

Role of Science, Technology and Innovation Policy in Transforming National STI Ecosystem: Indian STIP Study

Mansimran Khokhar, Radhika Trikha, Sheeraz Ahmad Alaie, Nirmala Chongtham

Abstract— Science, technology and innovation (STI) are the key factors driving socio-economic progress worldwide. The emergence of a pandemic has forced the countries to reorient their STI frameworks to successfully push around the effects of COVID19. India, through its STI Policy initiative has made an effort to reinvigorate the STI ecosystem and make it technologically self-reliant. The STIP draft has brought out principles catering to various themes and domains such as 'Open Science, Capacity Building, Financing STI, Research, Innovation and Entrepreneurship, Technology Development and Indigenisation, Equity and Inclusion, Science Communication and Public Engagement, International S&T Engagement, STI Governance and STI Policy Governance' that fall under the STI umbrella. The Draft includes individual chapters that provide aspirational inputs for strengthening each theme to achieving technological growth in tandem with national needs. The present article discusses the strengths and lacunas of the STIP draft along with articulating the additional policy recommendations and implementation points.

Index Terms— Science, Technology, Innovation, Research and Development (R&D), Policy, National Strategy

1 INTRODUCTION

THE COVID pandemic has acted as a wake-up call to every nation worldwide to reorient and strategise their socio-economic and emergency preparedness. Science Policy, for any nation, is of predominance because it embodies the efforts made towards achieving the aspirations of the country and its people. Generation of new knowledge and its application for development of the country is the major goal of a science policy. India's upcoming fifth Science, Technology, and Innovation Policy (STIP), at this crucial juncture, aims to renew national priorities and capabilities by invigorating and strengthening the science, technology, and innovation (STI) ecosystem.

The present policy draft of STIP India, is a joint initiative launched by the Office of the Principal Scientific Adviser (O/o PSA) to the Government of India and the Department of Science and Technology (DST), Ministry of Science and Technology, Government of India. The STIP Draft was released on public platforms through DST, O/o PSA, Science Policy Forum, and My Gov websites, respectively on 31st December 2020, for wider public feedback (<https://dst.gov.in/draft-5th-national-science-technology-and-innovation-policy-public-consultation>).

In these clamorous times, the STIP document brings forth a hope of achieving multi-fold growth in various domains and also recognises the imminent opportunities as well as challenges. The draft has been prepared in a manner to include everything possible within the ambit of STI and is an all-inclusive one.

However, one can't help but fear if the propositions set out are realisable. The propositions will stand realisable once STIP Implementation Strategy is placed in coordination with Ministries and States. Following section highlights the opinions of the authors on the propositions of the STIP draft according to respective chapters. The authors have made an attempt to collate major policy directives that could be incorporated into the current form of the draft addressing key missing STI issues along with some suggestive points that can be taken into an 'Implementation Strategy' of the documented STI Draft. This article presents a brief background of science policies in India till date; a panoramic view of new STIP draft and suggestive recommendations as well as implementation points, respectively.

2 BACKGROUND

Science and Technology (S&T) development in India, as an activity has been perpetual since the early centuries. Dynamic planning of towns, roads, and drainage systems has been operative since the Indus Valley Civilization however, it was only after independence, that the five year planning scheme was initiated and thus S&T emerged as areas of critical importance. It was under the leadership of the first Prime Minister of independent India, Pandit Jawahar Lal Nehru that the first policy was released – The Science Policy Resolution (SPR) 1958. A foundation for generating 'scientific temper' and 'scientific enterprise' was laid through this policy, which also aimed at transforming the country in a socio-economic manner.

The second 'Technology Policy Statement' (TPS) came in 1983 and focused majorly on achieving self-reliance and technological competence. Generating vast amounts of employment and

developing technology that was competitive internationally was also the focus of that Statement. Despite having some very strong recommendations the goals of TPS weren't realised due to the lack of inclusivity with other policies and regimes in the nation. Subsequently, came the Science and Technology Policy of 2003, which contributed towards bringing prominence to the benefits of S&T and additionally brought to attention the need for financial investments for advancing R&D. The 2003 Policy also included programs for the integration of socio-economic sectors with the national research strategies for addressing the national needs.

The years 2011-20 were declared as the 'Decade of Innovation' and in 2013, Science, Technology and Innovation Policy was rolled out. This policy recognised STI as the major drivers of national growth and aimed at a rather sustainable and inclusive development. It set the paradigm of 'Science, technology and innovation for the people'. With an aim to establish a robust national innovation system, this policy along with other relevant policies did lead to enhancing India's representation globally. However, what may be termed as discrepancies in implementation and change in political dimensions in the country, it did not do for the economy and STI landscape what the country had hoped for. In order to cope up with the Science Policy discourse limitations, formulation of STIP 2020 was initiated.

3 PANORAMIC VIEW OF STIP 2020 DRAFT

'The STIP Draft is guided by the following broad vision (i) To achieve technological self-reliance and position India among the top three scientific superpowers in the decade to come; (ii) To attract, nurture, strengthen and retain critical human capital through a 'people centric' science, technology and innovation (STI) ecosystem; (iii) To double the number of Full-Time Equivalent (FTE) researchers, Gross Domestic Expenditure on R&D (GERD) and private sector contribution to the GERD every 5 years; (iv) To build individual and institutional excellence in STI with the aspiration to achieve the highest level of global recognitions and awards in the coming decade'.

The policy outlines key big-ticket ideas that will play a significant role in strengthening India's STI ecosystem and make it globally competitive. The key aspects addressed in each chapter are outlined below.

The first chapter of the policy '**Open Science**' as elucidated by its name highlights promotion of open science, and the strategies for providing all kinds of data including scientific findings/related data of publicly funded research, open under one platform 'National STI Observatory'. The concept of 'One Nation One Subscription' and 'Open Science' are recommended to bring fair and unbiased participation in science by providing enhanced access to outcomes of research, creating a system with increased clarity and answerability in research; judicious use of resources by enforcing least possible restraints on reusing the outcomes of research, and warranting continu-

ous flow of knowledge between the producers and end users. The proposed Open Science Framework aims at making the STI related data more accessible, transparent and in a more streamlined manner for improving research and education systems.

The proposals stated though seemingly unreal, are propitious, e.g. the vision of a Central Repository such as the National STI Observatory. The policy overlooks the addressing of data related to continuation of projects undertaken at Ph.D. level and if they were continued further to the level of commercialisation. Additionally the subject of 'Mapping/Matching Expertise' (for commercialisation as well as advancement of project/technology) has also been forsaken while enunciating open science. The policy of Open Data for all Ministries, Funding Agencies, and Allied Government Bodies should have been addressed by the 5th STIP. The data and statistics of Indian R&D as generated by the government should also be added to the proposed INDSTA portal. Another farfetched proposal is the One Nation One Subscription proposal. However, until the said proposal is accomplished, the public funded R&D labs may be mandated to share their subscription with the Universities and other academic institutions (regionally or at State level). This will ensure a rather justified usage of public funds. A step in improving the awareness and visibility of Indian Journals may include reviewing the editorial committee of the said Indian Journals along with regulating the timelines for processing submissions. The proposed computational grid for research activity would require high connectivity and a comprehensive development and execution environment. This is to ensure that there is appropriate usage of resources at multiple domains to gain maximum benefit. Additionally, to develop a robust computational grid system it is necessary to employ the mechanism of 'Distributed Systems' to execute this in an efficient manner, creating a computational grid in each state which will be a part of the national grid seems to be a prudent approach. It is necessary to keep into consideration the uniformity of resources irrespective of the location of the user. This type of network creation will also bring forward prospects for collaboration and advancement in technologies.

The second chapter '**Capacity Building**' concentrates on proposals to improve learning outcomes and the need for advanced technologies and the capability to build them. To develop a system that is self-reliant, this chapter refers to developing skill and intellectual capability for achieving STI goals. The STIP draft is in conformity with the New Education Policy (NEP) that has been promulgated. Both the policies foreshadow each other in envisioning India as a forward looking country on the strength of its scientific prowess. Additionally, both the policies delve on reforming the education and research panorama at all levels of education, substantially. The chapter focuses on enhancing quality of research, nurturing

STI in the educational sector, introducing STI training and mentoring services and building STI infrastructural base. Critical interventions include, (i) Research Excellence Framework for Higher Education Institutions (HEIs) [REFI] for assessing research contribution of the academic sector on parameters, such as translational value, impact generated on industry, citation, etc. (ii) Creation of Engaged Universities for undertaking multi-disciplinary research for addressing needs of the community, (iii) Establishment of Collaborative Research Centres (CRCs) for bringing the private sectors (corporates, industries, medium and small scale entrepreneurs, start-ups), academia (R&D institutions, HEIs) and the government together for improved industrial research and innovation, (iv) Establishment of Teaching-Learning Centres (TLC) for better teaching-learning processes, effective pedagogies, innovative curricula, and innovative faculty development programmes to improve the overall quality of education. Upscaling and maintaining high end infrastructure has also been addressed through proposing establishment of autonomously managed, self-sustaining equipment infrastructures in the country.

The policy draft discusses building STI capacity at all levels of the educational sector but misses out on involving the associated domains which are imperative for making a science policy success. The effective inclusion of management, social and economic experts is the missing link. Example - The Cluster School & Innovation Hubs as mentioned in the policy have no mention of any management or legal institutions for enhancing interdisciplinary, multidisciplinary, translational research and entrepreneurship programmes. To enhance the flair of IP generation in the country, the existing Patent Information Cells (PICs) may be mandated to develop and operate a user-friendly portal for submission of ideas from the local regions including the suburban and rural areas. The portal may be used by any individual to submit an idea, which can then be vetted by a dedicated team at PICs.

The policy draft in general refers to the creation of a lot of new structures and new regimes. However, rather than harping on the establishment and creation of new institutions/centres focus should have been laid on strengthening the existing intellectual and infrastructural framework. The proposal of development of new 'Collaborative Research Centres' has been brought up whereas, there are a large number of public research laboratories/institutions which are undertaking excellent research and also have good linkages with the private sector. The focus should now be laid on strengthening these labs/institutions and link them with the already established 'Technology Enabling Centres' to ensure translation of research outcomes. The upcoming Immersive Technology can be used to create a personalised learning environment which will not only help students with specific learning disabilities but will also help every student in better understanding of the topic at their own pace. It will also generate interest among the

student section and will pave ways for creation of new jobs for the development of the environment.

The third chapter '**Financing in STI**' deals with the proposed reforms for financing the R&D through the public/government sector. As per the Draft, a central STI Financing Agency will be brought into force for financial governance of the national STI landscape and a 'Corpus Fund' will be established for investing in STI ventures. Besides, augmentation of the overall budget by the ministries has been proposed and long term investments in strategic areas will be made through an 'STI Development Bank'. To incentivise the private sector, governance and accessibility will be streamlined and additionally a model in which General Financial Rules may be modified/waived off for large-scale projects in mission mode will be tried out. The chapter lays a foundational support for innovative models for STI financing under hybrid model including both public and private sectors through ADMIRE programme.

The policy directives for incentivising STI investments through fiscal and financial support mechanisms is quite welcoming. The chapter articulates increasing extramural funding in order with the national priorities, which may be kept higher in amount for collaborative projects to foster increased participation of the private sector. It is also suggested that the guidelines and rules applicable to the utilisation of public funds be unified across public research institutions, universities and R&D organisations. The concept of Innovation Bonds and Social Impact Bonds should be strengthened. In context to introducing the concept of Innovation Bonds, where debt financing is offered by a local company to support local talent, the policy should have clarified on whom shall the onus of making the project a success fall, or who shall be answerable in case of genuine failure.

An intervention which is due in the Indian system and not addressed by the policy is the auditing of finances and R&D of the government and allied agencies/projects be undertaken by external evaluation agencies akin to the practice in a few advanced nations. R&D Budget of the scientific ministries and its agencies should be allotted out as per their STI performance. Micro-financing through end-users is another concept not addressed by the policy e.g. a central crowdfunding platform like 'Kickstarter' that will allow the end-users to finance interesting projects. To boost private sector investment, tailor-made joint research projects may be permitted that fulfil the private sector research needs as well as simultaneously leading to PhDs.

The fourth chapter '**Research**' deals with the aspects related to the significance and aspiring need of pursuing effective R&D in line with national priorities and ensuring commissioning of quality R&D through Research and Innovation Excellence Framework (RIEF). It focuses on expanding the

S&T ecosystem by promoting foundational and translational research. The STIP document lays impetus on pursuing research through mission mode programmes in key priority sectors, building a collaborative network for R&D wherein government, academia, and industry work in sync to address local and national needs at ministerial, institutional and individual levels.. There is an increased focus on attracting talent in the field of R&D by means of joint appointments, mentoring and incentivisation programmes. A Section on 'Engaged Research' brings to our importance the means of creating a strong engagement between STI stakeholders by undertaking collaborative R&D activities along with focussing on creating a conducive environment for ease of doing research at individual and institutional levels.

The lack of S&T connection between academia and industry is clearly highlighted and to achieve success in this aspect, the policy should have verbalized the engagement of user-stakeholders from an early development stage, particularly for technology projects. Establishment of dedicated cells consisting of legal advisors, industry persons, etc. to facilitate the translation of innovative ideas into patents/technologies for commercialisation, should have been mandated by the policy. Additionally, in the Indian scenario, the quality of research has to be ascertained to compete with the global standards. Even though all the research titles of proposed PhDs are approved by the Research Council there is still duplication of work and thus wastage of resources. The approval criteria should be made stricter viz-a-viz the topic of research to avoid repetition of work. Additionally, each researcher should be mandated to provide credentials for either direct or indirect commercialisation of the proposed research work.

The fifth chapter on '**Innovation and Entrepreneurship**' deals with three focus areas a) strengthening the overall innovation ecosystem in the country, b) fostering S&T led entrepreneurship, and c) promoting, facilitating, and integrating grassroots innovation along with traditional knowledge systems in the national STI ecosystem. It brings out a strong recommendation for creating an inter-linked innovation ecosystem where all the stakeholders identify with and prioritise their role and responsibility. The chapter focuses on strengthening existing and creating new innovation supporting assistive mechanisms and fostering cross-learning, building technology parks, entrepreneurial training, etc., which are crucial initiatives but rather than building new technology parks the existing ones may be first overhauled and be supplemented with proficient experts until they generate benchmark results. Additionally, it becomes imperative to provide vocational education and training for development of both cognitive and non-cognitive skills to individuals across the nation.

The chapter also presents recommendations on the creation of an optimised entrepreneurship supporting ecosys-

tem in the country that will also take into consideration the sharing of systemic risks, accessible resources, regulatory guidelines, and financial support ecosystem for budding entrepreneurs. pressing recommendations for mainstreaming grassroots innovations and traditional knowledge systems through developing new funding mechanisms to support them, incentivisation schemes, strengthening resource management associated with traditional knowledge systems, and creating advanced tools to protect, preserve and promote traditional knowledge have been laid out.

Despite promising initiatives, the policy fails to cater to rural and remote areas which are packed with traditional knowledge, thus while implementing the policy it may be taken into cognizance that Knowledge and Research Centers be set up in sub-urban and rural areas. This will help in promoting innovation and traditional knowledge up to national and international level. Furthermore, the policy does not emphasize on showcasing Indian inventions, innovations, and work in progress to attract the best minds in the world. Innovation showcase-State wise can also be executed under sub heads such as TKS Showcase, Grassroot showcase, frugal innovation showcase, science and heritage etc. Facilitating Innovation and Entrepreneurship at all levels of education, State government and Centrally Funded State S&T councils can play a major role in creating innovation facilitating vehicles where students, young researchers and scientists can register and coordinate for developing innovations and nurturing entrepreneurs.

The sixth chapter on '**Technology Development and Indigenisation**' lays down the roadmap for creating technological self-reliant India. The government's impetus and urgency in promoting technology indigenisation at the forefront is apparent from the two-way approach - developing indigenous technology in the country and indigenisation of imported technologies referred to in the draft. . A lot of indifferences such as lack of an effective blueprint for technology development and its deployment, disparity in resources allocated, unavailability of skilled workforce, lack of interconnect between stakeholders especially the public and private, etc. are a few bottlenecks in the path of India achieving technological self-reliance. The Policy lays down the establishment of a technology development support framework which will drive indigenous technology development with a focus on developing strategic and sustainable technologies. The draft also gave a special mention to strengthen the Indian strategic sector by supporting institutionalising of 'Strategic Development Board' and formulation of 'Strategic Technology Development Fund' that will support the private sector along with HEIs to work for collaborative R&D in a strategic sector. But, the policy does not refer to any 'Exit Strategy' in projects. It also does not refer to any policy for 'genuine failures' in technology development. Technology failure is a global phenomenon, which has not

been addressed duly.

It recommends the creation of assessment and financial tools at the local, regional, and national levels to integrate sustainability in the technology development process and life cycle. The chapter lays emphasis on shaping India's technological advancements by giving recommendations in supporting and developing disruptive technologies, allowing spin-off technologies from defence research, however, no focus has been laid on mitigating the risks (societal & cultural) that may emerge out of technology adaptation or allowing technologies for civilian use. The Policy also has not stressed on a roadmap for incentivising industries to collaborate with academia right at the inception of ideas for technology development, neither does it denote or suggest carrying out the 'Validation of Technological Potential of Scientific Research' at institute or organisational level.

The chapter seventh on '**Equity and Inclusion**' (E&I) absorbs the essence of equity in the STI ecosystem addressing socio-economic and cultural biases existing in STI. The Chapter refers to inclusivity that needs to be improved in the STI ecosystem in India by giving equal opportunities to all the members of the community, any gender, any ethnicity, any cognitive ability, people with special needs, any caste, any geographical region, etc. With regards to gender, especially women, in the Indian context the issue of females uptaking science and engineering degrees isn't as pertinent as convincing them to retain their careers in science. It is evidenced that with increasing position of authority and leadership positions the percentage of women is curtailed. Thus, a major attrition is witnessed during the transition from pursuing degrees to making them into careers. For the same the policy should have suggested measures to alleviate the perceived loss due to the gap, the organisations/employing institutions may provide special training and mentorship to women to pursue careers in science. Enacting change in behavior and practice is the key to achieve inclusivity and equity. Provide leaders training to lead teams that are diverse in nature. It is difficult to remove generations worth of ingrained societal and cultural bias therefore establishment of regular workshops for sensitising the staff and for creating an environment that is more acceptable to diversity. Development of hubs to provide mentorship to women by women especially in roles of leadership in STI.

To allow further inclusivity, the policy articulates developing guidelines and India specific templates on the basis of Charters of various advanced countries. The policy refers to the Athena SWAN Charter, but does not mention or cite examples of any Charters explicitly on Caste/Disability/Geographical Inequality, etc. Most of the interventions mentioned in the policy are for the equity of gender, especially women. Inculcation of rights for LGBTQ+community is very welcoming as it is for the very first time any science policy in the country has considered STI op-

portunities and equal rights for LGBTQ+ community. However, as a comprehensive policy it should include all the communities that have been treated unjustly in the STI ecosystem. Development of an E&I Charter to address discriminations in STI participation based on religion, gender, caste, language, geography, disability, etc., and creation of more networks for outreach and mentorship in STI areas for discriminated groups. Other associated attributes such as recruitment, retention, and promotion with a special focus on ageism-related issues, work from home culture, spousal benefits, etc. along with development of dedicated frameworks and instruments for measuring and accessing E&I in STI. Abolishment of 'Ageism' is a crucial intervention. A large number of early grants/fellowships/positions mostly requires the candidates to be of ages 35 or less. This sort of restriction reprimands anyone who hasn't followed a traditional career path, which is particularly suitable to men in our society. Additionally, it is also the time to keep an account for childbirth in the fellowships/grants and provisions of extension wherever necessary. All professional career milestones, such as recruitment, awards and funding schemes, age cut-offs, if any, should be implemented considering academic age rather than biological/physical age.

Mandatory inclusion of women and other communities that have been treated unjustly in the panels (recruitment, project approvals, promotions, budget appropriation, etc.) will support the advancement of women and others at higher positions in STEM. Strong institutional policies will also help in mitigating the long term inequalities and social biases. The Dual Recruitment Policy is a welcome intervention, the policy however, does not touch upon the negative aspects of the same, such as creation of a biased working environment.

Audits of Institutions with regards to gender and diversity at all levels should be conducted. The institutions would need to provide information regarding the percentage of women/different ethnicities/cognitive abilities in the number of faculty/researchers and other staff. Evolving goals for inclusivity should be set up for institutions and rewarded suitably.

The chapter eighth '**Science Communication and Public Engagement**' addresses the recommendations for strengthening science communication and alleviating the present disconnect between science and society at large along with articulating the limited scope of engagement of citizens of the country in the STI ecosystem. Numerous promising interventions have been stated but what is missing is the requirement of both science, humanities and social scientists with their effective linking and communication system. This is because social scientists can better articulate the expectations of public and incentive public engagement in science activities. Policy should clearly come up with an implementation plan to include media as a stakeholder in every science communication strategy. Furthermore, it should have articulated on find-

ing correct vernacular words for scientific names as far as possible. Every year national and regional workshops for print and electronic media persons may be conducted.

One of the mechanisms recommended is promoting the establishment of creative and cross-disciplinary platforms, like community-centric programmes and regional science centers with proper infrastructure and updated databases that will aid in providing training and building capacity for science communication. Second mechanism includes identifying barriers and stereotypes and promoting science communication with locally relevant and culturally-context-specific research models. Third, the outreach mechanism highlights the 'Scientific Social Responsibility' approach where researchers/scientists along with NGOs and other civil society groups will be motivated and incentivised to engage in science communication and public engagement activities.

The chapter ninth '**International STI Engagement**' addresses the strategies for strengthening India's STI engagement globally. Pro-active and facilitating mechanisms have been mentioned in the policy draft to take India forward in defining the global S&T discourse. It focuses on the participation of India in global STI agenda setting and governance with strengthening engagement with United Nations (UN) agencies, Organisation for Economic Co-operation and Development (OECD) and World Bank groups, etc. along with bilateral, multilateral and region level engagements which will be sector and challenge based. The engagement in large S&T initiatives for developing cutting edge technologies, training scientific capital has been highly recommended. One of the mechanisms for S&T engagement put across is the diaspora collaborations, leveraging their untapped potential with rewarding initiatives for brain gain strategies and providing facilitating channels for non-returning communities (brain circulation). The policy recommends for the S&T role in foreign policy to be vitalised, membership in S&T focused strategic groups, counsellors, consortia and technology regimes to be pursued proactively.

An important intervention that may be implemented by the policy plan is the building STI diplomacy cadre: professional positions to be created in Ministries to strategise science diplomacy in policy research.

Popularising Indian research being undertaken in accordance with the SDG commitments on a consistent basis. If S&T Diplomacy and Internationalisation is a priority, provisions can be made in the policy to create a supportive environment for foreign researchers in order to encourage a diversity of talent and internationalisation. On the lines of fellowships for building intellect in science policy, workshops may be conducted to educate and impart training in the field of science diplomacy as well.

The tenth chapter '**STI Governance**' focuses on inculcating good governance practices for STI with an emphasis on administrative, financial and regulatory governance mechanisms. The chapter has rightly highlighted significance for creating a system interconnectedness across the STI ecosystem connecting all the stakeholders of the STI ecosystem. Though mechanisms like inter-sectoral, inter-ministerial, interlinked center-state, inter-state governance linkages have been envisioned in the Draft, for improving coordination among ministries, departments, organisations and the Centre and the States to strengthen national STI ecosystem, the draft does not refer to any key strategies for strengthening STI ecosystem both in terms of individual and infrastructural STI capabilities.

STI enabling environment with sector-specific regulatory frameworks and guidelines will be streamlined and an STI Policy Institute and other think tanks will be strengthened to perform technology assessment, foresight and advisory activities. Strong interconnections/partnerships among various stakeholders and developing end-user community linkages are to be established to ensure last-mile delivery of S&T led innovations. However, there is yet to be a mention of the urgency of requirement of a legal framework at the Centre and State levels for streamlining industry-academia connect. There is no reference of introducing any Acts, Laws and robust I-A Policies, as prevalent in the developed nations USA, S. Korea, Japan, UK, etc. These legislative and regulatory interventions will provide the right thrust to the innovation ecosystem, encouraging scientists towards translational research and garner rewards allied with innovations. Such a framework will act as a testimony to a nation's intent for stimulating PPP in the domains of R&D and innovation. Furthermore, this initiative will assist in sketching out the action plan of each stakeholder within the ecosystem.

The STIP draft also has not referred to any key/priority areas i.e issues that need to be dealt with imminently, viz-a-viz governance and jurisdiction. Clear identification of key areas for the country for the forthcoming decade is necessary to direct the STI resources and capabilities. Furthermore, STI in India is generalised by dysfunctional infrastructure and administration. The degree of autonomy varies in organisations and institutions leaving with no scope of levelled governance. Therefore, it is suggested that governance as well as implementation with regards to STI policy be defragmented and not be distributed to different 'Committees' or 'Agencies'.

The eleventh chapter, '**STI Policy Governance**' addresses the need of a robust STI policy governance system and setting up an institutional mechanism for STI policy research in different sectors to strengthen the evidence supported science advice mechanism. It recommends establishment of an 'STI Policy Institute' positioned within and governed by the apex-level STI governance institutional architecture with a mandate to serve all aspects of STI Policy governance. A cen-

tralized body may be established on lines of the 'Office of Science and Technology Policy (OSTP)' such as that in the USA. The Office should be monitored by an apex level committee and this task can be given to the already existing Prime Minister-Science, Technology and Innovation Advisory Committee (PM-STIAC). The role of National STI Policy Institute, as mentioned in the policy, should be widened by including institutional mechanisms functioning for implementation, monitoring and evaluation of science policies and promoting inter-linkages between various policies and programmes within sectors and ministries.

The Institute should work with think tanks and policy institutions as a hub at national and international level to strengthen the STI policy ecosystem and provide knowledge support for other STI planning, coordination, evaluation and capacity building. The Institute may also be mandated to maintain robust interoperable STI metadata architecture including inputs, processes, output, and outcome with monitoring mechanisms. The draft states that inter-sectoral linkages need to be strengthened by creating systemic synergy between scientific and socio-economic ministries and departments. For the same, STI policy Institute can be directed under the STIP oriented research institutes involving related ministries, hence integrating R&D governance to execute the synergised national STI and Policy related R&D programmes.

4 CONCLUDING REMARKS

The STIP envisions radical, transformational and impactful technological growth in the country. In order to fulfill aspirations of the policy, the government has to create an adequate implementation plan. The implementation strategy should be laid out with unison of all the line and socio-economic ministries and their associated departments. The Policy implementation plan should take into consideration the viewpoints of both the STI performers and STI consumers. An STI nexus needs to be built to achieve the aspirational goals spelled out in the STIP draft. It is imperative that during drafting the 'Implementation Strategy' of STIP, people from the domain of social science and economics take part in designing the implementation plan if the advancement envisioned is to be achieved in a sustainable and socially acceptable manner. The transforming and revolutionary ideas marked in the STIP draft can be a game changer in advancing the STI ecosystem nationally and globally and placing India in the top bracket of STI based global recognition. In addition, the emphasis given on indigenous technologies, traditional knowledge systems and grassroots innovations will play a facilitative role in highlighting Indian practices and resources that can be explored to address global and national challenges. This policy at this crucial juncture of Post Pandemic times will definitely set a new agenda for the country to vitalise STI for socio-economic and competitive growth.

Science and Technology promoting innovation can be produc-

tive only if the policy segment of the STI is grounded on the deep analysis of the nation's scientific and technological potential and the present and future needs. The earlier science policies of India have not properly fledged the scientific and technological cultural transformation which have resulted in dependence of science on governance and diplomacy within the country. In the recent policy, the policy and governance of S&T should be taken as a national priority under a very neutral political and power system.

(1)

DISCLAIMER: The authors wish to state that the views expressed in the present opinion article are solely of the 'Authors' and in no way are to be taken as views of the Department of Science & Technology, GoI or any of its allied Organisations/Centres.