TAKSHASHILA INSTITUTION

Rebooting AI in India

One disruptive idea to shake the status quo

Shailesh Chitnis

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This document provides a pragmatic assessment of India's capabilities in Artificial Intelligence (AI) today. It then proposes one bold idea which, if properly executed, has the potential to catapult the country into a dominant position in the AI race.

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The elevator pitch

India is languishing at the bottom of the artificial intelligence (AI) leaderboard when compared with its G20 peers. Other than exporting our best brains, our contributions have been tiny. Even as the gap between the United States and China on one side, and everyone else on the other widens, India's policymakers, researchers, and business leaders have shown little urgency.

The first AI strategy document by the government was released in 2018, a year or so after China had released its detailed, target-linked AI plan. Five years later, India is still in the strategy and consultation phase, while China has left us behind.

We need to shift gears. Our research surveyed the state of AI in India and evaluated various policy options. While there are many recommendations that can be made, we prefer those that are immediate and agile.

Our big idea: launch a privately-funded research and development firm whose sole focus is on fundamental AI problems. This company, BharatAI, has the potential to become the hub of India's AI innovation ecosystem. Our initial estimate calls is for an investment of roughly $250 mn over five years. This, we argue, is a high-risk, but high-impact idea that can kick-start India's AI efforts. Details on rationale and the approach follow.

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Outline of the report

Most reports on AI in India follow a predictable pattern. First, they fuss over the potential of AI to alter every aspect of society and the economy. Next, they present eye-watering numbers on the impact of AI on India's economy. Finally, there's a mild caution against missing out on this once-in-a-generation boom.

Left unsaid are the steps needed to get there.

This is not such a report. It assumes that the reader is astute enough to know the transformational nature of AI. The reader also agrees that over time, this general-purpose technology will permeate every aspect of our lives. The extent of change depends on how successful we are in adopting this technology. But no one, this report hopes, needs to be convinced of the potential pay-off with AI.

Instead, this short paper is focused on that space between strategy and outcome, namely execution. It deliberately takes a near-term – three to five years – view in its analysis, since the intent is to spur action.

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2030: What if?

Imagining a future with India as a laggard in AI

On May 17th, 2017, AlphaGo, an artificial intelligence (AI) system built by Google's DeepMind, defeated Ke Jie, China's leading player in the board game Go. In his book "AI Superpowers", Kai-Fu Lee cites this as the seminal moment in China's AI awakening. Considered by the Chinese to be the hardest game to master, Go's dominance by a computer roused the government into action. Within a few months, China announced plans to dominate AI by 2030.

As origin stories go, perhaps it's a little too neat. Regardless, six years on, China's leadership in AI is undeniable. With each breakthrough, China and the United States continue to pass the AI leadership baton to each other. Europe is a distant third. India is not even in the race, and the time to catchup is closing fast.

But what does losing out on AI competitiveness look like? To imagine this, think of a future in which the two dominant nations, the U.S. and China,

a. Own key algorithms that underpin most AI applications
b. Control critical technologies, from semiconductors to compute, that are necessary for AI innovation

c. Corner the supply of scientists and developers that work on these technologies

If such a future came to pass, what does India look like in 2030?

Outcome 1: India's growth prospects will take a hit

India is on track to overtake Germany and Japan as the world's third-largest economy by the end of this decade. But with AI's ability to boost economic output, countries at the forefront of AI adoption, mainly rich economies, will capture a larger share of growth than AI laggards. According to a study by consulting firm McKinsey, leading AI economies will see an additional 20% to 25% bump in their GDP (McKinsey & company 2018). At its current trajectory, India will manage only get a 5% lift in its economic output, severely denting the country's ambitions to be a leading player in the world economy.

Outcome 2: India's national security will be compromised

China is one of the leading countries in drone technology today. Its cybersecurity capabilities are also formidable. As the country continues to invest in AI-enabled "intelligent warfare" (Xi 2022), India's defence capacity could be overwhelmed (Epstein 2022). India's public infrastructure, from ports to energy, will also be vulnerable to state-sponsored attacks (Insikit Group 2021), particularly when direct military engagement between the India and China is expensive. With US as the only other country capable of

Scenario: India continues to underinvest (public and private capital) in AI capabilities. Despite many empowered committees, countless conferences, and the promise of thousands of crores of government funding for AI, progress on the ground is very slow.

One reason is the lack of a clear plan with measurable targets. Another was poor, coordination between industry, academia, and the government.

Whatever the reason, in 2030, India isn't counted among the leading countries when it comes to AI capabilities.

matching China's technological edge in warfare, India will become more reliant on the US for advanced weapons.

Outcome 3: The country becomes a technology-taker

Today a big area of conflict between the government and Big Tech is over access to user data. As AI algorithms make their way into all aspects of the technology stack, it's plausible that the battle ground will shift towards access to models. But without capabilities to develop its own foundational models, Indian firms and the government, will have rely on algorithms from Big Tech companies. The "black box" nature of these algorithms would give very little visibility or control over how the code made a decision.

Outcome 3: Our best brains continue to be drained

India will continue to lose its brightest sparks to the US unless it has a fully developed AI ecosystem of high-quality research institutions, deep-tech companies, and a deep capital pool to fund these ideas.

This will perpetuate the vicious cycle: graduate-level research programmes will be unable to attract qualified candidates, lowering the quality of their research. As a result, the quality of ideas that emerge from these institutions is limited. And the cycle continues, with India's top undergraduate institutions reduced to producing software whizzes for US tech.

If we continue down our current path, such a scenario isn't unthinkable. Both the US and China believe that the next half of this decade is a crucial period,

both for countries and companies, in claiming the AI crown. Regulatory and technical standards will also be set during this time. Countries viewed as leaders will have a seat at the table when these decisions are made.

India must act quickly to alter its current trajectory.

Mind the gap

Plain-facts analysis of India's current position in AI

Before outlining a plan for improving India's AI capabilities, it's useful to gauge how the country stacks up when compared with its aspirational peer group.

A nation's proficiency in AI rests on four factors: research & development (R&D), capital, talent, and government support. An analysis of country-level AI benchmarks shows that India gets failing marks in most measures, save talent (table 1). This view is based on two reports.

1. Tortoise Global's 2022 AI Index that benchmarks nations on their level of investment, innovation and implementation (Tortoise Media 2022)
2. The AI Index Report from Stanford University, a robust analysis by an interdisciplinary group of experts from across academia and industry (Daniel Zhang 2022).

Table 1. A long-way away

India's capabilities in AI across key pillars (1 is the highest rank)

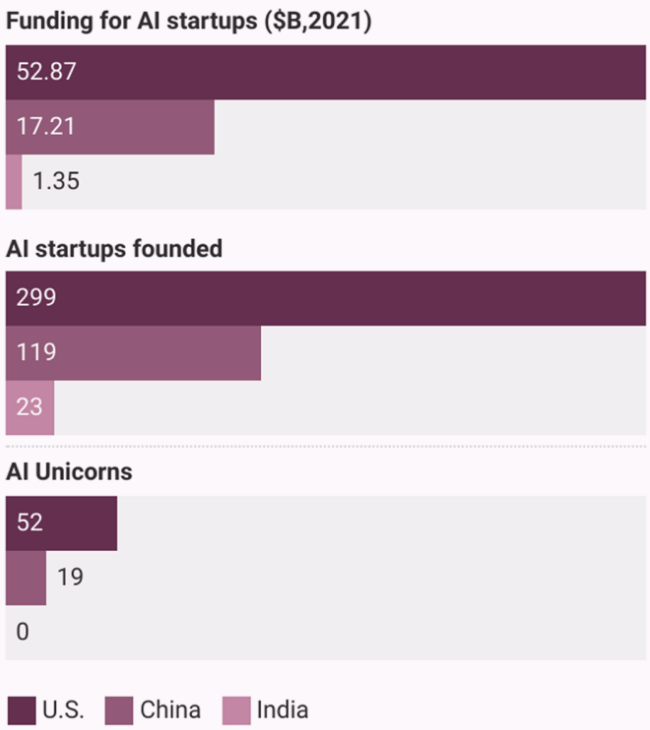
	Overall	Capital	Research	Development	Talent	Public
US	1	1	1	1	1	17
China	2	2	2	2	24	2
UK	3	4	5	11	3	11
Canada	4	6	10	10	7	1
Israel	5	3	7	9	5	45
Singapore	6	5	4	14	4	15
S.Korea	7	15	12	3	28	7
India	17	11	25	6	2	38

Source: Stanford University, Global AI vibrancy tool, Tortoise Media

Start with capital. In 2022, India was among the top four markets (Global Data 2023) for startup funding, trailing America, China, and Britain. However, very little of that money made its way to startups that are tinkering with fundamental or frontier AI technologies (figure 1). Almost all of India's unicorns – private companies that are valued at $1bn or higher – are focused on improving efficiencies within India's clunky infrastructure.

Figure 1. Need Googol, get Zepto

Focus of startup funding in India is predominantly on consumer and application-oriented technologies



Source: Stanford University, Global AI vibrancy tool

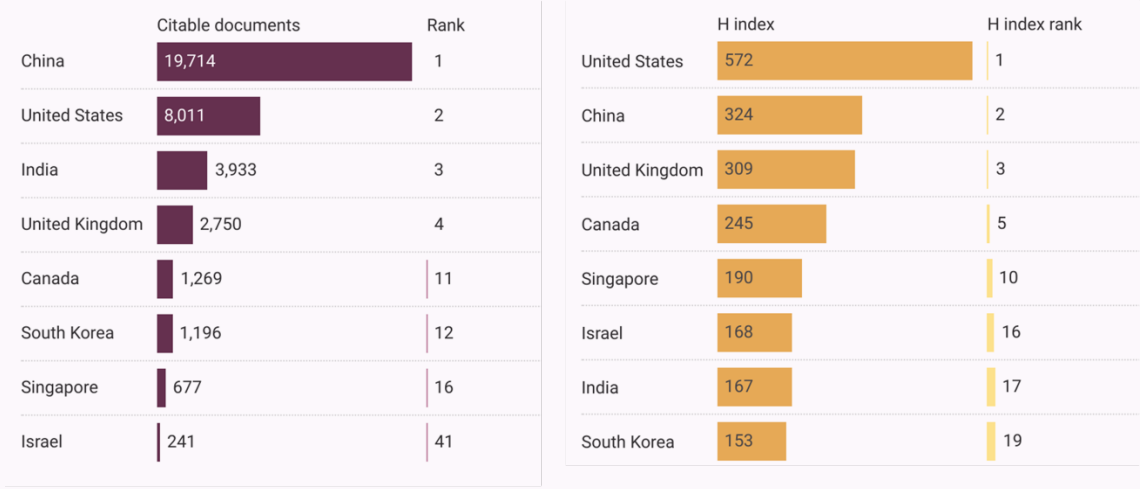
The share of companies engaged in innovative research will always be lower than those working on solutions for everyday uses. Even accounting for that

disparity, the number of Indian startups engaged in innovative AI-related applications is very low.

Moving "upstream" from applications of technology to innovative R&D, the results are mixed. Indian researchers churn out AI papers at a prolific rate – the country is only behind the United States and China in the volume of papers published (figure 2). Yet the quality isn't up to snuff.

Figure 2. Quantity not quality

Indian researchers publish at a fair clip, yet the quality of these publications is average



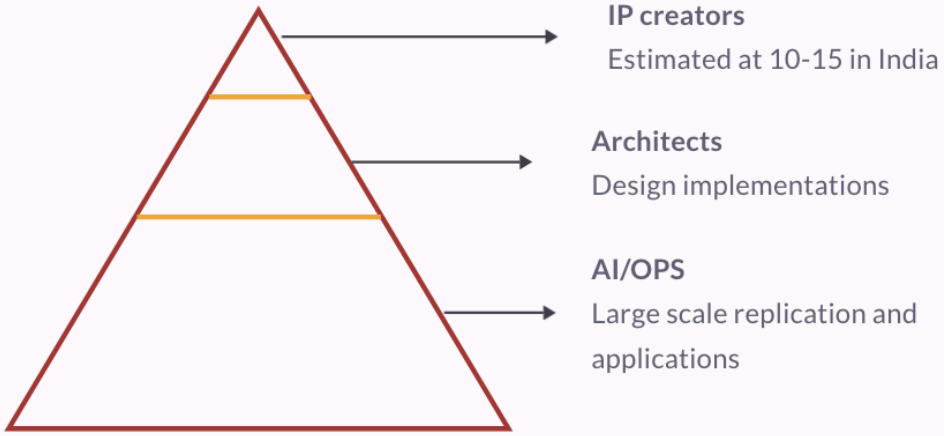
Source: Scimago Journal & Country Rank

The H index measures both the productivity and citation impact of the publications; the higher the H index, the more influential a publication or author (SCImago 2022). When ranked by the H index, India slips down to 17th position, indicating the middling quality of our AI-related research.

Finally the brains. India has a clear advantage in terms of brain power. The country is a top source for engineers who work on AI problems. But all AI talent isn't the same (figure 3).

Figure 3. "Full stack" of AI talent

AI developers and researchers aren't fungible. A well-developed ecosystem needs a good mix of thinkers and doers



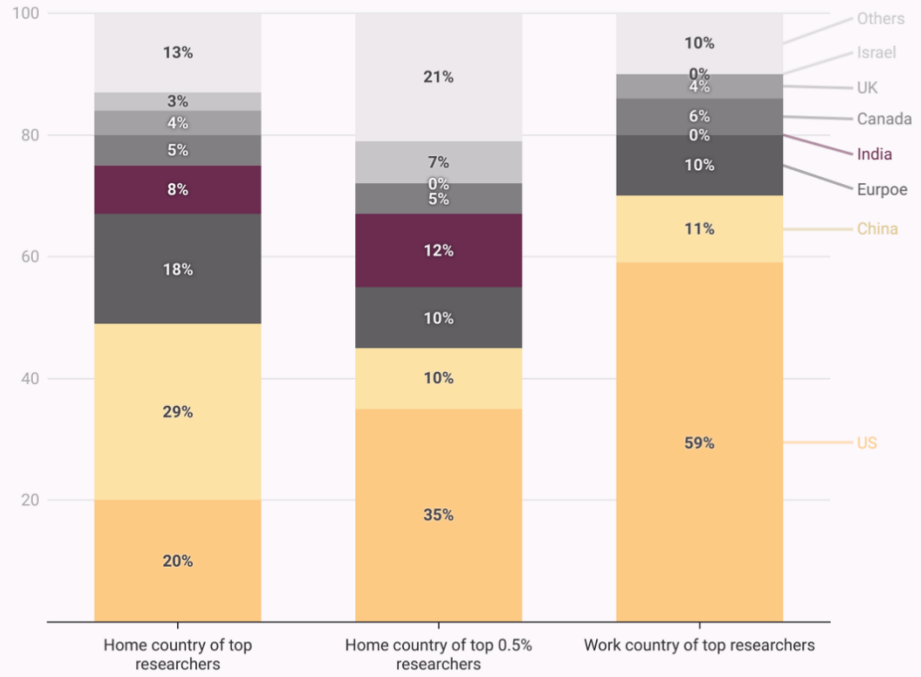
Leading AI economies have a pyramid-like distribution of their AI workforce. At the top is a small, but innovative, group of IP creators. These are researchers who design new algorithms and approaches that advance the field. IP creators are typically Ph.D. level scientists that work in academic institutions or corporate labs.

A 2022 study by MacroPolo, a Chicago-based think-tank, finds that India is the third-largest source of rarified AI talent (MacroPolo 2021). But none of this talent stays, with most migrating to Big-Tech labs in the US (figure 4). According to our research, the number of highly qualified AI scientists in India is in the low teens.

This is a problem. India's role in the AI age cannot be restricted to simply supplying talent. We need to retain and even attract outside talent if we are serious about moving up the AI value chain.

Figure 4. Losing our best minds

India is the fourth largest source of AI researchers and the second largest when restricted to the top 0.5%. Yet few work in the country.



Source: MarcoPolo, Paulson Institute

It's not all doom and gloom. India has challenges in building world-leading AI capabilities. Yet, the country also has a few advantages, which, if correctly harnessed, can help paper over some of the limitations.

Revving the data engine

Low prices for mobile internet access coupled with a push to digitize services has created a torrent of data, from financial transactions to Aadhaar-enabled applications. In 2012 India contributed only 2% to the global mobile data traffic. In 2022, Indians guzzled more than a fifth of the total mobile data traffic.

Today much of this data is messy and unstructured, limiting the usefulness of the data in AI. But, if this data can be modelled into a defined structure and developers get access under controlled conditions, the volume of data can be a differentiator. The government recently announced plans to make large datasets publicly available (Shinde 2023). While the details are still unclear, this is a move in the right direction.

Tailwinds from US-China decoupling

In October 2022, the US announced sweeping restrictions that limited Chinese companies' access to advanced semiconductor technologies. One reason was to make it harder for China to develop supercomputers with military applications. Another was to slow its progress in AI by denying them access to high-end processing power.

For India, this opens a window in which to partner with the US and other allies. Technology cooperation will enable India to play on its relative strengths while benefiting from its know-how in key areas.

India shouldn't let its usual scepticism of multilateral treaties and country blocs stand in the way of greater cooperation. The Initiative on Critical and Emerging Technologies, announced in February 2023, paves the way for the United States and India to collaborate in a variety of areas, including quantum computing, AI, 5G wireless networks, and semiconductors. Similarly, the Quadrilateral Security Dialogue, a grouping of four countries – the US, Australia, India, and Japan – also seeks to foster teamwork among its members with the development of AI. It is in India's advantage to actively participate in these initiatives.

Sliding up the AI stack

Technology leadership will be decided by AI models, not applications

For almost 50 years, Moore's law – the observation that processing power doubles every two years – propelled the tech sector to build faster, cheaper, and smaller. Now AI is blazing its own version of this law.

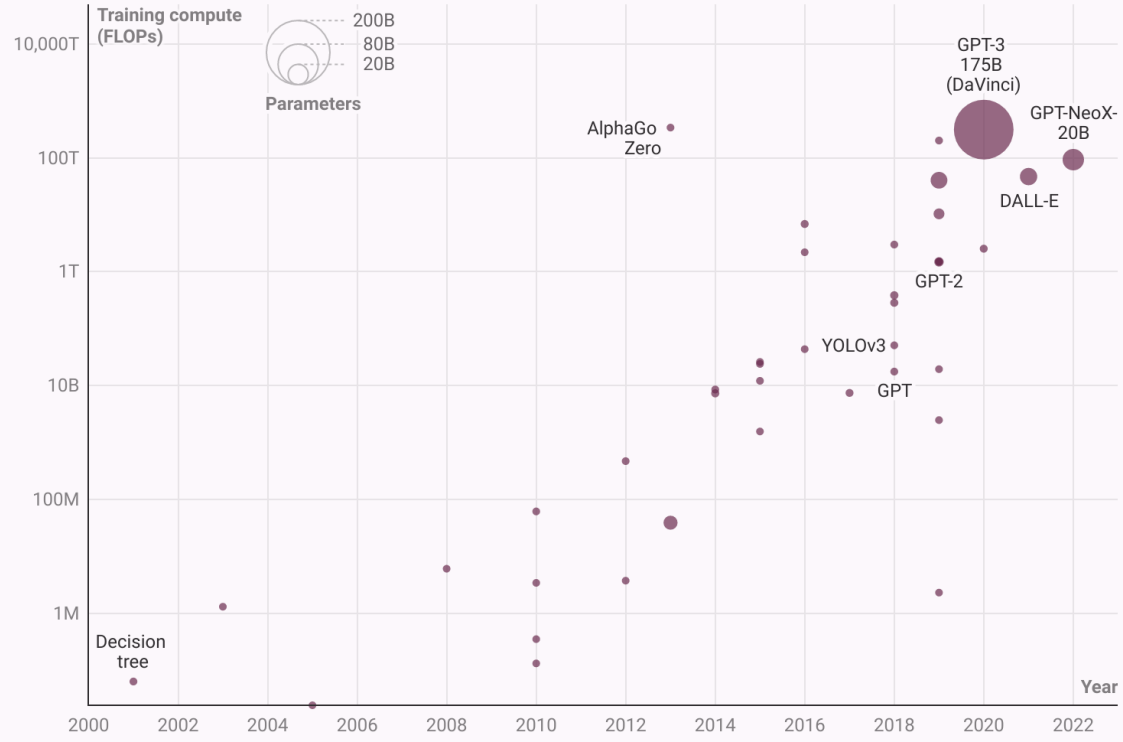
Progress in AI depends on compute, training data, and algorithm improvements. Until 2010, the processing power used by training systems for AI doubled every 18 months. Since then, that number has fallen by a third (figure 5) (Jaime Sevilla 2022). The size of data required by these models has also grown, as has the complexity of algorithms. In 2014, the Go-beating champion code, AlphaGo, used an algorithm with 46 mn parameters and trained on 5.8 bn data points. In 2020, ChatGPT's algorithm used 175 bn parameters and chomped on 375 bn data points.

The scale of these numbers and the pace of their growth is an indication that, for AI, these models or algorithms, are where the action is. Fundamental models have wide applicability across areas. They are also the basis for building the next iterations of algorithms. During the first phase of AI's growth, loosely the period from 2010 to 2020, most of the development was an open science. Some of the breakthrough algorithms were accessible to all through publications and open-source repositories. This openness allowed

newcomers to "catch up" with the incumbents by sinking large amounts of capital and talent.

Figure 5. Up, up and away

Compute, training data and algorithmic complexity are now exponentially increasing



Source: James Sevilla 2022

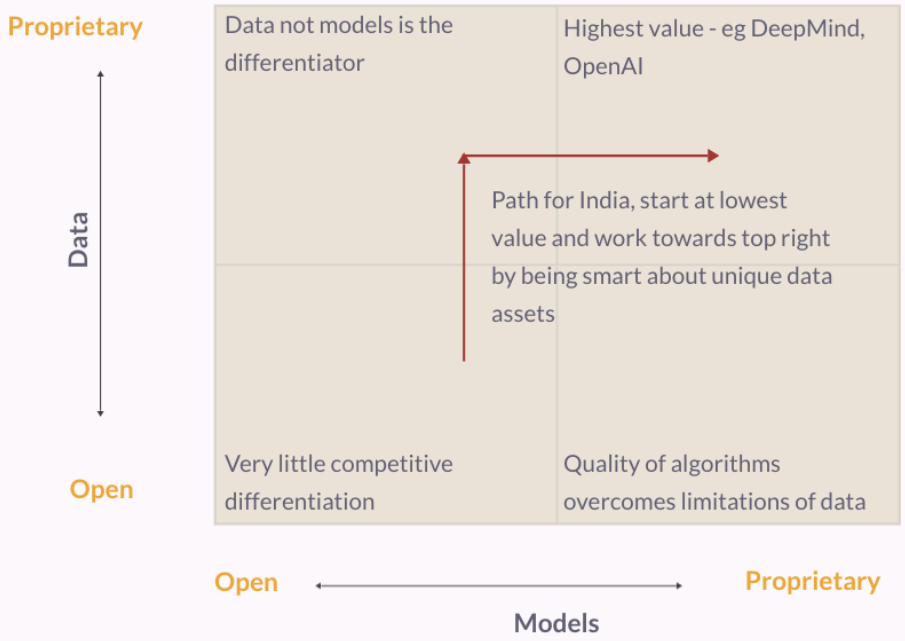
But over the past few years, AI development has forked into two paths. On one side, lies the traditional open-source development approach, and on the other, is closed, proprietary innovation. OpenAI is an example. While its APIs are available (for a fee), the language model that powers ChatGPT is not. Companies that use the know-it-all bot to build applications must pay for access.

Mastery of these models also indicates a country's (Xi 2022) or firm's technical depth. The prestige conferred by advancements in these models' size, output, or intelligence makes it easier to attract the best AI talent. So far, the ability to build foundational AI models has been limited to a few countries and institutions. The US is by far the leader through its envious mix of tech companies and academic institutions. Companies such as Google, OpenAI, and Meta and academic institutions such as Stanford University and Carnegie Mellon University are at the top of most AI rankings. China has also been making steady progress through its version of Big Tech, namely Baidu and Huawei. They are also markers of national pride.

How can Indian institutions make a start? By taking a calibrated approach. Primacy in AI requires data and models – the more unique the ingredients, the more powerful the model (figure 6). Indian companies that are starting out on this journey will have to rely on open source models and publicly available data. This combination might not result in any innovative output, but it will build organizational capability and confidence.

Figure 6. Traversing the AI value chain

Indian companies will start with undifferentiated data and models, but should quickly move up the stack by leveraging access to unique data assets



The next logical move is to get access to unique data. Here, with the right policy support, Indian companies can have an edge over their foreign counterparts, through access to India-specific data assets. For instance, with the right privacy and security features de-identified transaction data from the Unified Payment Interface (UPI) platform can be used to train better fraud

detection programs. Similarly, if the push to adopt digital health records is successful, healthcare startups can use de-identified patient-level data to train models that identify disease trends, co-morbidities, and treatment patterns for hundreds of millions of Indians.

Applications built on this data can also be marketed to other regions, not just India. In this phase, Indian companies have a slight differentiation due to their models being trained on novel data assets.

The last phase is the transition to building unique models. It is also the hardest. This is the space occupied by the leaders and requires India to get top marks in all the AI pillars – talent, capital, R&D and regulatory support.

It's time for private sector to chip-in

India's AI revolution will not be publicly funded

In her budget speech this year, the finance minister Nirmala Sitharaman announced plans to fund three centres of excellence for AI, housed within leading academic institutions. This was a scaled-down version of the NITI Aayog's recommendation five years earlier to establish five institutes of research excellence and 20 international centres for transformational AI (Niti Aayog 2018). Details of the exact amounts are hazy, but reports suggest that the government think-tank wanted to pump ₹7,500 crore (~$900 mn) over three years for these AI hotbeds.

The government's plans are well-intentioned. They are also misguided. Our research indicates three reasons why public funds aren't the constraint taking India's AI capabilities to the next level.

Private sector isn't pulling its weight

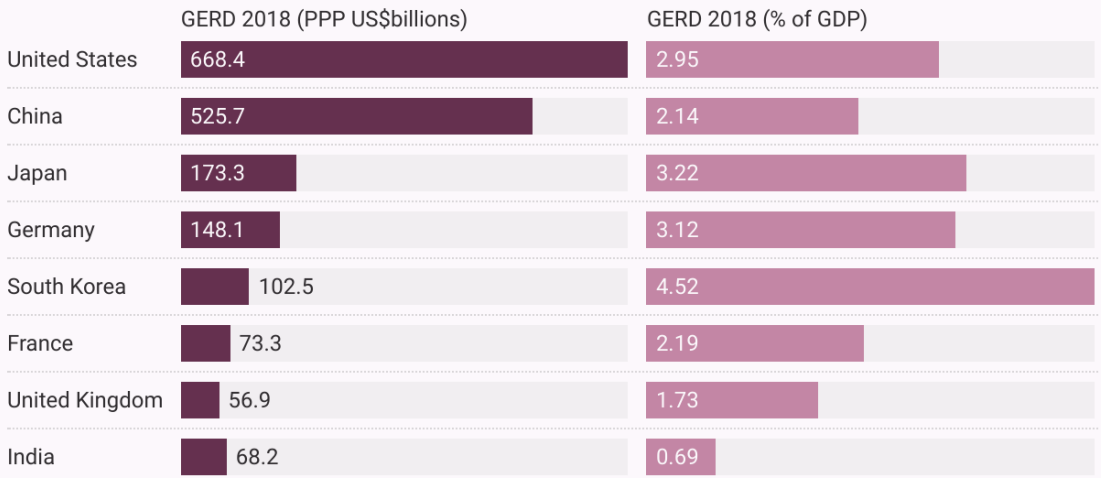
The first is the lackadaisical investment by the country's businesses into R&D. When compared with its aspirational peer group, India is at the bottom tier in R&D spending, both in absolute terms and as a percentage of GDP[1]. The

[1] Gross domestic spending on R&D is the total expenditure (current and capital) on R&D carried out by all resident companies, research institutes, universities and government laboratories

US invests almost $670 bn or an equivalent of 2% of its GDP on R&D. China spends more than $500 bn, which is more than 2% of its GDP. R&D in India gets a paltry $68 bn or roughly 0.7% of the country's annual output (figure 7).

Figure 7. India invests less in R&D

Country's spending per capita is among the lowest in aspirational peer group[2]



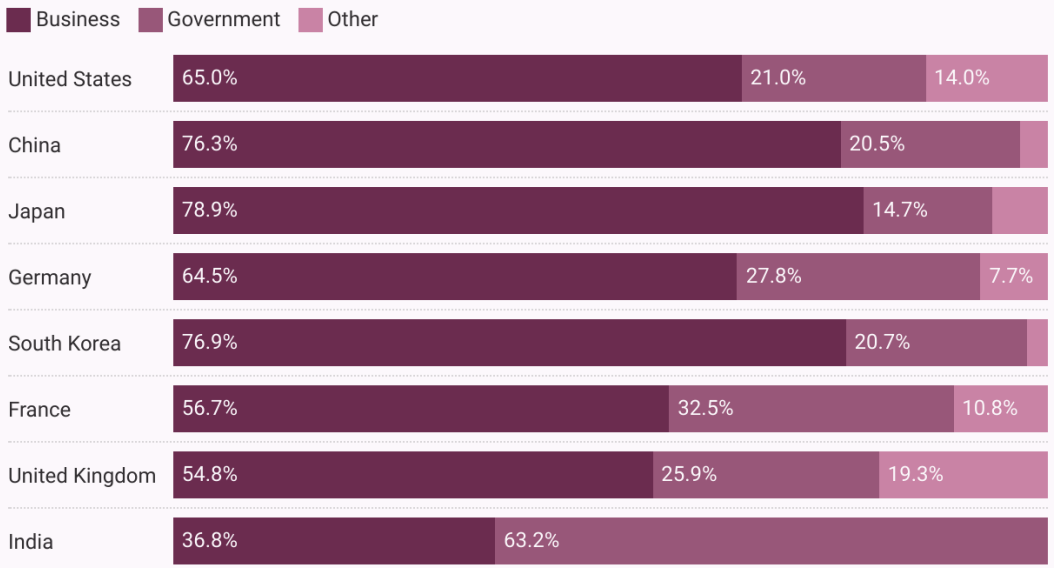
Source: World Bank, NSF, DST India

[2] GERD = gross domestic expenditure on R&D

The culprit here is the private sector. If you break down the components of R&D into various constituents, the low investment of India's private sector is an outlier (figure 8).

Figure 8. Don't blame the government

Issue isn't government spending, India's private sector is stingy investor in R&D[3]



Source: World Bank, NSF, DST India

[3] Other bucket includes educational and non-profits. In India these figures are very small for non-profit and educational budgets are largely government backed

In all the economies in its peer group, R&D spending by the private sector swamps that by the government or academic institutions. In India, it's the opposite. The public sector, which also includes most of the leading academic institutions that are government-backed, stumps up almost two-thirds of the country's research funds.

A simple back-of-the-envelope calculation suggests that if government spending on R&D was held constant and the private sector contributed at the same level as the peer group average, India's spending on R&D would rise to almost $107 bn or 1.1% of its GDP.

Skewed profile of R&D

The poor record of India's academic institutions in taking ideas from the lab to the app is another reason why more public funds aren't the answer. R&D activities can be classified into three types (OECD 2015): basic research, applied research and experimental development.

Basic research is experimental or theoretical work into foundational areas. For instance, research on the properties of general algorithms for handling large amounts of real-time data.

Applied research tries to use insights from basic research into solving problems or designing novel solutions. Building on our previous example,

researchers would investigate the applicability of the new large-data algorithm to reduce fraud in high volume e-commerce transactions.

Experimental development is the final leg of R&D, which builds on basic and applied research to launch business or customer-based applications. An example of this would include a startup that uses code developed by researchers in the previous phase and builds a fraud detection application for e-commerce vendors.

A country with a well-functioning innovation engine has a graded profile for R&D spending, with basic research at the base and experimental development cornering a larger share of funds. This indicates a good rate of transfer of technologies from the lab to the field. Most leading AI countries follow this profile (figure 9). China has been making steady progress towards its goal of 8% of GERD (Gross Domestic Expenditure on Research and Experimental Development) being allocated to primary research.

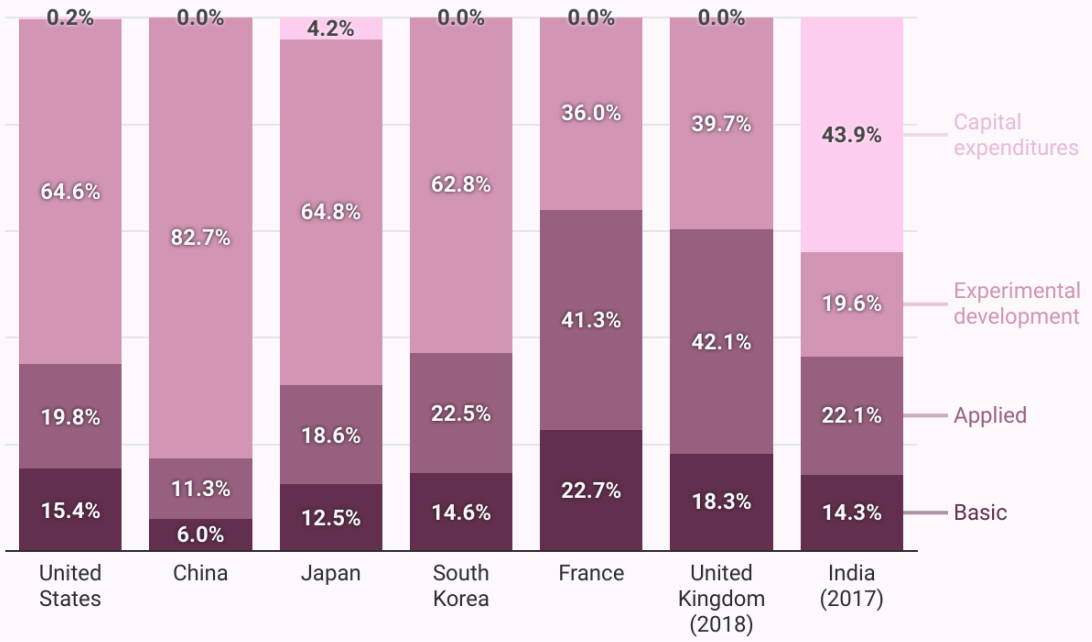
US and China spend an outsized portion on experimental development. Not surprisingly, they dominate in innovation-driven applications such as AI, semiconductors, and 5G.

For India, the numbers are skewed by a high allocation towards capital expenditures, which could be an artefact of differing accounting practices.

Even ignoring this anomaly, at absolute levels, applied and experimental developments are very low.

Figure 9. Potholed road from lab to app

India's R&D profile shows a low rate of technology transfer from the lab to the field



Source: World Bank, NSF, DST India

Given this record, the way to spur innovation isn't by spending more on academic research. These institutes haven't shown a track record of relaying ideas from the lab to the real world. India needs more money for experimental development – taking ideas and code from a research setting into applications.

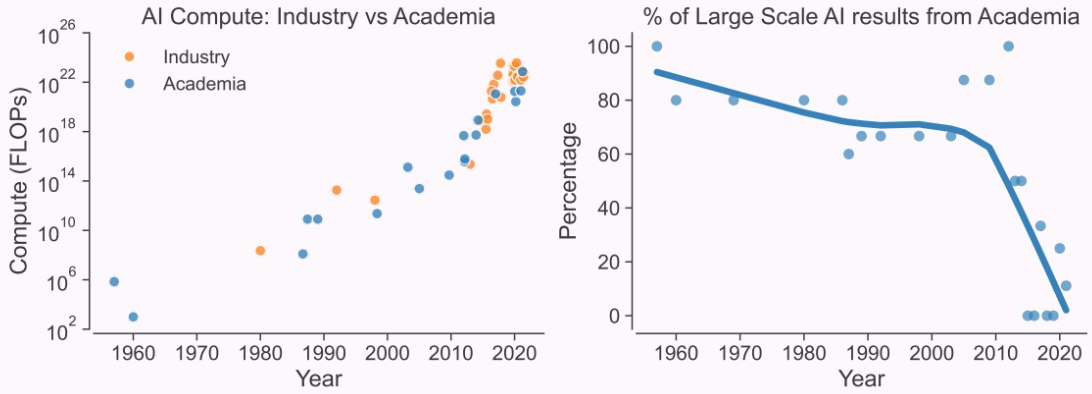
The rise of corporate labs

Finally, leadership in AI is no longer being decided in the ivory towers of academia. The computation power required for large-scale AI experiments has shot up by more than 300,000 times in a decade (Ganguli 2022) (figure 10). This has imposed a high cost on academic institutions for research and experimentation. During the same period results from academia plummeted by more than 60%.

This trend of cutting-edge research moving from academia to industry is most visible in the hottest form of AI right now – large language models (LLMs). These models underpin the intelligence of chatty bots from Open AI's ChatGPT to Google's Bard. Ganguli 2022 estimate that the largest language models that are free and publicly available today are magnitude smaller than those developed by industry by a few orders of magnitude. Access to large compute resources is now a superpower that only a few academic institutions can match.

Figure 10. Businesses have, academia have-not

The compute requirements have exponentially increased (left graph), severely constraining the ability of academia due to high costs (right graph)



Source: Ganguli 2022

Calls for more government funds aren't justified until businesses also start contributing. The cost structure of AI research today is also better suited for industry. The next section introduces one way in which India's private sector can have an immediate impact.

BharatAI

Private-led, transformational lab to spur India's AI ambitions

Notable partnerships between AI companies and compute platforms

- Microsoft & OpenAI
- Google & DeepMind (acq.)
- Google & Anthropic
- Google & Cohere
- Google & AI21 Labs
- Amazon & StabilityAI

AI is mainstream. And, as the preceding sections have demonstrated, India needs to catch up. Fast. Industry leaders can wait for guidance from the government on a roadmap, with defined milestones, ample funds, and coordinated action among industry, the public sector, and academia. But India is not China.

Disruptive change will come from the private sector. One approach is to launch a privately funded research lab that works on foundational models for AI. We call this lab BharatAI.

Billion dollar pursuits

Leadership, or even competency, in AI isn't cheap. DeepMind was founded in 2010 and acquired by Google in 2014. Its first public success came in 2016 when it released its AlphaGo program. Google doesn't disclose its investments in DeepMind, but estimates suggest that so far DeepMind has absorbed over $1.35 bn and has over 1,500 employees. It's a similar story to OpenAI. Founded in 2015, it raised over $1 bn from investors until 2022 and picked up an additional $10 bn from Microsoft in 2023.

One reason for the large upfront investment is to attract the right talent. High-end AI engineers are prized by all companies, and their salaries, in the

US, can run into seven figures (Metz 2018) with the average salary close to $500,000.

The infrastructure costs of processing training data for the models is also steep. By some estimates, OpenAI spends close to $1 mn a day on cloud computing bills chit- chatting with users around the world. As the number of parameters and the size of training data continues to increase, most AI builders are partnering with large cloud providers (side box).

"Average is probably single-digits cents per chat; trying to figure out more precisely and also how we can optimize it"

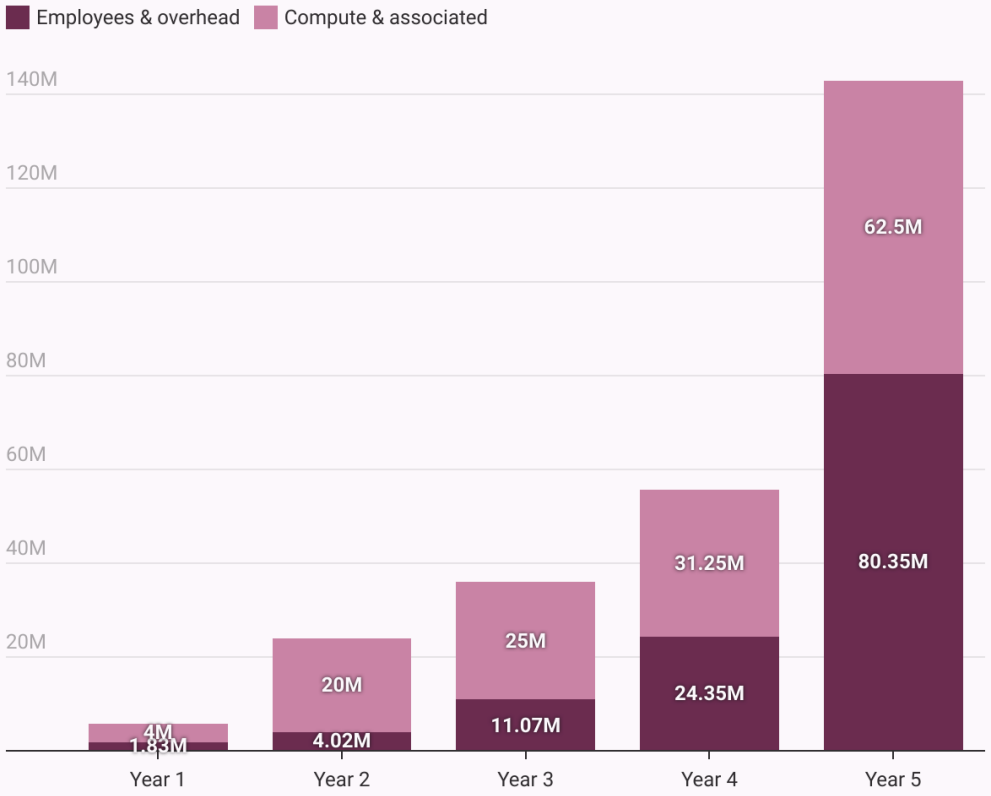
Sam Altman from OpenAI when asked about the average cost per chat for ChatGPT

In India the costs will be lower, but not significantly. While salaries of the AI researchers will be less than those in the US, our research suggests that they'll still be sizeable. Infrastructure costs will remain as is, whether the training data is run in US servers or Indian. On the revenue side, it will take at least four to five years before the company has any monetizable revenue from its products.

Given these factors, getting a company that works on foundational AI problems in India, isn't for the faint-hearted. Our research estimates an investment of around $265 mn over five years (figure 11).

Figure 11. BharatAI strawman investment needs

$265 mn over five years which includes people costs and infrastructure bills



Source: Author estimates

This is why the proposal by NITI Aayog to fund 5 centres for core research and 20 institutes for applied research isn't useful. Assuming that the government allocates the full $900 mn over three years that was requested by

the think tank, each centre or institute would receive between $6 mn and $10 mn annually. The size of the investment, which is large in aggregate, is tiny for each individual centre to make any meaningful difference. The gap between the top-line and actual investment on the ground also highlights the pitfalls of government funds: political calculations dictate investment decisions.

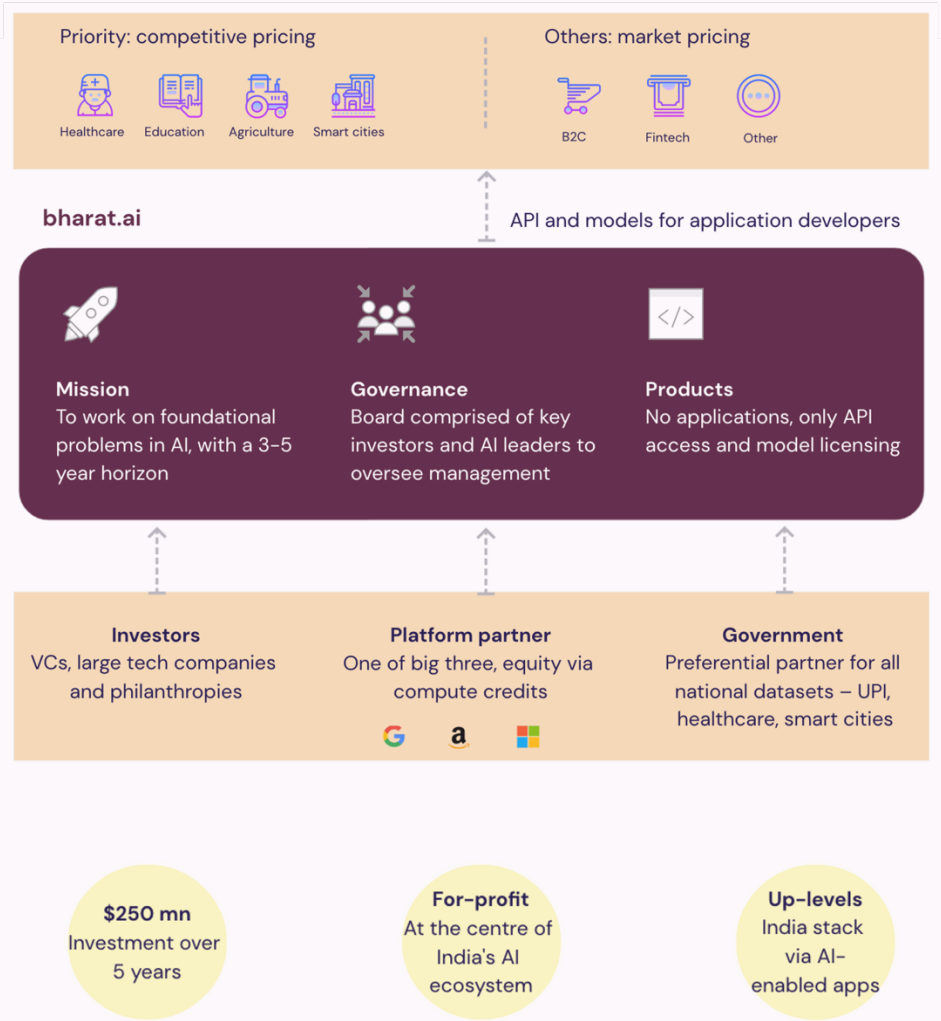
Structuring for success

But an unproven company that requires over $250 mn over five years with no defined product or revenue won't be flush with investor cash. The mismatch between high upfront costs and a long horizon to recoup the investments, requires patient capital.

Hence we propose a pooled investment approach. Similar to a venture capital (VC) fund, BharatAI's investors will resemble limited partners (LPs) that park their money into this venture for a defined period, say 10 years (figure 12). In return, they buy equity into the firm but are not involved in the company's management.

Figure 12. Built in India

We picture BharatAI as a for-profit company that is at the center of India's AI ecosystem



Investors into this company can be of three types.

a. **Strategic investment from India's large technology services companies**: AI will have an impact on the growth prospects on services companies, since a large part of their revenue is tied to building and maintaining software systems. These are now being automated through intelligent applications. It's hard for a services company to build innovate products. By backing a company that will work on this transformation, India's services sector can get access to transformational technologies.
b. **Venture capital funds**: There are few opportunities for investors to invest in "deep tech" startups in India. The current wave of venture funding now seems to be drawing to a close; the euphoria over B2C startups is confronting the realities of revenue. Investing in a foundational-layer AI startup is a risk, but the upside, if it succeeds, makes it one worth taking.
c. **Private endowments**: India's wealthy have recently become active in philanthropic efforts. The mission and impact potential of BharatAI makes it a worthy candidate for capital that's looking at positive scale social change through its investments.

The company will also have two other backers who will be critical for its success: a platform partner and the government. The platform partner will be one of the big three tech platforms – Microsoft, Google or Amazon – whose

investment into BharatAI can be in the form of compute credits. For the platform partner, engaging with an Indian AI champion will be good optics.

A government partnership would help BharatAI get preferential access to datasets. The scale and diversity of data available to train the company's systems would be an advantage as it builds its capabilities on the models.

The company itself would focus on foundational AI problems with broad applicability. BharatAI should not attempt to develop end-to-end applications. It should instead provide tools through application programming interfaces (APIs) and open-source or licence its models.

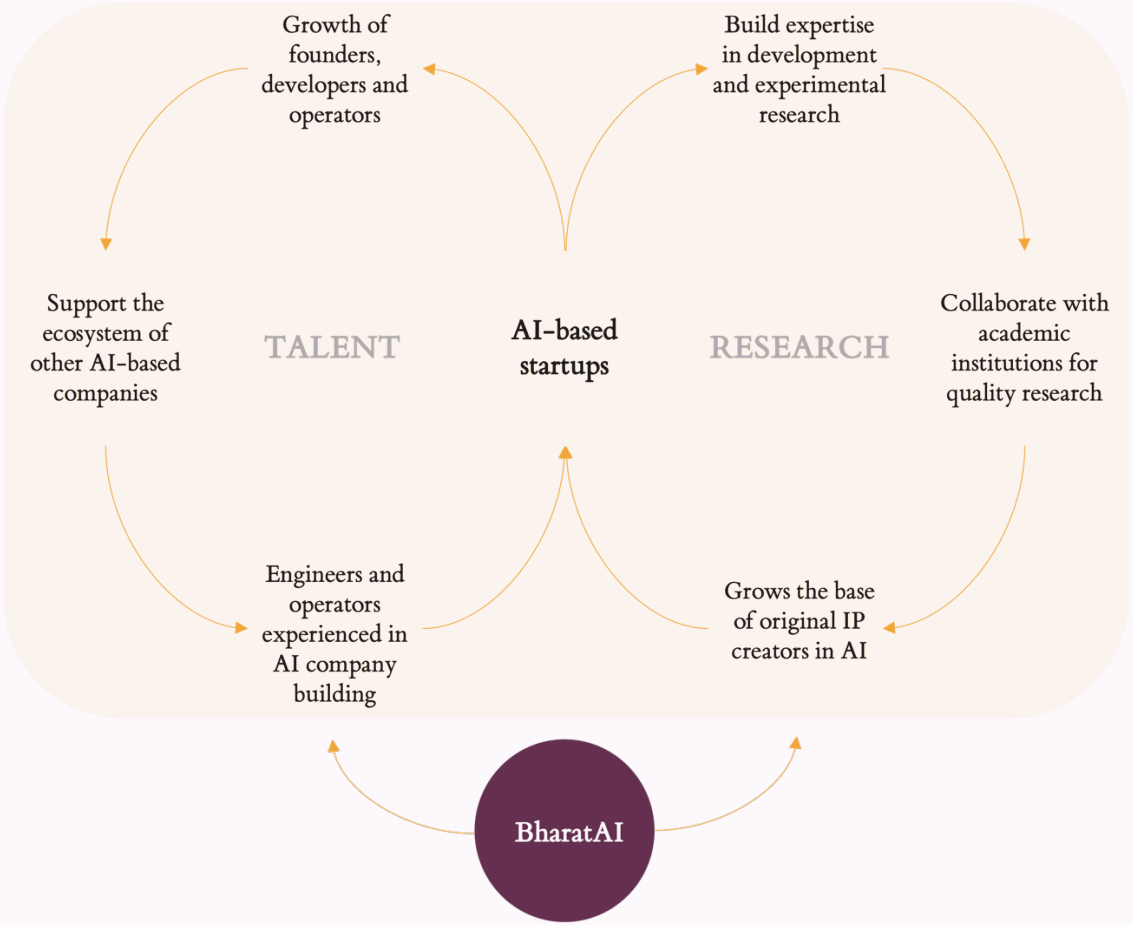
The company should be a developer-friendly platform that allows engineers to build applications using its tools and models. Builders in the government-identified priority sectors benefit from cost-effective pricing. This could be an area where the company receives government credits to support low-revenue but high-social-impact sectors.

A multiplier effect

At the start of this document, we highlighted areas of weakness for India as it competes against mature AI economies. A single company cannot alter India's AI trajectory. But it can make a sizeable dent in our efforts to overcome our handicaps (figure 13).

Figure 13. Kickstarting the AI flywheel

BharatAI seeds talent and research capabilities for Indian technology companies



BharatAI can serve as a talent magnet for high-quality, high-demand engineers. These could be Indian-origin researchers that migrated to the US for their post-graduate studies and then stayed back. Currently, there aren't many options for these researchers and engineers in India.

A research lab that is closely tied to industry will also promote a culture of innovation that is privately-led. India is the largest exporter of IT services and has the 3rd largest pharma industry. Yet, it doesn't lead in innovative R&D. This is an opportunity to change that.

India's startup boom was built on the success of a few homegrown companies like Flipkart: early employees from successful startups have founded their own companies. BharatAI can be the hub of the next generation of AI-centred startups with its own ecosystem of researchers, developers, and investors.

Finally, the Indian government is keen on expanding India stack – a set of open APIs and public digital goods – globally. Having an AI layer in the stack that offers countries an alternative to Big Tech capture will be a big benefit.

The final word

The US had its Sputnik moment that jolted the country out of its stupor and forced it to match Russia's technological progress. AlphaGo's drubbing of human champions galvanized the Chinese government into action with a clear plan for AI dominance.

India's AI ambitions are still waiting for a spark.

A country, with India's size, ambitions and resources needs to be an active participant in the AI economy. Not merely as a data and people supplier, but also as an innovator. But overcoming systemic issues that dog our poor record in innovation will take while. And yet, the success of India Stack has shown that India can implement complex technology projects, if private and public-sector interests are aligned.

The push for private-led innovation is also consistent with global innovation trends in AI. Most of the recent headline grabbing breakthroughs in the field have all come from large technology companies and well-funded startups.

BharatAI is a bold approach. It's also very risky. But, if successful, the payoff is outsized. And that should make the investment worthwhile.

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Appendix

Brief discussion on other policy options considered

During the course of our research, we evaluated various other policy initiatives. We zeroed in on BharatAI as the most transformative piece, given our time-horizon. Table 2 summarises other alternatives and their rank in key measures of impact.

Proposal A1: Issue a detailed plan for India's AI targets

Taking cues from the Chinese government, Indian policymakers should go beyond strategy briefs and announce country-level targets for India's AI efforts. This report, developed in collaboration with industry and academia, should include clear milestones as well as success measures for those milestones.

For instance, one measure of our research capabilities can be our rank in citations among top-tier AI journals. This is a more specific metric than simply counting total publications. Similarly, access to funds should be linked to meeting these milestones, with rewards (and penalties) for beating (or falling short) these targets.

Table 2. Other policy alternatives

Qualitative assessment of other options to improve India's capabilities (5 is the best rank)

No.	Proposal	Primary responsibility	Secondary responsibility	Time to impact	Impact potential	Probability of being implemented
Suggested	BharatAI	Industry	Government	3- 5 years	5	4
A1	Issue a detailed plan for India's AI targets	Government	Industry, Academia	7-10 years	3	3
A2	Have a common view on all government AI-related spending	Government		5-7 years	3	2
A3	Appoint a Chief Data Officer at the center	Government		5-7 years	4	2
A4	Encourage procurement from local AI startups	Government	Industry	5-7 years	4	4
A5	Set R&D targets for academic institutions	Government	Academia	7-10 years	3	1

Proposal A2: Have a common view on all government AI-related spending

AI is a general-purpose technology that has applicability across various sectors. With each department separately announcing an AI policy and allocating funds for it, monitoring progress and the return on investment will be difficult. Having a common view of all AI-related investments can help

identify areas where collaborations and partnerships across agencies can yield better outcomes.

Proposal A3: Appoint a Chief Data Officer

India's potential as a data engine for the world is undeniable. However, the country cannot capitalise on this dividend because much of the data is unstructured and messy. The Smart Cities initiative shows the benefit of appointing a Chief Data Officer (CDO) who is in charge of the data integrity of various initiatives.

Indian businesses will benefit if the government appoints a CDO who is responsible for unifying data collection and sharing, across various initiatives (healthcare, smart cities, finance, etc). By defining a common data model across verticals/applications and creating a process for data access, the CDO can enable qualified entities and researchers benefit from India's data deluge.

Proposal A4: Encourage procurement from local AI startups

One of the reasons for China's dominance in computer vision is the number of contracts that these companies signed with local governments for surveillance and security technology. Moral arguments aside, by being the "guaranteed buyer" for these new technologies, China's government has incentivized its local startups to build capabilities in image processing. These skills are transferable to consumer and business products. Israel's technology industry also benefited from its close relationship with its defence industry.

The Indian government can play a similar role in encouraging local AI startups. The government has allocated large sums for priority areas like healthcare and education. The sheer size and variety of India's market create a range of opportunities for Indian startups and established companies to build targeted AI applications. Local firms are also better equipped to understand and address the unique needs of the Indian market. Given the data dividend, India has an opportunity to lead in applications related to finance, healthcare, and education.

Proposal A5: Set R&D targets for academic institutions

As highlighted in the section on India's R&D investment, university-industry linkage in India is very weak. Although Indian institutions conduct a large amount of research, their relevance to real-world problems is very low. One way to incentivize technology transfers from the lab to the industry is to set clear targets for academia-industry collaboration. A yearly target for each of these categories can help to correct the lopsided distribution of basic, advanced, and experimental research. In ten years, the ultimate goal could be to have a mix similar to advanced science economies.

Similarly, academic institutions should be graded on their output by tracking contributions in top-tier publications and conferences. The H-index and other measures of research quality should guide decisions on funding.

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