



Inputs to TRAI's Consultation Paper on Encouraging R&D in Telecom, Broadcasting, and IT (ICT) Sectors

Education and Training System

Q.1. Whether current education system adequately promotes scientific temper and skills among students encouraging them to contribute towards Research and Development activities in ICT sector? If yes, please indicate what additional measures are needed to make them effective contributors of innovations to the industry. If not, please identify areas which need to be strengthened to orient students towards research and development activities in ICT sector.

A.1. Education and research cannot be two separate streams, instead they should be handled together by educational institutions. After independence, on one hand, we have created a chain of higher educational institutions like IITs, IISc, IIITs, NITs etc and on the other hand we have also created chain of research institutions and laboratories in the form of CSIRs etc. Both being visionary endeavors, Education and Research haven't converged in general. Generally, in the countries like South Korea, Japan, Israel etc. education and research have been institutionalized in the same institution and these nations have done exceptionally well in the domain of Education and Research and Development Activities in ICT sector. There is a need for imbibing the learnings from these nations and introduce some structural change to see that education and research are convergent and done together under single institution.

The employability and quality of human resources that are coming out from the institutions depends primarily on the quality of faculty. Somehow, the quality of faculty in the tier-II and tier-III institutions have not been good. It is because we fail to attract talented and meritorious students to pursue academic field and hence, we find the average students, after passing out, are taking the teaching jobs. And this trend has the most alarming impact on the quality of students taught by them. There is need for having some path breaking initiatives to attract the most talented students to come to the academic field, to create next generations of exceptional faculty, otherwise this will keep on impacting the entire output of such institutions in the negative manner. The talented and meritorious students should be properly supported and incentivized to venture into the academic field.

Good faculty is not coming or being attracted to Indian education system as the good faculty look for research support & research fund along with teaching. Unless educational institutions have research infrastructure and funds, quality faculty will not come. So, unless and until we incentivize the faculty with lots of research opportunities, resources, and research grants (fund), we cannot attract good faculty and as a result, our products (students) will fall short in quality and employability.

Q.2. What should be done to further strengthen the roots of R&D ecosystem in general and specially in the ICT sector of the country, which allows:

- a. Increase in number of post-graduates going for doctoral and post-doctoral programs in institutions other than IITs?**
- b. Assured career progression opportunities in the field of Research and Development for students graduating from tertiary educational institutions?**
- c. Researchers to continue entire career in advanced research.**
- d. Increase in employability and career progression skills of students enrolled in STEM courses?**

A.2. Once an Institution proves its credibility in terms of high-quality faculty / researchers and infrastructure, industry would be happy to partner with the institutions for contract research / joint research etc. including recruitment of postgraduates / doctorate for doing R&D in industry. This will create a pull for more and more talented students to come into research. Industry should be attracted to partner with institutions for sponsoring PhD students by topping up Scholarship amount to PhD students for doing research in industry-given areas with flexibility.

To encourage more and more industry investing in R&D and recruiting more PhDs, the Government should also incentivize industry in sharing the risk of R&D, in some form. Unless we create a huge demand from



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industry for recruiting large numbers of PhDs, we will continue to see the decline of number and quality of PhD students.

In the education outputs, we should possibly aim for a substantial increase in Gross Enrollment Ratio (GER) in higher education from the current 27% to 50%. We aspire to see India's 50 STEM (Science, Technology, Engineering, and Mathematics) institutions in the list of QS World University Rankings. There must be a substantial increase in the number of "quality" PhDs in STEM and an improvement in Citation Index. We would also like to see a significant increase in R&D professionals, say 50 R&D personnel per thousand employed in India.

Q.3. What measures should be taken pertaining to the tertiary institutions with a focus to encourage students towards advanced R&D at the university level?

A.3. Answer included in A.1 & A.2.

Science System

Q.4. Whether current science system (network of public and private institutions involved in the production and consumption of R&D and innovation) is sufficient to foster R&D and innovation in India in general and ICT in particular? If not, what additional measures are required to strengthen science system of the country and ensure availability of adequate resources for the same? Please support your answer with justification and best practices being followed in India and abroad in this regard.

A.4. Answer included in A.1 & A.2.

Q.5. How can the participation of public sector enterprises involved in R&D be augmented towards a synergized national effort in research, development, and innovation in ICT? Please support your answer with justification and best practices being followed in India and abroad in this regard.

A.5. A few Public sector enterprises in India have heavily invested in R&D and have grown to Navaratnas in the past. However, this phenomenon wasn't embraced by other PSEs and we all can see the conditions of many. In fact, PSEs should have been the torchbearers of Industrial R&D and Institutional partnership. Going forward, the following actions could be considered by the PSEs in this regard:

- a) PSEs should be tasked to develop critical platform technologies of national priority / security in the respective sectors in time-bound manner.
- b) A consortium of national research institutions & educational institutions should be constituted to be the partners in this technology development program.
- c) The government should share 50% investments (with balance 50% coming from PSEs) required for these technology development programs.
- d) Research institutions will provide researchers and research infrastructure.

Q.6. What should be the prerequisites and key characteristics of an effective next-generation technology testbeds in India? Will defining national-level mission and strategic objectives for ICT help in their effective utilization? Please support your answer with justification and best practices in India and abroad in this regard.

A.6.

Q.7. What role do you envisage for the service providers and industry in facilitating indigenous R&D in the ICT sector respectively?

How can industry participation in R&D in the ICT sector be further improved? Please support your answer with justification and best practices in India and abroad in this regard.

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- A.7.** The same model as described in A.5 can be explored for the Private Sector.
- Q.8.** **How Telecom Centres of Excellence (TCOEs) can be made hubs of innovative product delivery to telecom industry? What can be done to further strengthen the TCOEs in order to provide an impetus to innovations in the telecom sector? Please support your answer with justification and best practices in India and abroad in this regard.**
- A.8.**
- Q.9.** **Is there a need to establish new Centres of Excellence for the broadcasting sector? What can be done to synergize telecom and broadcasting sectors for the objective of convergence? Please support your answer with justification and best practices in India and abroad in this regard.**
- A.9.**
- Q.10.** **What are the reasons behind MNCs primary focus on software rather than hardware in India? What measures can be taken to promote basic/applied research by MNCs strengthening the current R&D efforts in software and improving R&D efforts in hardware? Suggest a suitable mechanism to establish a balanced R&D Science System in the country.**
- A.10.** For some reason, we didn't recognize the contributions made by the MNCs in India's R&D ecosystem. We always felt MNC's are creating technologies with Indian brain. But MNCs have immensely contributed to India's R&D landscape by imbibing R&D culture in Indian industry and by training Indian R&D professionals. We need to recognize these valuable contributions made by the MNCs and involve them in creating solutions for local needs as well as for the world. We also need to build a confidence in the minds of MNCs about the protection of IP (primarily Patents and Design) to attract them in investing in Hardware development. We should aim to double the foreign investments in R&D infrastructure and co-development of technologies in India.
- Q.11.** **What are the steps required to strengthen government-industry- academia linkages in the ICT sector on long terms basis? Please support your answer with justification and best practices in India and abroad in this regard.**
- A.11.** The bottom-up model to strengthen government – industry – academia linkages did not work since independence. This is time to explore the top-down model, and this may work, as mentioned below:
- a) Prioritize (in consultation with all stakeholders), 10 technology development programs in ICT sector during next 5 years.
 - b) Create consortiums of industry, institutions, and Govt. for each program, with private sector leading each program.
 - c) Government to provide 50% funding support and the balance is brought by consortium partner industries.

Regulatory Framework: Policies and Programs

- Q.12.** **Whether the current institutional mechanism is adequate to cater to the needs of R&D in ICT sector in India? Is there a need to create a separate agency to coordinate and look after R&D functions specifically in ICT sector? If yes, suggest a suitable framework for the overarching agency. If not, how can synergy between stakeholders be established to ease out processes and monitor timebound R&D outcomes? Please support your answer with justification and best practices being followed in other sectors nationally or internationally.**
- A.12.** We have more institutions than what we need. What we don't have are the appropriate delivery model, ownership, and performance review system cum actions.
- Q.13.** **What steps must be taken to ensure a transparent mechanism for adequate and timely disbursement**



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of funds for R&D programs? What should be indicators for the tracking mechanism for the funds and outcomes of R&D programs? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.

A.13. We have more institutions than what we need. What we don't have are the appropriate delivery model, ownership, and performance review system cum actions.

Q.14. How can participation of private sector in R&D be encouraged? Which incentivization model(s) or combination thereof would produce better results:

- (i) Tax-break model, or
- (ii) Product-Linked Incentivization model
- (iii) Any other model.

Please provide details of the suggested model(s) in terms of structure, functioning, monitoring, and evaluation.

A.14. To create global technology leaders, Governments in many countries provide special incentives to domestic companies who are seriously investing in R&D and product development.

Many countries have already enacted regimes like patent box to spur innovation and create domestic manufacturing jobs. Among the countries that have patent box regimes are China, Belgium, the United Kingdom, France, the Netherlands, Italy, and Belgium. A "patent box" is a term for the application of a lower corporate tax rate to the income derived from the ownership of patents. This tax subsidy instrument has been introduced in several countries since 2000.

During the last 15- 20 years, the telecom services have shown robust growth. However, in the absence of domestic manufacturing ecosystem, the growth of the sector was dependent on high import. As a result, Telecom equipment imports in FY 22 stood at INR 46,785 Cr and it is major contributor to cumulative electronics imports in India.

In absence of comprehensive government framework to boost domestic telecom products manufacturing, most of the companies are engaged in designing and very few are engaged in manufacturing. Insufficient govt. funding to boost R&D and lack of fiscal support (both capital availability and incentive structure) makes it difficult for Indian player to flourish and compete with global multinationals.

Special Support to create global champions in digital technology & communication sector. There is need for push to the Govt. for providing additional 5% Income Tax reduction to Indian Corporates over 2.5% of their turnover on Research and Development and filing Patents / Design in India. Also, 10 years Tax holiday on sales of products having Intellectual Property (Patents & Design) developed through R&D.

Q.15. Is there a need for a mechanism to promote research, development, and innovation at the state level? Will a ranking mechanism for the states help to promote the spirit of innovation? If yes, please comment on the structure of such a mechanism with key performance indicators.

A.15. All the Centrally funded Academic and Research institutions reside in states apart from state-funded institutions. However, the contributions of these institutions to the state's development and problem solving have been not satisfactory. These institutions should be mandated to address the State's needs in terms of technological solutions to problems and development. Govt funding support should be given to these institutions only when they address the state's issues as a priority. In such a scenario, state government will also be interested in working with these institutions hand in hand for the development of the states. Ranking of states has no meaning.

Regulatory Framework: IPR Framework

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- Q.16. How can awareness about IPR be increased among the researchers and industry in ICT sector? Suggest action points for making IPR as a part of syllabus in graduation /post-graduation level in colleges. Please support your answer with justification and best practices in India and abroad in this regard.**
- A.16.** The following actions can be taken:
- Engage experts and professionals: Invite experts and IPR professionals to guest lecture at colleges and share practical insights.
 - Encourage industry professionals to mentor students and promote IPR awareness. Collaboration with industry experts ensures practical relevance and industry-specific insights.
 - Provide resources: Develop and distribute IPR-related educational materials, including guides, videos, and e-learning resources. Establish online platforms for easy access to IPR information and updates.
- Q.17. What essential steps can be taken to further improve the speed and efficiency of the patent approval process for ICT in India? Please support your answer with justification and best practices in India and abroad in this regard.,**
- A.17.** The following steps can be taken:
- Prioritize ICT-related patents: Given the rapid advancements in ICT, prioritizing the examination of these patents can stimulate innovation and economic growth.
 - Collaborate with industry and experts: Collaborating with industry stakeholders and experts can lead to better understanding of ICT inventions, resulting in quicker and more informed decisions esp. in the areas of 5G, 6G, AI and blockchain.
 - Establish a dedicated ICT patent examination division: Creating a specialized division focused on ICT patents can lead to more efficient examination by experts in the field.
- Q.18. Is there a need to reduce the cost of filing patents in India? If yes, how can it be done? Please support your answer with justification and best practices in India and abroad in this regard.**
- A.17.** Yes, there is a need to subsidize the cost of filing patents (outside India) for domestic companies. Subsidizing the cost of patent filing outside India will encourage innovation, particularly domestic companies and allow them to develop patent portfolio that can compete with the global competition.
- Q.19. As far as the ICT sector is concerned, suggest measures to enhance filing of patents in India in general and by resident Indians in particular. Do we need a mechanism for handholding in patent filing? Do we need a mechanism of IPR sharing for collaborative research projects? Please support your answer with justification and best practices in India and abroad in this regard.**
- A.19.** We need to encourage for more filing of patents by the resident Indians. For example, making IP (primarily patents and design) as a mortgageable asset like physical property with due valuation. In such cases, industry or start-ups can mortgage IP assets to designated banks or financial institutions as collaterals and get funding / loan / working capital. The other way to encourage more IP filing would be to provide tax incentives on the sales proceeds for the products having IP embedded.
- IP sharing in collaborative projects should be left with the partners for mutual agreements.
- Q.20. (a) Is the Fair, Reasonable, and Non-Discriminatory (FRAND) mechanism for licensing of Standard Essential Patents (SEPs) functioning satisfactorily and effectively? Is there a need for any reforms in this aspect?
(b) How can small innovators be protected from the predatory practices?
Please support your answers with justification and best practices in India and abroad in this regard.**



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A.20. The FRAND mechanism heavily favors MNCs. The lack of transparency in the FRAND mechanism raises questions about whether it can adequately address emerging technologies, potentially depriving domestic industries of access to critical innovations.

Reforms should focus on making the FRAND terms more transparent and standardized, enabling equitable access to SEPs, especially in emerging technology areas. The European Telecommunications Standards Institute (ETSI) is continuously refining its guidelines for FRAND licensing, serving as a valuable model for adaptability. Strengthening legal mechanisms, such as antitrust and patent misuse laws, can be a shield from exploitation.

Q.21. (a) What additional measures should be taken to strengthen IPR dispute resolution mechanism to ensure confidentiality of the innovation and time-bound disposal of IPR-related disputes?
(b) How can Alternate Dispute Resolution (ADR) mechanisms for IPR disputes be improved?
Please support your answer with justification and best practices in India and abroad in this regard.

A.21.

Q.22. Whether there is a need to introduce IP-backed financing system in India for ICT sector? If yes, what could be the framework to recognize IP as a collateral? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.

A.22. Yes, there is a need to introduce an IP-backed financing system in India for the ICT sector.

- Establishing a framework to recognize IP as collateral can benefit innovation-driven companies seeking funds.
- Legislative Support: India must enact legislation explicitly recognizing IP as collateral for loans, ensuring legal protection and enforceability. It's a well-established practice in the US and Europe.
- IP Valuation and Due Diligence: Establish a system for accurate IP valuation and due diligence to assess the value of the IP assets.
- Lending Guidelines: Develop guidelines for lenders to evaluate the creditworthiness of borrowers based on their IP assets.

Global Leaders in R&D

Q.23. What measures should be taken to strengthen international collaborations in the field of STEM by the Government of India? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.

A.23. International collaborations in the field of STEM have been going on for decades in the academic and research communities. However, international collaborations need to be strengthened in the industry communities. While industry are collaborating with their overseas partners on their own, the Government may encourage and support such collaborative research through flexible platforms.

Q.24. What are the best practices which need to be adopted by India to promote private sectors investment in R&D activities? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.

A.24. Answer included in A.14.

Q.25. Is there a need to introduce avenues for continuing patents in India such as provisions like "Continuation-in-part Application" in the USA? Please support your answer with justification, strategies and best practices in India and abroad in this regard.



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A.25.

Q.26. In view of the best practices being adopted by the global leaders in R&D in general and ICT in particular, which are the policies, programs and incentives which need to be adopted by India? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.

A.26. Answer included in earlier section.

Key Learnings from International Experience

Q.27. What should be the regulatory framework for R&D efforts in the ICT sector for establishing an outcome-based measurable system? Please suggest changes required in the present laws or creating new policies or regulatory frameworks with regard to carrying out R&D, testing of products allotment of spectrum and commercializing of products in ICT Sector.

A.27. Answer included in earlier section.

Q.28. In the context of India, whether top-down or bottom-up approach, or combination thereof should be preferred to facilitate indigenous R&D? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.

A.28. Answer included in earlier section.

Q.29. Apart from the measures indicated under New Education Policy what additional measures should be taken to establish a framework at initial stages of education to encourage students for opting experiment-based learning (learning by doing), rather memory-based learning? Please provide your answer quoting the best practices being followed internationally.

A.29. Answer included in earlier section.

Q.30. What interventions are necessary at policy or governance level to facilitate the growth of knowledge-based industries in India with respect to ICT sector?

A.30. Answer included in earlier section.

Q.31. How educational institutions can be linked with industries on long term basis for basic R&D, development and commercialization of innovative products on self-sustainable model? Is there any policy intervention also needed? Please support your answer with the best practices being followed in India, or internationally.

A.31. Answer included in earlier section.

Q.32. Start-ups are carrying out some outstanding work in all kinds of industries. What additional incentives can be given to start-ups to take up R&D activities in the ICT sector? In this regard, will establishing an exclusive venture capital (VC) fund for ICT help startups in the ICT sector to flourish and prosper in India? If yes, please provide a mechanism for the same.

A.32. We should explore a completely different model than funding the incubators and the start-ups. We should encourage and incentivize subject-experts-cum-Venture Capitalists to establish subject-specific Incubation Centres where they will evaluate the potential start-ups before giving access to their Incubation Centre with an initial funding. The government may have a mechanism to enroll such Incubations centres based on credibility. Government may top up the funding such VCs will be investing in the start-ups. This model has successfully worked in Israel – the Start-up Capital of the world.



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- Q.33.** Suggest ways and means to improve the acceptance of Indian technological innovations globally? Do you envisage the need for a Technology Transfer Organization at the national level to help towards commercialization of innovations in ICT? Please support your answer with justification, frameworks and best practices in India and abroad in this regard.
- A.33.**
- Q.34.** ICT sector is enabler for fin-tech, health-tech, ed-tech and a host of other applications. In such a scenario, what should be the specific focus areas for R&D in ICT sector? Please support your answer with suitable examples or frameworks and best practices in India and abroad in this regard.
- A.34.**
- Q.35.** Is there a need for additional tax or fiscal incentives to support R&D activities in emerging technologies in ICT sector? If yes, please give suggestions with justifications and best practices in India and abroad in this regard.
- A.35.** Answer included in earlier section.
- Q.36.** What should be the best practices followed in India to make it a favourable destination for IPR and Patent award nation? Please support your answer with justification, frameworks and best practices in India and abroad in this regard.
- A.36.** We need to strengthen our IP enforcement in a stringent manner to gain the confidence of global technology leaders.
- Q.37.** What measures should be taken for quick disposal of IPR or Patent related disputes? Is there a need to create a specialised legal platform for the same? If so, what steps may be taken to adopt them? Please provide your answers for above questions, quoting the best practices being followed globally.
- A.37.**

Others

- Q.38.** Please comment on any other related issue to promote R&D in the ICT sector in India. Please support your answer with suitable examples and best practices in India and abroad in this regard.
- A.38.** The much-awaited National Research Foundation (NRF), a high-powered apex body, is in place, with a budgetary allocation of INR 50,000 cr. for five years, to provide high-level strategic direction of scientific research in the country. Many past "ahead-of-time" research funding bodies like Technology Development Board (TDB); Science & Engineering Research Board (SERB); Global Innovation & Technology Alliance (GITA); Biotechnology Industry Research Assistance Council (BIRAC) and a few others have fulfilled their purposes quite well. However, neither of them was mandated to have a broader vision or strategy to transform the research & innovation landscape and take the country towards a knowledge economy, and with the formation of NRF, this looks now possible.

It would be good to have a similar body focusing on R&D in Telecom, Broadcasting, and IT (ICT) Sectors with a similar budget allocation of NRF.

A robust "education-research-innovation" or knowledge-economy ecosystem of a nation enables its intensity, speed, and efficiency of economic and social development, touching every citizen. Many countries in the



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western world and a few in Asia have proved this by prioritizing knowledge-economy ecosystem with strategic planning, high degree of seriousness and resources and got immensely benefitted.

India being one of world's finest talent sources, having high quality education and research institutions and infrastructure, with many champion industries around, has somehow couldn't reap the benefits for its overall development and attaining technological leadership. While India has done exceedingly well in space research and in a few others, it needs a tectonic shift in our strategy, policy, implementation mechanism and more importantly in participation of private sector, to take India to the league of top five knowledge economies in the world.

Time has come now, to start the strategic planning process other way round, starting with impacts we are aspiring for, and then defining the outputs that will bring those impacts, and finally what are the inputs required for delivering those outputs. Let's go into the details of this reverse planning process focusing on R&D in Telecom, Broadcasting, and IT (ICT) Sectors.

As a step one, for any nation to strengthen its knowledge economy ecosystem, it needs to have some time-bound and measurable socio-economic impacts, upfront. What are the key socio-economic impacts we wish to see from a strong knowledge economy ecosystem in India? While there could be many impact-aspirations, but just for example, we can aspire for impacts like increase in India's value-added manufacturing from current 13-15% to 25% or more of GDP and increase in India's High Technology exports from current 10% to 25% or more of total manufactured exports coupled with substantial improvement in India's charges for intellectual property, Receipts (BoP). We should aim for doubling the foreign investments flowing into India in R&D infrastructure and co-development of technologies. There must be a concerted effort to transform some Indian champion industries to be the global champions and brands in key industry sectors where we have already crossed the thresholds. And the key impact, we should aim for is significant increase in high value employments in India. Additionally, these impacts should also be viewed on the backdrop of how we are performing vis-à-vis other competing economies. Therefore, we can set our target to move India's rank up to be in the top 5 nations in relevant global indices or rankings like Global Innovation Index, Global Competitiveness Index, ICT Development Index, Global Startup Ecosystem Index, World Intellectual Property Indicators, etc. These impacts or aspirations once set, should be periodically measured to confirm the progress in the right direction.

Once the aspirations cum impacts are set, as a step two, there is a need to strictly define the outputs of knowledge economy ecosystem those will eventually be instrumental in ushering these impacts as mentioned above. In the education outputs, we can possibly aim for substantial increase in Gross Enrollment Ratio (GER) in higher education from current 27% to 50%. Our aspiration should also be set on seeing India's 50 STEM institutions in the list of QS World University Rankings. There must be substantial increase in "quality" PhDs in STEM, and improvement in Citation Index. We would also like to see significant increase in R&D professionals, say 50 R&D personnel per thousand employed in India. One of the major outputs on R&D & Innovation could be co-development of critical platform technologies in the national priority areas / sectors. This will lead to significant increase in yearly filings of Intellectual Property by Indian residents from current 30,000 to 75,000 Patents and from current 20,000 to 50,000 Industrial Designs. We should also aim for significant increase in deep-tech Start-ups every year.

Once the impacts and outputs are defined, as a third and final step, we need to figure out what are the inputs needed and fundamentals are to be in place to ensure these outputs. This could be broken into three subsets – Institutional Reforms, Investments and most importantly Political will and Restructuring.

In terms of institutional reforms, some of the key actions could be aligning all public funded R&D institutions and educational institutions under one umbrella with performance-based funding. This should be followed by creating consortium or alliance of R&D and academic institutions of similar subjects/ sectors for infra & manpower sharing and to avoid duplication of research.



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Investments into the knowledge economy is the most vital enabler and some of the ideas are increasing govt investment in R&D from current 0.7% to 1.5% of GDP from which 0.5% can be invested in basic and fundamental research in the institutions and 1% in applied or industrial R&D with matching investment from industry. The industrial R&D programme should be led by the industry where the line ministries and the state governments should also invest. Thus, Gross Expenditure in R&D (GERD) will be 2.5% of GDP that is comparable to some knowledge economies. There must be significant increase in Govt investment in Higher Education. The education sector's reforms attracting private sectors and foreign education providers would be vital. To encourage more technology driven MSMEs, Govt may provide credit guarantee to Banks/Financial institutions who will extend credits to MSMEs against Patents/Designs (intangible property) as a collateral. The government may develop a model to co-invest, along with Venture Capitals on 50:50 share, in Deep-tech Start-ups. Reforms in Public Procurement Policy will be another important enabler to encourage innovation and start-ups.

This is a big opportunity for India to unleash its knowledge prowess to be one of the top knowledge driven economies in the world during this "Kartavya Kaal".