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SCIENCE

Why India's R&D Dreams Are Falling Behind: Funding Aside, Here's A Look Inside The System

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A view of Mission Operations Complex-1 (MOX-1) at ISTRAC (File photo by ISRO/representative image)

- Until the work culture at Indian public-sector R&D organisations improves, India will struggle to produce world-class outcomes.

Aarav Ramesh (name changed) was a young engineering student full of promise in the late 2000s. He felt a calling early to work in research and development (R&D) at a top public-sector laboratory (a PSU) in India.

Enrolled in an undergraduate programme, he decided to waste no time in getting a taste of R&D. He sought out an internship at a government research facility. His pick was Hindustan Aeronautics Limited (HAL), India's top aerospace and defence manufacturer and a household name.

Inspired by the giants that walked before him, such as Homi Bhabha and Satish Dhawan, Aarav harboured aspirations of someday helping advance the nation's scientific and technological prowess. And this internship at HAL was meant to be his first step.

Little did Aarav know that he would be in for a rude surprise. His short time interning at HAL left a bitter taste in his mouth, so much so that he vowed never to work in the Indian public sector again, let alone the specific lab.

Aarav described the work environment as having "a lax work ethic" and said there was "a lot of hierarchy, with more importance given to respecting authority than actual competence and getting things done."

He was especially put off by the "office politics and turf wars," and he was just an intern at the time. Imagine how much worse things might have been higher up the organisational chain.

"Improvement projects were often just for show and records, done for optics rather than real change," he said. Factory workers effectively worked for fewer hours than the fingers on a hand.

"It's a good place for career coasters," he concluded stingingly about how it was to work at the R&D institution.

India Falling Behind in R&D

Remember the Indian defence community's meltdown on the social platform X in December 2024? It was quite a moment for the usually chirpy Indian defence Twitter.

The anguish was stirred by footage of China's next-generation — "sixth generation," as per China's claims — stealth fighter jets (yes, not one but two) gliding gleefully across the skies. China, on the back of its powerhouse R&D work, was expanding its aerial arsenal, while India was falling behind with not even a single stealth fighter jet of its own to boot.

The gap between Indian and Chinese military technology had never felt wider.

The low R&D spending in India is an obvious, significant, and oft-spoken concern, so we won't dwell on it much. It is almost common knowledge that India invests way less in R&D as a percentage of its gross domestic product (GDP) — 0.64 per cent — than China (2.41 per cent), the United States of America (US) (3.47 per cent), Israel (5.71 per cent), but its figure is lower than even its BRICS peers Brazil, Russia, and South Africa.

With aspirations to become a \$5 trillion economy, India must raise its R&D spend as a percentage of GDP to at least 2 per cent.

But there's more to India's sorrowful R&D story than just the inadequate funding. The work culture in these R&D organisations is a tale of woe as it fails talented individuals trying earnestly to make a mark, as we saw in Aarav's case.

'Senior Knows Best'

Aarav's experience is not an isolated one. It reflects a broader issue plaguing India's public-sector R&D organisations. The hierarchical culture, deeply ingrained in these institutions, often stifles innovation and discourages young talent.

The researchers with whom *Swarajya* spoke frequently brought up submission to seniority as a major impediment to doing top-tier research work. The experience can be best summed up this way: 'The senior knows best under all circumstances.'

Respect for elders and experience, in general, is a virtue embedded deeply in Indian culture. But taken to the extreme, this respect can turn to submission. In government R&D workplaces, this problem is a feature, not a bug.

Tripathi (name changed) graduated proudly from an Indian Institute of Technology. He wished to contribute to meaningful R&D work but also in the safe cocoon of a "government job." He joined the Bhabha Atomic Research Centre (BARC), India's premier nuclear research facility based in Maharashtra.

What was supposed to be a "safe job," however, quickly turned turbulent. Like Aarav, Madhukar found himself troubled by the seniority issue. He and other young engineers would be left frustrated trying to get their ideas across to their seniors. The work environment felt "claustrophobic" to them.

Another engineer, Ananya Suresh (name changed), sharing her experience of working with a defence PSU lab, said, "A senior engineer or scientist will always have the final say, even though he may be wrong."

"When we meet some of these PSU scientists," she added, "we are asked to address them as 'Sir' instead of just 'Mr so-and-so.' While this may seem like a minor issue, it reflects a bigger problem. If they focus on such matters rather than the task at hand, it shows where their priorities lie, rather than on getting the job done."

"You should have a culture where even a 40-year-old can report to someone who is 25 because that 25-year-old is really good at what they do," she said.

Turf Wars and Politicking

Researchers reveal that the staff at these R&D organisations try to create and hold on to their turf for dear life. This leads to friction and infighting in the workplace. This is attributed to a sense of insecurity around one's capabilities in these organisations.

"If you are really good at what you do, you have no insecurity, and you also want to get the best people on your team. Whereas if you are not good enough to begin with, you will start playing turf wars, you will want to consolidate your own little turf, and do all the politicking to grow up the chain. And that's what you are doing most of your career," a scientist who works for a premier research institution tells *Swarajya*. "This culture, unfortunately — especially at DRDO — is set very strongly," they add.

Aarav too spoke about feeling let down by the "office politics and turf wars" at HAL. Similarly, Madhukar, who worked at BARC, said of his time there: "Everything would become political, and people would fight over the smallest, stupidest things."

The scientist, who did not wish to be named, attributes the turf wars and politicking to the lack of talent in these setups. "Most people who apply for these jobs are just looking for government jobs. I don't want to paint the entire organisation with the same brush, but at the end of the day, the fraction of the people who are truly capable in these organisations is less than the majority. And that is the problem."

This is a problem acknowledged by no less than the Chairman of the Indian Space Research Organisation (ISRO), S Somanath. The ISRO chief has spoken candidly about how IIT graduates, learning about the highest salaries on offer at ISRO, have walked away.

The "best talents are supposed to be engineers from IITs, but they are not joining ISRO," he said in a television interview, admitting on a different occasion that he "would be happy to see more IITians joining the space programme and contributing towards nation-building."

The scientist this writer spoke with wonders why the best people are not working in India's R&D the way the best athletes are picked for national-level sports. "When India sends a team for the Olympics, we are sending our best. Can you say the same about specific technologies we are trying to develop? Can you tell me that the top 20-30 experts in India who could, say, realise a gas turbine are working at GTRE (Gas Turbine Research Establishment) today?"

The problem stems from the *sarkari* way of recruitment at government R&D labs. This scientist says, "A Department of Defence R&D functions like any other department of the Government of India, like the Ministry of Agriculture, broadly, in terms of the rules." Government departments, as is well known, are not known for their effectiveness or efficiency.

Aarav echoes a similar sentiment: "It is like an IAS service. This cadre system is a huge problem." In his view, the *sarkari* system makes lateral entry an unworkable proposition when in reality it would be a blessing for Indian R&D.

Lateral entry refers to the induction of expert scientists for short periods of time with the objective of providing scientific and technological breakthroughs. After they help crack hard-to-solve problems, these experts head back to their regular jobs in academia or industry.

"There is one problem with the Kaveri engine which can be solved by a couple of experts in IIT Madras and IIT Kanpur. But does DRDO have a way to recruit those people laterally at a very senior level and give them all the authority to direct DRDO scientists? Will DRDO scientists accept that?" Aarav asks.

As long as the in-house talent remains in the minority, turf wars and politicking will hold sway, and R&D work will continue to suffer.

Non-Technical Priorities

Things like preparing the project file and pleasing the "government finance guy" dominate conversations among PSU staff, when to state the obvious, the discussion in an R&D organisation should centre around technical ideas and how to bring the best new ideas to fruition.

"The first thing that often comes up in these discussions is, 'How do we prepare this file? The finance guy will object.' Most of the discussion is non-technical at these meetings," says the scientist working at a top-rated institution.

"People are spending so much bandwidth thinking about how to make a case file rather than 'There is a good idea; let's quickly try it out and see where it goes.' That spirit is completely missing," they add.

Once the file is made, typically several months or longer after the origination of the idea, the threat of "the finance guy" derailing the process through a simple note looms large.

"There are these finance guys who have absolutely zero technical background, but they have the power to just sit on files. I don't know why we do that in India, especially on technology development programmes," the scientist says.

This "finance guy" appears on the technical scene, independent of the managerial and technical personnel who have been running the R&D projects all this while. "These guys come in, they want to feel important, they just put a little note on a file, after which people are very hesitant to touch it," they say.

The hesitation comes from the fact that those who address or overrule the finance guy's note to move the project along get called out, risk

being denied critical R&D work in the future, or, worse, get pulled into a "scam" if their brave endeavour culminates in a failure. However, failure is all but expected when working on the cutting edge of technology.

"See, any advanced tech involves risks. For whatever reason, say, this (project) fails. Then they will try to use this (failure) as a weapon to beat up the people who were supporting it. They will say, 'Look, the finance guy did warn you, but you still went ahead, and you wasted taxpayer money.' Or even worse, they will try to make a scam out of it," the scientist explains.

Frustrated by this situation, the researcher wonders why "someone who has the ability to design missiles and rockets" cannot "undergo a short course and be trained to do government finance."

The scientist narrates to this writer a particularly revealing incident when a startup that had come up with a novel, advanced technology was stonewalled due to an absurd remark made by the finance guy.

"One of the government departments was keen to work with the startup to get a product out in a short time so they could deploy it. The file was made. There was a final meeting with a top official. One of the guys representing finance in that meeting — not even a very senior person — simply remarked that he found it hard to believe that a startup in India was able to come up with technology like this." Such a whack objection had left even the top official baffled, but there was nothing he could do.

Such bureaucratic red tape not only delays projects but also discourages risk-taking, which is essential for technological advancement.

Dispersed Accountability

Projects in India's government R&D organisations tend to be committee-run. As a result, accountability for projects is scattered across a spectrum of collaborating individuals and institutes. No one individual or organisation is empowered to drive the project and held responsible for its operations and outcomes. Such a style of working leads to finger-pointing among the various collaborators when the output is not up to standards.

"Projects are all committee-run, so there is no one person to whom you can say, 'I'll give you all the powers, but it's up to you to ensure that this happens.' Like how Kalam sir helped in missile development, in today's world, there are not many such people. Maybe ISRO has Somanath sir, previously Sivan sir, and others. But ISRO is different," Aarav says.

ISRO is different from other R&D organisations in that, explains Aarav, "It is its own product developer, its own customer, its own manufacturer, and its own R&D organization. They design, make, and manufacture for themselves. This has been helpful for ISRO because whatever little they do, they are able to do to their own satisfaction and will, with an element of self-accountability. The incentive systems are more aligned in ISRO because when you are doing it for yourselves, you do it better."

Whereas, in a DRDO, for example, while the organisation designs and develops products, the manufacturing work is handed to another PSU, such as the Ordnance Factory, HAL, Bharat Electronics (BEL), or Bharat Dynamics. So, apart from the design and R&D aspects where DRDO holds sway, the overall quality of its products is determined by factors like manufacturing quality that are out of its hands.

This stands in contrast to how most organisations in the private sector, such as Boeing, Northrop Grumman, or Lockheed Martin, operate, where a single agency becomes responsible for a project assigned to it, including all the intervening aspects — R&D, product development, manufacturing, and support.

In DRDO's case, for example, if a product doesn't meet expectations or is not delivered at all, a blame game ensues between the various parties involved. The lack of clear accountability obstructs top-quality R&D work in Indian setups.

Opportunity Cost

The systemic issues within India's public-sector R&D — ranging from hierarchical culture and office politics to bureaucratic inefficiencies and dispersed accountability — significantly hinder the nation's ability to produce world-class research and technology. Addressing these challenges is crucial for India to bridge the gap with global leaders in R&D and harness its full potential.

The mighty but hidden cost that Indian R&D is paying is the flight of bright R&D talent to the private sector, such as a global capability centre (GCC) of a multinational company (MNC), to an international research facility, to a business operating beyond India's shores, or to a different field altogether in search of more lucrative and fulfilling careers.

About 15 years after his HAL experience and owing never to work in the Indian public sector again, Aarav is still connected to government R&D efforts but from the outside. He works for a GCC of an MNC involved in core mechanical engineering.

Madhukar left BARC after working there for six years. He went on to start two companies of his own, employing many talented individuals from his region and raising over \$100 million in funding from top investors for his second venture.

Mohan Kumar (name changed), despite a double master's in the US and patents to his name in a growing field, now works in marketing in India. He had returned to his homeland to look after his parents but was unable to find a role commensurate with his qualifications, experience, and expectations. He changed course by getting a Master of Business Administration (MBA) degree and switching to marketing — a far cry from R&D.

Such is the opportunity cost of the work culture at Indian public-sector R&D organisations. Until the culture changes, India will struggle to produce top-tier R&D work on par with developed nations.



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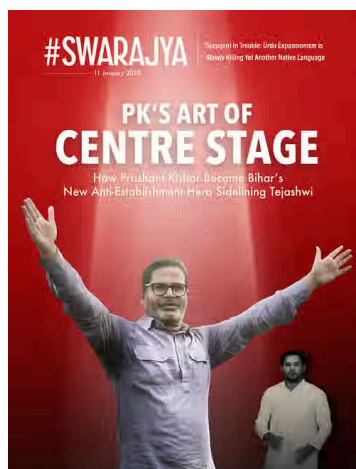
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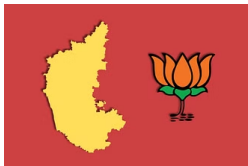
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