Deep-Tech Startup Ecosystem

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Deep-tech startups arise from research-based, disruptive innovations from STEM labs of academic/research institutions and solve hard problems and challenges. India lacks deep-tech startups. Deep-tech startups constitute less than one per cent of the number of startups, far below what a fast-growing, complex, and large economy like India should have.

India has a vibrant startup ecosystem with supporting infrastructure– incubators, development grants, angel/venture investors, mentors– and a conducive policy environment. The Economic Survey of India 2021-22 says that there are 61,400 registered startups in India, making it the third-largest startup ecosystem in the world behind China and US. Around 14,000[1] new startups were registered in India during CY2021[2]. Over the past decade, Indian startups have created 6.6 lakh direct jobs and 34 lakh indirect jobs.

Indian startups raised USD 24 billion in CY21, compared to USD 10 billion in CY20. There has been a significant localisation and diversification in the investor pool for startups in India over the past decade. There were more than 750 institutional investors in India in CY21, 80% more than in CY20. The number of angel investors grew in CY21 by 20% to about 2,400. More than half the investment deals in CY21 had an India-based investor. Over 250 corporates have engaged with Indian startups in some way, including by running 80+ open innovation programmes for startups in CY21.

The Central and State governments in India have actively supported the startup sector over the past decade. The Startup India platform, which started in 2016, has been instrumental in encouraging startups and integrating them with the corporate and investment community. Over 26 States in India have a startup policy.

What is a Deep-Tech Startup?

Notwithstanding the healthy development of India's startup ecosystem, one weakness that keeps India behind the developed countries is that we lack deep-tech startups. "Deep-tech" startups constitute less than one per cent of the number of startups, far below what a fast-growing, complex, and large economy like India should have.

The absence of deep-tech startups harms India considerably by weakening her capability to meaningfully address complex socio-economic challenges that afflict our society in multiple sectors such as agriculture, healthcare, transportation, education, energy, etc. The solutions to such challenges that address the UN's Sustainable Development Goals would necessarily have to be radically new and disrupt existing industries and business processes.

In India's population of 130 crores, only the top 25%[3] (affluent and middle-class) benefit from the fruits of technological progress, be it healthcare, consumer goods, clean water, safe transportation, education, etc. In contrast, the remaining 100 crore people do not get enough or are substantially bypassed. This is because most of the hi-tech goods and services are designed in the developed world for rich people– the average per capita income in OECD countries is about USD 40,000, while the average per capita income of the bottom 100 crore people in India is around USD 1000[3]. They simply cannot afford modern innovations with an income of 2.5% of the people for whom such innovations are designed. So, how do 100 crore Indians move towards development?

The answer lies in becoming Atmanirbhar in commercialising domestic science and technology to solve our challenging problems.

India's development challenges are so unique and idiosyncratic that innovators from developed countries, not familiar with our context or cost structures, will not be able to provide solutions. The clarion call from the Prime Minister for 'Atmanirbhar' is apt here– we have to grow our own deep-tech ecosystem.

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Need for Deep-Tech Startup Ecosystem

The phrase 'deep-tech startup' does not have a precise definition, but there is a broad consensus on what it is. Deep-tech startups arise from research-based, disruptive innovations from STEM labs of academic/research institutions and solve hard problems and challenges. Some examples are— (a) recycling sewage to get clean water at an affordable cost, (b) a low-cost solution at scale for curing blindness, (c) affordable solutions for treating diseases such as diabetes, dementia, cancer, etc., (d) creating an alternative to Lithium-ion batteries, and (e) low-cost satellite launching systems.

There are three major problems that deep-tech startups have vis-à-vis other startups (including those that are called tech-based startups).

1. Deep-tech startups need a longer gestation for development than other startups. The latter might need from 1-3 years to reach revenue, while deep-tech startups need 5-8 years.
2. Deep-tech startups require different types of inputs– they require more patient capital, specialised talent, and expert knowledge in more than one domain, to develop and validate a science-based innovation to the point where it is acceptable to commercial investors. For example, assume an invention involving creating a new substance (say a chemical that removes heavy metal from water). It takes time and resources to test and validate samples, obtain regulatory approvals, and set up a new manufacturing process to produce at scale. All these are capital-intensive, time-consuming, and have no assurance of success.
3. A deep-tech startup follows a different development path than other startups. A deep-tech startup derives its IP from the underlying science. The startup has to work backwards and find a real-life problem that is worth solving using its technology and validate the adequacy and nature of the market demand for the innovation.

Therefore, deep-tech startups take more time, talent, and capital to develop, upto when commercial investors find them acceptable. The risk of failure is high at every stage for a deep-tech startup, usually higher than in the case of other types of startups. But the payoffs of successful deep-tech startups are tremendous. Think of Microsoft, Google, Apple, Intel, Tesla, Moderna, SpaceX, etc. They are large corporations today, but they started as mere technology bets not very long ago.

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India has also created a few deep-tech startups over the past decade, whose impact has been overwhelmingly positive. It lends credence to the suggestion to step up policy and financial support to the deep-tech startup ecosystem.

Creating Ecosystem

India has produced about 94 unicorns so far, but barely any of them can claim to be a deep-tech startup. We have several venture funds in India, but most pursue relatively 'lower risk' investment opportunities that exploit India's growing consumption economy or those making cloned products. While India has a problem of inadequate R&D expenditure for an economy of her size, there is a sufficient amount of high-quality research in India's top STEM colleges to fuel a deep-tech startup revolution. Some key reasons why our academic researchers lag in their potential to convert research into deep-tech startups are:

1. There is inadequate appreciation amongst policymakers and university administrators for the need to build capacity amongst academic researchers, scientists, and STEM students in India to truly understand what entrepreneurship entails and what commercialisation of research means. Being formally trained in science and technology but not having adequate exposure to the real world of business/commerce, academic researchers conflate invention and innovation. There is a big difference between making a successful technological breakthrough in the lab and building a successful enterprise around it. Becoming entrepreneurial cannot be imbibed by reading or scholastic programmes but only through experiential learning and expert mentoring/coaching.
2. While Government has made good efforts to fund innovation in universities through programmes such as prototype development, filing for IPR, incubation, etc., few academics (<5%) commercialise their research by startups. A key point is that even if academics aspire to convert their inventions into enterprises, they do not have the mental make-up (the entrepreneur's mindset) or the knowledge of how to organise what they have and collaborate with others to get what they do not have/know. Many universities have set up incubators to help with this, but they are not adequately equipped or incentivised to commercialise research. Although they are not-for-profit entities, incubators look for startups that have a good chance to be commercially viable. With their limited budgets, incubators face a tough challenge to nurture startups to scale their revenues and become

attractive investment propositions. It is difficult (if not impossible) for incubators to engage more deeply with academics/researchers in labs and handhold them in crossing the early-stage valleys of death (e.g. finding proof of technology or proof of market). Incubators are vital for the ecosystem but their inbound supply chain needs to be strengthened.

3. Indian corporates and industries that are engaged with deep-tech startups do so only with those where technology is substantially developed or where revenues are visible. A majority of Indian corporates do not have knowledge or mechanisms for dealing with Open Innovation processes that our university/research institutions can potentially offer for creating deep-tech startups.

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It is being proposed that policymakers should introduce Customer Discovery and Customer Development programmes to develop deep-tech startups from academic/ research institutions in India.

In 2013, the US Government through the National Science Foundation[4] introduced the I-Corps programme[5] with great success to commercialise academic research in US universities. Quoting from NSF: "The I-Corps program uses experiential education to help researchers gain valuable insight into entrepreneurship, starting a business or industry requirements and challenges. I-Corps enables the transformation of invention to impact". The most significant risk for startups is not failure of technology but failing to get adequate customers. The I-Corps programme is mandatory in the US for startups to obtain federal funding for research/commercialisation.

Analogous to the I-Corps programme, the Government of India should consider making it mandatory for every translational research proposal at a university/research institution or a deep-tech startup seeking admission to a government incubator to undergo a rigorous Customer Discovery exercise. The learnings at such a programme can be truly transformative.

The Gopalakrishnan-Deshpande Centre for Innovation & Entrepreneurship (GDC) at IIT Madras has successfully run its I-NCUBATE programme for the past four years and trained over 170 deep-tech startups from over 50 colleges/incubators across India with excellent outcomes. The I-NCUBATE programme is inspired by the I-Corps programme. The empirical evidence of I-NCUBATE programme for success is described below:

1. Every participant startup in I-NCUBATE, without exception, found its innovation as not a good fit for the market. They would tweak their innovation or pivot it to become relevant. Two-thirds of startups found their early adopter customer segment in this manner. This puts them on a strong footing to build their prototype/MVP and provides insights into a good business model.

2. The remaining one-third of teams that do not find a "problem to solve" for their innovation have two outcomes post I-NCUBATE. Around 50% continue their Customer Discovery exercise and end up finding their early adopter customers. The residual 15% of teams conclude there is no problem to solve– i.e. their innovation is unlikely to succeed in the marketplace. This is not a failure (which is how incubators or investors would conclude) but actually a very good outcome for the researchers. Had they gone ahead with building their startup (without having done the I-NCUBATE programme), they would have spent 2-3 years on it, spent money and other inputs and then encountered failure.

3. The Customer Discovery exercise helps researchers know in 8 weeks (rather than learn it the hard way in 3 years) if their innovation has a market, or how they should shape their startup journey to maximise chances for success. A "No-Go" is one of the best outcomes a researcher can get from the I-NCUBATE programme.

Conclusion

Unfortunately, very few researchers and startup founders in India conduct a robust Customer Discovery exercise. This is more due to a lack of awareness and appreciation amongst policymakers of its transformational impact on the researchers/entrepreneurs. By linking development grants/seed investment programmes for deep-tech startups with a robust Customer Discovery exercise, we can create in India a significant amount of deal flow of robust and curated deep-tech startups into incubators and the ecosystem. More importantly, a fair share of deep-tech startups will help in solving India's hard challenges. ❑

(Views expressed in this article are personal.)

References

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