EVA STALIN IAS ACADEMY

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India's R&D funding, breaking down the numbers

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The announcement in the interim Budget for 2024-25, of a corpus of ₹1 lakh crore to bolster the research and innovation ecosystem within the country, has sparked enthusiasm within the scientific and research communities. The decision to rebrand the slogan, '*Jai Jawan Jai Kisan*' (by Lal Bahadur Shastri) to '*Jai Jawan, Jai Kisan, Jai Vigyan*' (A.B. Vajpayee) to now '*Jai Jawan, Jai Kisan, Jai Vigyan, Jai Anusandhan*' (by the Prime Minister) is intended to reinforce the foundation of research and innovation for development. The significance of research and innovation cannot be overstated in fuelling economic growth, technological advancement, and global competitiveness. However, to fully realise the impact, it is crucial to assess the current research and development (R&D) funding landscape in India and its resulting output. This entails examining India's comparatively lower R&D expenditure as a percentage of GDP alongside its noteworthy output in terms of patent grants, PhDs awarded, and publication outputs. Analysing the quality of this output is equally imperative in understanding the true implications of these initiatives.

India's R&D is witnessing significant growth, with a notable increase in Gross Expenditure on Research and Development (GERD) from ₹6,01,968 million in 2010-11 to ₹12,73,880 million in 2020-21. However, with research and development investment as a percentage of GDP standing at 0.64%, India falls behind major developed and emerging economies such as China (2.4%), Germany (3.1%), South Korea (4.8%) and the United States (3.5%).

Research output, innovation

Despite the comparatively lower share of GDP dedicated to R&D, India has emerged as a powerhouse in producing academic talent. Annually, India generates an impressive 40,813 PhDs and is in third place after the United States and China. This achievement reflects India's commitment to fostering intellectual capital and contributing significantly to global research endeavours. Additionally, India's research output remains substantial, ranking third globally, with over 3,00,000 publications in 2022, highlighting the nation's robust research ecosystem and its commitment to advancing knowledge across diverse fields. India also demonstrates commendable performance in patent grants, securing the sixth position globally with 30,490 patents granted in 2022. While this figure is lower compared to the U.S. and China, it underscores India's evolving innovation landscape and its potential for further growth in intellectual property creation.

India's technological and manufacturing aspirations hinge on a transformative shift in its R&D landscape

Comparison of research productivity and innovation metrics in selected countries (2021-22)

Country	Researchers per million inhabitants (2021) (FTE)	PhDs produced annually (2021) (Rank)	Publication output (2022) (Rank)	Top 1% most cited articles (% share)	Patents granted (2022) (Rank)
India	262	40,813 (3)	3,06,800 (3)	0.7	30,490 (6)
The U.S.	4,452	69,525 (1)	15,06,000 (1)	1.88	3,23,410 (2)
The U.K.	4,491	27,366 (5)	2,87,200 (4)	2.35	10,578 (15)
China	1,887	53,778 (2)	9,78,100 (2)	1.12	7,38,347 (1)
S. Korea	9,082	13,882 (11)	1,09,200 (16)	1.02	1,35,180 (4)
Japan	5,638	15,804 (10)	1,71,000 (9)	0.88	2,01,420 (3)

Source: Publications data has been extracted from OpenAlex on February 7, 2024.

In India, GERD is primarily driven by the government sector, including the central government (43.7%), State governments (6.7%), Higher Education Institutions (HEIs) (8.8%), and the public sector industry (4.4%), with the private sector industry contributing only 36.4% during 2020-21. Collaboration between the government, business enterprises and HEIs is essential to maximise the positive impact of science, technology, and innovation on economic growth and technological advancement.

Investment in R&D

According to the R&D statistics (2022-23) of the Department of Science and Technology, India's total investment in R&D reached $17.2 billion in 2020-21. Within this sum, 54% ($9.4 billion) is allocated to the government sector and predominantly utilised by four key scientific agencies – the Defence Research and Development Organisation (30.7%), the Department of Space (18.4%), the Indian Council of Agricultural Research (12.4%), and the Department of Atomic Energy (11.4%). A significant portion of R&D funding originates from the government, with considerable allocation directed towards autonomous R&D laboratories operated by the government. These laboratories serve a pivotal role in driving research and technology development with strategic implications. This symbiotic relationship between government funding, R&D execution, and strategic focus underscores the integral role of the government in steering and fostering key scientific advancements.

However, the contribution of private industries lags behind that of many other economies. At approximately $6.2 billion, Indian businesses represent 37% of the country's GERD, in contrast to the global trend, where business enterprises typically contribute over 65% of R&D. In leading innovative economies such as China, Japan, South Korea, and the U.S., a significant portion (>70%) of R&D funding is from private industries, driven by market forces and profit motives, and the actual R&D activities are conducted in the HEIs. India's R&D ecosystem has its advantages in terms of efficiency, but could benefit more from strong private enterprises involvement and stronger industry-academia collaboration, facilitating knowledge transfer and fostering innovation.

HEIs play a comparatively minor role in the overall R&D investment, contributing 8.8% ($1.5 billion). It is important to recognise that increasing industry contribution to R&D is a complex issue with no single solution. A multi-pronged approach involving diverse stakeholders is necessary to address the challenges and unlock the potential of R&D for India's economic growth and competitiveness. Learning from the R&D ecosystem in other developed countries while maintaining India's strengths in streamlined decision-making and strategic alignment could be a powerful force to optimise its R&D landscape. India must implement policies that incentivise private companies to invest in R&D.

Impact of initiatives

India's technological and manufacturing aspirations hinge on a transformative shift in its R&D landscape. Closing the existing gap demands a dual strategy: encouraging private sector involvement and fortifying academia's research infrastructure. Initiatives such as the National Deep Tech Startup Policy (NDTSP) signal a strong commitment to technological progress and innovation. This policy holds the potential to incentivise private sector engagement in India's R&D ecosystem. Despite the substantial time and technical uncertainties involved in Deep Tech's creation, allocating resources to safeguard intellectual property and tackle technical obstacles can unlock untapped markets. The recent enactment of the Anusandhan National Research Foundation (ANRF) Act, underscores the government's dedication to catalysing research and innovation as the cornerstone of development.

This legislative move will bolster scientific research nationwide. The Act aims to bridge India's persistent R&D investment gap while nurturing a robust research culture within HEIs. Although promising, this initiative must surmount challenges such as ensuring equitable fund distribution, fostering interdisciplinary collaborations, and upholding global standards. These efforts are poised to elevate R&D spending in India, providing strategic guidance for research, innovation, and entrepreneurship while encouraging greater private sector involvement. The interim Budget, combined with the NDTSP and ANRF Act, sends positive signals regarding India's commitment to incentivising private sector-led research and innovation, particularly in burgeoning industries.

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The Karnataka civil engineers Bill, its pathway

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The Karnataka Professional Civil Engineers Bill pushes a bright-line rule and flounders

The goal of the Karnataka Professional Civil Engineers Bill, that was passed recently, to improve professionalisation and construction standards, is laudable. However, the route it recommends, which mandates only certified civil engineers to offer engineering designs, is bound to create confusion, become unnecessarily restrictive, turn impractical and remain out of sync with best practices.

The brick and mortar

The Bill establishes four key things. First, it defines a civil engineer, lists engineering designs, imposes restrictions on those who can offer engineering design services, and, finally, instructs how to ensure this.

Anyone with a diploma or a degree in a civil engineering discipline in India or abroad can qualify as a civil engineer. However, they must register with the Karnataka Council of Professional Civil Engineers within one year from the date of commencement of the Act. In addition, they should obtain a certificate to become a 'professional civil engineer' in Karnataka. For this, those with degrees need one year of experience, while those with diplomas require two years of experience. Only professional civil engineers can offer engineering designs, which includes 'civil, structural, geotechnical, and environmental engineering designs and drawings'. It also includes 'conceptual plans, master plans, layout plans, and other designs and drawings for buildings and infrastructure'.

The Bill insists that any building that is more than 50 square metres in plinth area or taller than the ground floor or that is not built with load-bearing masonry structure (meaning, buildings with columns and beams, and others) or a group housing project with more than three buildings must be supervised or executed or certified only by professional civil engineers. Strict gatekeeping is imposed by instructing government authorities not to permit construction unless registered professional civil engineers certify designs and drawings.

These provisions must be rethought for three reasons. First, despite the overlaps between professional services in the building industry, the Bill ,unmindfully and restrictively, defines engineering designs. This is baffling since the Supreme Court of India, pointing out difficulties in a comparable situation involving architects, has refused to exclude related professionals from offering overlapping services.

In 2020, while settling architects' claim that their professional Act prohibits non-architects from offering architectural services, the Court pointed out that services, including site design, structural design, structural integration of services, incorporation of mechanical systems and inspection of construction, are carried out concertedly by a host of related professionals. Hence, to favour one group by imposing 'absolute prohibition' on others would lead to 'considerable confusion'. It wisely observed that 'varied professions form essential cogs in the overall machinery of construction' and one cannot take a hard and exclusionary regulatory view.

It is probably for these reasons that the Gujarat Professional Civil Engineers Act, 2006, which is similar, is restrained in its scope. It limits registered professional civil engineers only to certify engineering designs, which it does not define. Even this limited version may not withstand a legal challenge. Also, on the ground, anecdotally, the regulations are more honoured in the breach.

Global practices

Second, many countries are cautious about regulations restricting competition, reinforcing monopoly tendencies, raising prices, and working against user interest. Hence, they support the self-regulation of professions. Recalling a study on engineering licensing and professional practice across several countries would also be worthwhile. It pointed out that "there is no hard evidence that tight engineering licensure provides economic gains to societies". Also, large firms that employ many engineers and architects could easily countervail these provisions, making them difficult to implement.

Third, many professional councils across the world, aware of these complexities, have not tried to ring fence their services. Instead, they take the alternative and effective route of protecting titles such as 'chartered engineer or architect' by establishing a rigorous process that demands high academic standards and experience.

The councils also mandate additional peer interviews or examinations as non-negotiable requirements. Through this, they let users know that professional titles are not offered lightly, and only the competent ones earn them. Users, convinced by the credibility of the collective, voluntarily seek certified professionals.

For example, the Engineering Council in the United Kingdom clarifies that there are no restrictions on practising as an engineer. However, it protects titles offered to the qualified and those who pass professional reviews. Only a limited number of high-risk constructions, such as reservoir design and road tunnel safety regulations, are reserved for licensed persons. The same goes for the Architects Registration Board in the U.K. In comparison, the Karnataka Bill seeks an absolute protection of services and falls short of licensing requirements. There are no examinations and fewer experience requirements in the Bill. It would serve better to tighten the process leading to certification.

The question of which professional is more competent to offer a particular service will continue to arise regularly. As was decided in one of the cases involving the architect-engineer dispute in the signing of drawings for permits in Washington State, U.S., there cannot be a bright-line rule, and divisions are impossible in a 'general sense'. It must be decided on an event-to-event basis, locally and based on education, experience, and special knowledge. What would be even better is to resist the demand for professional turfs to control supply. An effective solution would be to influence the demand side by continuously demonstrating the usefulness of professionals and certification.

The views expressed are personal