance transparency, efficiency, and accessibility of public services. For example, the UMANG app offers access to thousands of government services.

Technological Initiatives like DigiLocker and PMG Disha have promoted digital literacy, helping rural populations gain skills in marketing, e-commerce, cyber security and empowering citizens. Innovations from the S&T sector, such as advancements in Artificial Intelligence and IoT, are integrated into industrial processes and digital platforms, boosting automation and productivity.

## 3. Technological Transformation in Agriculture

Agriculture remains vital to India’s economy, employing nearly half the population. Science-driven innovations are enhancing agricultural efficiency and sustainability. Precision agriculture, supported by drones and satellite data, ensures optimal use of resources[3]. Biotechnology has produced climate-resilient, high-yield crop varieties. Digital platforms like eNAM empower farmers with real-time market data and transparent trade mechanisms. Collectively, these initiatives promote food security and rural development[4]. However, there is large room for Indian agriculture to grow further through scientific advancements.

### 4. Healthcare and Biotechnology Innovations

Technological advancements have revolutionized healthcare accessibility and quality. Telemedicine and AI-assisted diagnostics are bridging the urban–rural healthcare gap. India's success in COVID-19 vaccine development showcased its leadership in biotechnology and pharmaceutical innovation[5]. The Ayushman Bharat Digital Mission integrates healthcare services into a unified digital ecosystem, enhancing efficiency and transparency. Integration of Ayush with modern medicine further enriches India's health system through holistic care[6].

### 5. Energy Security and Environmental Sustainability

Science and technology are essential for ensuring India's energy independence and environmental sustainability. The rapid expansion of renewable energy sources especially solar and wind power positions India as one of the world's leading green energy producers. Research on green hydrogen, biofuels, and energy storage systems is the key driver in achieving the national target of Net Zero emissions by 2070[7].Technological advancements in smart grids, electric mobility, and waste-to-energy plants ensure efficient energy utilization and environmental protection. These initiatives contribute not only to energy security but also to sustainable development, aligning with global climate goals.

However, China is the global leader in installed renewable energy capacity, significantly outpacing the United States, with over 1,800 GW in mid-2025. India has risen to become the world's third-largest producer of electricity from combined wind and solar sources, surpassing Germany by 2025, a testament to its rapid capacity expansion. While India's overall renewable energy capacity 204.3 GW in mid-2025 ranks fourth globally[8].

India has accelerated growth in solar generation, with output quadrupling in five years and accounting for 5.6% of global solar growth in the first half of 2025[9].Despite its leadership in capacity deployment, China accounted for three-quarters of global investment in renewable manufacturing in 2023, though the United States and Europe saw strong investment growth in batteries. In terms of market attractiveness, India has consistently been ranked highly, placing fourth on Ernst & Young's renewable attractiveness index in 2021, behind China, the USA, and Germany.

### 6. Space and Defiance Technologies

India's progress in space and defiance technology symbolizes its growing global stature. The Indian Space Research Organization (ISRO) has achieved remarkable milestones through missions such as Chandrayaan-3, Aditya-L1, and the upcoming Gaganyaan human spaceflight programme. These projects contribute to scientific research, national pride, and international collaboration.

In defiance, the Defiance Research and Development Organization (DRDO) has enhanced indigenous capabilities through innovations in missile systems, radar, drones, and cybersecurity. Such achievements not only strengthen national security but also stimulate industrial and technological growth through public-private partnerships. However barring Ukraine due to present war, India is the largest defiance importing country in the world[10].

In the latest Indian Union Budget for the Financial Year 2025-26, the Ministry of Defence has been allocated ₹6,81,210.27 crore. This represents 13.45% of the total Union Budget, making it the highest allocation among all ministries. This also marks a 9.53% increase over the Budgetary Estimate of FY 2024-25[11]. To flip the scenario of India being largest defiance importer to net exporter we have to improve technologically.

### 7. Education, Research, and Skill Development

Human capital is the foundation of any developed nation. Digital initiatives such as SWAYAM, DIKSHA, and PM eVIDYA have made quality education accessible to millions. The National Education Policy (NEP) 2020 emphasizes multidisciplinary learning, innovation, and research through the establishment of National Research Foundation (NRF).Skill development programs in AI, data science, and robotics are preparing youth for Industry 4.0 demands. Encouraging innovation and critical thinking in education is vital for creating a scientifically literate and technology-driven workforce.

As per ASER 2024[12] report India, struggling with learning poverty that only 23.4% of Class 3 students in government schools can read a Class 2-level text. The World Bank's Learning Poverty Index indicates India's learning poverty rate stands at 70%.High dropout rates: According to the Economic Survey for 2024–25, dropout rates remain a concern, especially at the secondary level, at 14.1%[13].A massive shortage of over 1 million teachers, particularly in rural areas, compromises teaching quality and inflates the pupil-teacher ratio. Outdated curriculum and infrastructure: A significant portion of education relies on rote learning, with outdated curricula and inadequate infrastructure in many government schools are other major problems in Indian education.

In the Union Budget 2025–26, the Government of India allocated ₹1,28,650 crore to the Ministry of Education, 6.22% rise over the previous year. In research and innovation, the Department of Science and Technology was granted ₹20,000 crore advocated private-sector-led R&D, alongside a ₹10,000 crore Deep Tech Fund, ₹2,000 crore for the National Research Foundation, and 10,000 PM Research Fellowships for IITs and IISc. Skill development allocations include ₹8,800 crore for the Skill India Programme, establishment of five National Centers of Excellence, an increase in ITI Upgradation. However, when benchmarked globally, these allocations appear modest. India's R&D spending remains around 0.7% of GDP, significantly lower than global innovation leaders like South Korea (4.9%), Israel (5.6%), the U.S. (3.5%), and China (2.4%). Similarly, India's public expenditure on education (around 2.9% of GDP) still falls short of the UNESCO-recommended 6%, limiting the potential for large-scale quality enhancement and global competitiveness. While the Budget 2025–26 takes progressive steps in funding education, research, and skills, the scale of investment must expand substantially to achieve Viksit Bharat's vision of transforming India into a globally leading knowledge and innovation hub by 2047.

### 8. Urban Development and Smart Infrastructure

Science and technology enable urban development by converting existing cities and creating new "smart cities" that use IoT, AI, data analytics, and GIS to improve resource management, traffic, energy, and public safety, leading to more efficient, sustainable, and livable environments. These technologies provide data driven insights for informed decision making, optimize city services like transportation and waste management, and foster economic growth and citizen empowerment[14]

### 9. Integration of Indigenous Knowledge and Modern Science

India's indigenous knowledge systems such as Ayurveda, organic farming, and water harvesting offer sustainable models for modern scientific adaptation[15]. Integrating these traditions with advanced research fosters innovation grounded in cultural wisdom and ecological balance. This synergy is particularly valuable for rural development and low-cost technological solutions tailored to local needs[16].

## 10. Challenges and the Way Forward

As per Department of Science and Technology "Science, Technology, and Innovation Policy (STIP) draft policy of 2023[17], to achieve technological self-reliance and make India a leading scientific power by fostering human capital and an inclusive STI ecosystem. Ethical regulation of AI, data privacy safeguards, and climate resilience must guide technological advancements. Public–private partnerships and global collaborations will be instrumental in realizing the Viksit Bharat vision.

## 11. Conclusion

Science and technology are double engines of India's journey toward Viksit Bharat 2047. Aligning technological growth with sustainability will make India a global leader, developed nation.

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