India's Pursuit for Deeptech Sovereignty: Challenges and Opportunities

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To realize its deep tech potential, India must commit across three fronts. The State must play the long game-funding patient capital, de-risking early research, and streamlining procurement. The Market must evolve to value intangibles like IP, dual-use potential, and scientific defensibility. And Society-from universities to media-must celebrate technologists and scientific builders, creating cultural capital around invention.

Innovation led economic growth is an imperative for strategic autonomy. This has been India's Achilles heel since we decided to be a free market economy in 1990's. The architecture of nation building today has to be a cumulative of socio economic stability, public service continuity, national security, healthcare, finance, and defense and it all depends on integrity and alignment with evolving deep-tech infrastructures. In the past decade, the Indian government has created nationalistic concepts known as Atmanirbhar Bharat ("Self-Reliant India"), in addition to earlier initiatives such as "Make in India" success of which depends on access to technology besides investment. This dependence creates a delicate balance, as government and businesses must navigate relationships with technology companies or Digital public Infrastructures. For too long India's deep tech story has been one of dependency, be it software products, critical minerals, renewable energy, semiconductor components and now lithium-ion cells. This has exposed critical and digital infrastructure goals to supply chain risks and geopolitical challenges. Deep Tech is often called "high risk, high reward," but for India, it is far more, it is high impact, shaping industries, strengthening national capabilities, and defining the country's emerging global tech identity. It is the principal strategic vulnerability of the next decade. "Deeptech sovereignty" is now imperative due to realignment of the world order with increasing number of sanctions imposed by the collective West on Iran, North Korea, Venezuela and now Russia. However, these are not the only countries to have been subject to sanctions. In the wake of Pokhran-II in 1998, India was also subject to sanctions by the United States (US) and a number of Western countries. They are also necessary for India to leapfrog into a matured economy having answers to some of the challenging problems around universal education, climate change, affordable healthcare, and strategic control.

The solution lies in embracing innovation centric cutting-edge fields like artificial intelligence,

quantum computing, and most other emerging & advanced technologies which not only hold the potential to generate substantial economic value, but their profound impact extends well beyond financial considerations and tackling monumental geopolitical challenges. The real question is not whether India has the ambition. It is evident we do. The question lies whether the country can sustain the institutional patience, scaling disciple that is demanded by deep tech over a 10 to 15 year horizon. China's domination in clean energy supply chains was the result of 20 years of subsidised scale, state backed R&D and a strategic decision to own the full value chain. India's path is different. It is more distributed, more private-sector led and has a shorter timeline.

As is universally believed, the deep tech story in India will emerge from our large startup ecosystem. However, India's main weakness is not that we lack technical capability in creating IP intensive Deeptech solutions. Startup policy is focused on formation and India is producing innovative startups and technical talent. However, scale-stage bottlenecks are largely untouched and it is urgently required that deep tech startup ecosystem be completely isolated from the market driven Entreupreunership with a much deeper focus on some of the fundamental bottlenecks where companies need deep growth financing and market structures that can not only hold them domestically but also become globally competitive.

At the same time, while the startup ecosystem should continue to grow in alignment with rapid technological advancement, it is equally important that the sector evolves with stronger governance, sustainable financial discipline and long-term institutional stability. What has happened in the Byju's situation should not become a recurring pattern for India's technology and deep tech ecosystem, particularly when these sectors are expected to play a defining role in the country's future innovation and strategic growth story.

For decades, India's R&D investment has remained modest compared to global innovation leaders, limiting the country's ability to scale breakthrough ideas into world-class technologies. It is also the inability of the system to recognise and scale cutting edge solutions where capital system though supports company creation but weakens as firms require larger, longer-duration financing both for R&D and also for scaling and market access. India, which is now the world's fastest growing large economy, remains a bit player in cutting-edge technologies. It spends $71bn a year on research and development (R&D), less than a tenth of America's or China's outlay. Its R&D intensity (spending as a share of GDP) is just 0.7%, compared with 3.6% in America and 2.4% in China. In an index published by the World Intellectual Property Organisation, which ranks countries relative to their size and innovation capabilities, India ranks 39th. China is 11th; America is third. In particularly innovative countries, the private sector leads R&D spending, typically accounting for around two-thirds of the total. In India, it contributes just over a third. Among the world's top 2,000 corporate R&D spenders in 2023, only 15 were Indian. It is thereby becoming increasingly evident that many Deeptech and AI startups shift headquarters and follow deeper capital markets, especially in the United States, when growth financing and public market access become decisive. We are so moving from an era of brain

drain to Intellectual Property leakages.

But this landscape has potential to shift provided the recent initiatives do not face our traditional regulatory and bureaucratic bottlenecks. Transformative initiatives such as the ANRF (Anusandhan National Research Foundation), The 1 Lakh Crore R&D investment fund, AI mission focussing on infrastructure, dedicated Innovation Initiatives in strategic sectors like IDEX , mission-driven scientific programmes for quantum computing and a renewed national focus on high-risk, high-impact deep tech fund, India is signalling a decisive commitment to strengthen its innovation engine. These interventions are enabling deeper industry–academia collaboration, supporting frontier research, and unlocking resources for bold, long-term cutting edge technology pursuits. As these initiatives gain momentum, India is poised to elevate its R&D capacity to global standards, moving from incremental progress to true innovation leadership.

India missed the Industrial Revolution and played catch-up during the information age. But in deep tech where software meets science, and long-term strategy trumps short-term metrics-India has a unique chance to compete. With a young and globally competitive talent base, promising state commitment, a maturing private capital ecosystem, and global tailwinds demanding technological diversification beyond US and China, the moment is now. Deep tech can serve as the backbone of India's industrial renewal, defense readiness, and export competitiveness in an increasingly multipolar world. To realize its deep tech potential, India must commit across three fronts. The State must play the long game—funding patient capital, de-risking early research, and streamlining procurement. The Market must evolve to value intangibles like IP, dual-use potential, and scientific defensibility. And Society—from universities to media—must celebrate technologists and scientific builders, creating cultural capital around invention.

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