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Author(s):	Krishna Ravi Srinivas, Amit Kumar and Nimita Pandey
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Abstract	This report contains a study on Responsible Research and Innovation (RRI) and the RRI Keys in India. It includes two case studies, one of a funding and policy making agency, Department of Science and Technology (DST), and one on a research university, Jawaharlal Nehru University (JNU). The study includes an analysis of the national Science, Technology and Innovation policy context. It shows that some of the RRI keys are part of the policy discourse and programs.
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## 1. Executive Summary

RRI is a novel concept in India. While the concept of responsibility as discussed in RRI literature cannot be found in science policy in India, by contextualizing the idea of responsibility one can discern some features that indicate that science policy in India is primarily concerned with S&T for societal and national development. On the other hand the new ideas of Scientific Social Responsibility (SSR) promoted by Department of S&T and the call for Responsible AI indicate that new ideas are gaining currency in policy making. This can create a conducive milieu for RRI if efforts are taken.

Over the years the strategies and policies have changed but some of the core concerns remain the same. The science policy has been sensitive to the changing dynamics in global S&T and to the need to harness emerging technologies. India's S&T and I policy is ambitious and questions have been raised as to whether the funding is commensurate with the aspirations and expectations.

Ethics, Gender, Open Access, Science Education and Public Engagement, the five keys are present in the science policy in one way or other. The terminology may vary but the objectives are the same. In recent years ethics in policy and practice has gained prominence in life/bio/health sciences and guidelines and rules have been updated, revised and rewritten, making most of the practices compatible with best practices in the world. Still lack of a comprehensive framework to deal with plagiarism, research misconduct and misappropriation is a matter of concern. Gender and participation by women have gained the attention of policy makers and academies of science resulting in specific policies and programs. But the lack of a comprehensive framework on this coupled with institutional, social and cultural factors act as a barrier. Open Access finds favor in terms of policies and initiatives but is hamstrung by predatory open access journals, lack of uniform policies and principles and the failure of institutions to work together in connecting silos and in making open access more meaningful and really accessible. Science Education in the Indian context is different from what the EC has defined in RRI. Still Science Education gets enough support in India from government although much remains to be done. Public Engagement is not explicitly supported in policy and is often treated as an equivalent of science communication. This is premised on the belief that there is a deficit in public understanding of science which should be addressed more by educating the people, communicating to them and enhancing their understanding and appreciation for science. Thus monologue is preferred over dialog or engagement although some initiatives have tried to reverse this.

Our research finds that DST as a funding institution and JNU as a research organization are potential candidates for taking RRI forward and in testing and implementing it. There are many favorable factors in both institutions although there are barriers and unaddressed questions.

DST as a funding organization and policy making department, is working on social responsibility in science and has policies/programs in gender, open access, science communication, and ethics although they do not come under any broad rubric. Never the less, the significance of these programs and policies and their long term impact on conduct of science and promoting innovation makes DST a unique organization. In our interactions and interviews it was noticed that scientists in DST were willing to discuss RRI and they had their own understanding of responsibility in science and the relevance of keys. Although DST may not fully accept RRI as a principle, in our view the RRI community can learn a few lessons from DST and should try to have a dialog with DST. We will continue our interaction with DST and try to learn from them as well as have an ongoing dialog with them.

JNU as a university and as a research organization can be an institution where RRI can be introduced and popularized given the level of awareness among the faculty and the overall progressive milieu. The

presence of an Ethics Review Board, interest among the faculty and the academically strong social science schools and interdisciplinary research centers provide a conducive atmosphere to discuss about RRI or responsibility in science. Since the University is an autonomous organization that can frame its own courses and syllabi we can examine the scope for introducing RRI or responsibility in science through them. Still there are many hurdles that range from lack of general awareness to different interpretations and understanding of RRI or responsibility in science.

To sum up although responsibility and RRI are novel in India, they are relevant for science system in India. The challenge lies in contextualizing them, using the five keys suitably to demonstrate their relevance and in creating institutional and policy space that can support and enable their adaption in India which is not the same as 100% adoption.

## 2. Introduction: About the report

This is the national report for India prepared by RIS and this report is for the period ending on June 30<sup>th</sup> 2018. This report maps the position of RRI in the context of India and assesses two institutions, one funding agency ([Department of Science and Technology, Govt. of India (DST)]) and another research organization, more precisely a University, Jawaharlal Nehru University, JNU. It was prepared after a national consultation in 2017 and interviews with scientists and experts besides extensive review of literature and documents. The report's structure is as envisaged by the consortium.

The key messages from the report are

- 1) India's S&T and I system is evolving rapidly and despite challenges it is poised for growth and sustainable contribution to global S&T
- 2) The policy measures and new initiatives are sensitive to the emerging technologies and opportunities provided by them
- 3) There is a significant continuity and also departure or shift in the policy frameworks and these make sense in the context of shifts in S&T dynamics globally
- 4) The RRI keys are relevant for India and contextualization is necessary.
- 5) Among the keys, Public engagement and gender are getting more attention now while others are not getting that much attention
- 6) There is scope for introducing RRI as a concept in India and argue that it makes practical sense and hence it can be integrated, partially or fully in policy frameworks

This report points out that although RRI is relevant for India, there are issues, conceptual and practical that have to be addressed to make it meaningful in India. It points out that 'responsible' and 'responsibility' have different understandings and in institutions and organizations, the idea responsibility in research and innovation or responsible research and innovation can be interpreted in many ways. However it also states that these interpretations need not result in a set of incomplete and non-comparable words and phrases. Rather by using the RRI keys, the mandates/visions and the plans and programs, it is feasible to map as to what extent responsible research and innovation can be integrated in the vision and functioning of these institutions and in policy making in general. What we anticipate is that synergies among RRI keys and objectives and goals on one hand and with specific programs on the other hand can be built by proposing RRI keys as principles that are compatible with broad mandates and also with specific programs. For example Gender and Diversity can be linked and contextualized with broad mandates and specific programs. If institutions and organizations find this convincing and feasible,

they may relate to RRI better and will understand its relevance in their functioning. Otherwise RRI as a concept may sound novel and be found interesting but may be considered as an import from Europe that has little applicability.

### 3. Methodology

#### 3.1 Analytic approach<sup>1</sup>

RRI-Practice project has taken an organisational institutionalism perspective while trying to understand the implementation of RRI as a process of organisational change. On the basis of this, the RRI-Practice consortium has to analyse institutional barriers and drivers in organisational RRI reviews in order to effectively develop RRI Outlooks. For both the RRI reviews and Outlooks, we have to use the analytic framework mentioned above. This approach is inspired by Scott (1987) and include the following main dimensions:

	Rational system	Natural system	Open system
Aspects of organisations	Mandates, legislative frameworks, formal hierarchies	Culture, informal routines, informal reward systems, focus on management	Policy learning, pressures from key stakeholders (owners, the public, etc.)
Potential drivers	Active ownership (e.g. the state), legislation that includes social responsibility as a core element of the mandate, formal evaluation criteria adapted to RRI goals	RRI dimensions become mainstreamed, managers start seeing RRI dimensions as an obvious part of their responsibilities, no social acceptance for neglect of the RRI dimensions	Pressure from the media, success stories from organisations considered to set 'gold standards' in the field
Potential barriers	No formalised pressures to conform to RRI dimensions	Informal incentive systems reward economic output/excellence/etc., effectively marginalising the RRI dimensions	Important stakeholders reward, for instance, excellence and economic performance to a greater extent than RRI related matters
Methods	Analysis of formal documents	Interviews with employees at different levels in the organisations, focus groups	Media analysis, interviews with top management

<sup>1</sup> This analytic approach is taken from the RRI-Practice project document.

## 3.2 National mapping

### 3.2.1 Document analysis

Many documents ranging from the earlier five-year plan documents, annual reports, policy documents, academic/research reports were reviewed along with literature on S&T and I, in India. We analyzed the literature on issues and debates in science, technology and innovation in India and also the ones relevant for specific keys such as ethics, gender, public engagement and open access.

RRI is a novel concept in India and hence hardly finds a place in policy documents or in the discourse on science, technology and society. At the same time some of the keys have been given emphasis in documents and through specific programs. Given the diversity of actors and stakeholders in S&T and I, in India, publications from a wide range of sources including civil society were taken into account. For the purpose of this report we took into account the documents/literature available in English only although there is substantial literature on some of the keys in other languages in English. For example, in science communication, most of the work is in languages other than English and there is a vibrant and dynamic discourse on science, technology and society in other languages. These were not taken into account as the literature is huge, amorphous and not easy to translate.

### 3.2.2 Interviews

We conducted interviews with experts and scientists at DST and with faculty members in JNU as part of study of these two organizations. In addition to these conversations were held with many persons from different backgrounds as part of the work on National Workshop.

### 3.2.3 National workshop

National Workshop was held in April 2017. It was held in association with Department of Science and Technology (DST). The one-day Workshop was held in New Delhi and the participants included inter alia, policy makers, academics, researchers, civil society representatives and students. The agenda of the Workshop included sessions on different keys of RRI and the Secretary, DST, delivered the key note address. The overall message from the Workshop was that RRI was a novel concept although many could comprehend the relevance of keys like Gender, Ethics and Open Access. It gave us ideas to take forward RRI as a concept and practice in India and how it could be contextualized in India, for wider understanding and adoption.

Most of the participants agreed that the five keys of RRI, as prevalent in Europe, i.e. ethics, societal engagement, gender equality, open access/science and science communication are important and do belong to any framework on social responsibility and science whether it called as RRI or not. However, the participants also suggested including the keys of access, equity and inclusion (AEI) to broaden the RRI framework in the Indian context.

Participants expressed that in a RRI framework people have to be at the centre. The research and innovation needs to be citizen-centric and problem-centric; not consumer-centric and domain-centric

The discussions during the Indian National Workshop on RRI were quite productive, in which participants covered a number of important issues: the 5 RRI policy keys (ethics, societal engagement, gender, open access and science education) and their place in the Indian context and practice, where there are concerns related to the access, equity and inclusion (AEI), which are more paramount than the general ideas of ethics, engagement etc; theoretical and practical dimensions of responsibility in science and innovation; and good RRI practices and possibilities for their wider uptake. It emerged during the Workshop that



though the term RRI was not used in any official document; the parallels of elements of RRI can be found in both, policy and practice.

### 3.3 The organizational studies

DST was chosen as a funding agency. JNU was chosen as a research organization. DST is the key department in funding for S&T and in science policy. It is also the department that plays a vital role in external engagements in S&T and the multi-lateral division of S&T promotes India's engagement with other countries and groupings like IBSA, BASIC and BRICS, and, ASEAN, in S&T. Established in 1971, it is the first department devoted to S&T funding and science policy formulation and implementation. In addition to its key roles, DST is involved directly and indirectly in Technology Forecasting and Assessment, Science Communication, Climate change research, promoting research in emerging technologies and incentivizing science education and careers in science. The DST is headed by Secretary who reports directly to the Minister for S&T. DST was chosen for its wider role and its importance in promoting S&T and Innovation. DST has many autonomous institutions and bodies under its control and these are engaged in many activities that are related to RRI.

Our engagement process with DST on RRI was continuation of our earlier and ongoing engagement with DST. DST co-sponsored the National Workshop. We engaged with heads of different units/divisions of DST besides individual scientists. DST Secretary was briefed about RRI. Our engagement and interaction has resulted in at least some scientists in DST becoming aware of RRI and the relevance of the keys in science and innovation policy. On the other hand, engaging with DST is and will be an ongoing process that does not begin or end with a project or concept.

Given the novelty of RRI and lack of awareness of it among the scientists and policy makers in India, it is not possible to make a department agree to an action plan or points for action, unless it has been incorporated in the policy or has become an approved principle. So there was no agreed action plan or agenda with DST. Policies and guidelines are framed after much deliberation and when the government is keen to promote a principle or idea, they get incorporated easily in the policy. Another issue here is while RRI as a concept is novel, DST's policies and programs cover almost all the keys such as ethics, gender, open science and open access, engagement and communication. In other words, DST itself is doing a lot to make relevant policies in this and to promote some of the keys. Under these circumstances there was no agreed action. There is scope for DST to learn from the experiences and practices involving RRI keys in other countries/contexts and for others, there is scope to understand and learn from DST's policies and programs. This report points out some relevant initiatives of DST in the keys of RRI. Through our engagement with DST we will try to bring to the notice of scientists and policy makers in DST, the relevant policies/schemes based on RRI keys, being implemented elsewhere.

JNU is a premier research university based in New Delhi. It has schools/departments in social sciences, humanities, arts and sciences. No college is affiliated to it. It has an expansive campus in New Delhi. As it is about four decades old and has a global reputation for research and academics we chose it over other universities which have colleges affiliated to them. As described in the section on JNU, in many ways JNU is a unique institution with a mandate that reflects the modern and progressive ethos of Jawaharlal Nehru, India's first Prime Minister who saw S&T as vehicles for national development and social transformation.

Given the RRI keys and the idea of RRI we chose faculty members to represent different disciplines/schools and to ensure that they were involved in research. As described in Section 6, we had conducted a FGD, a series of interviews and conversations with them. In total we spoke to, interviewed twenty faculty members, ranging from senior professors to assistant professors. This included a scientist who could not participate in FGD but was well known for his views on nuclear disarmament and who was honored by

American Physical Society with a prestigious prize, and, a senior professor who was a vice-chancellor of a central university besides heading a national academy. We also interviewed a professor associated with the body that reviews proposal for ethical clearance. Similarly, we had interacted and interviewed a professor in center for studies in science policy. Our sample size thus had a good representation and mix of faculty members.

JNU being a central university is well funded and enjoys autonomy. Interdisciplinary research is encouraged in JNU and there are initiatives which promote this. As a result, although RRI is a new concept, almost unknown to academic community in India all whom we interviewed could understand the concept of RRI and the keys. As explained in the relevant section, among the keys Ethics, Open Access and Gender needed no introduction to them although they had been interpreted differently or meant different things to different persons in terms of core issues, solutions and role of JNU in addressing them.

There are systems and procedures in JNU as in any other university to introduce a new subject or start a new course. With respect to RRI and the keys, some of them like Open Access, and Ethics are already part of the systems and procedures or institutional norms. Regarding Gender, there is an indirect incentive for women in admissions. Public engagement and science communication are not part of any rules or incentive schemes but are known to the faculty as there are activities, in a limited scale, on them. As a result, we found that there is an awareness on the keys even when RRI virtually unheard of. To introduce any new process or regulation in JNU, first it has to be proposed by faculty members and taken up for discussion at different levels before it reaches the highest decision making body for its consideration and approval. The process is long and needs effort to make a new idea or concept or scheme, acceptable to a minimum number of faculty members to propose it and take it forward. For example, introducing a course on responsible innovation or public engagement will take about two years, if the proposal comes from outside as it has to be deliberated and discussed and voted/decided. If it is a proposal from a faculty member then it has to be approved by the department first. In case of introducing changes in policies or bringing in a new policy, the process is more elaborate and that is not an easy thing, unless it has wider acceptance from beginning or is introduced from the top. In case of RRI there was no agreed action on account of these factors. This does not mean that we are not doing anything on this. Our endeavor would be to have discussions and dialogs and create an awareness on RRI and the keys and make the academic milieu conducive to RRI in theory and practice.

### 3.3.1 Document studies

The policy documents, annual reports and the various notifications and guidelines from both institutions were used. They have been referred to or cited in the respective sections. We analyzed them and used them to prepare questionnaire and for discussing with scientists and policy makers in DST and for interviewing and discussing with faculty in JNU.

### 3.3.2 Interviews for Reviews (including justification of sampling strategy)

On the basis of the analysis of the organizational structures, we identified persons in different divisions and disciplines to be interviewed taking into account their roles and their relevance for RRI keys. The first interviews were conducted with division heads or with those who manage an autonomous body. Then we identified officials who were involved in implementation, funding, project management and assessment in different units. They were invited for FGD also. In DST we interviewed 15 persons and in JNU we interviewed 25 persons. These interviews were conducted in formal and informal contexts over a period of time. Some were interviewed more than once. The response rate was good although we

could not interview some key persons, for one reason or another. However they have assured that they are open for interviews in future.

### 3.3.3 Focus group

In each institution one focus group meeting was conducted. They were preceded and succeeded by meetings with small groups and individuals over a period of time. While the meetings that preceded them set the tone and context for Focus Group Discussions, the post discussions meetings were used to extend the conversation, to link points that were discussed and to clarify some views and to build rapport. We are following up the Focus Group Discussions and more interviews and group interactions and meetings will be held in the coming months.

### 3.3.4 Outlook process

The engagements in JNU and DST were done over a period of time. With DST we have been interacting more frequently on account of the DST being co-sponsor of the National Workshop. The engagement process was useful and mutually enriching. It enabled us to understand these institutions better and insights on their functioning were gained. They did not result in any agreement on Outlooks to be achieved and the reasons as mentioned in 3.3 . However, the engagement process will continue.

## 4. The National Science Policy System

The National Science Policy System in independent India emerged in the early 1950s when India adopted five year planning model. The Advisory Committee for Coordinating Scientific Research which was functional in 1948-55 was the first body mandated to institutionalize and organize science in India. Since then there have been many committees / single person offices that have been providing advice on science policy to the government of India. At the risk of over simplification it can be stated that the three components of the system are:

- 1) Apex Committees and National Commissions
- 2) Policy Think tanks/Institutions
- 3) Departments/Ministries and organizations/institutions under them (including state level departments and organizations)

At present there is no apex committee or National Commission on S&T. The Principal Scientific Advisor to the Prime Minister and his office are playing an advisory role to the Prime Minister and to the Government. Policy inputs have been provided by the Principal Scientific Advisor to Government of India and also by Scientific Advisory Committee to the Cabinet (SAC-C).<sup>2</sup>

Earlier Planning Commission was the primary institution in planning and oversight and evaluation it has been replaced NITI Aayog in 2014. According to NITI Aayog website “The National Institution for Transforming India (NITI) Aayog, was formed via a resolution of the Union Cabinet on January 1, 2015, as the premier policy ‘Think Tank’ of the Government of India. The mandate of this institution is to provide both directional and policy inputs to the government, both at Centre and State, on various issues and

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<sup>2</sup> PSA (2018), “The Office of the Principal Scientific Adviser to the Government of India”, Accessed on May 3, 2018 from URL: <http://psa.gov.in/>

sectors, in order to aid them in designing strategic and long term policies and programmes ([www.niti.gov.in](http://www.niti.gov.in)).<sup>3</sup>Prior to June 2014, India was following a five year plan which was produced by the then Planning Commission, a body tasked with planning, monitoring and evaluation and advisory roles. The five year plans, starting from 1952 were developed by the Planning Commission as documents that would guide developmental objectives for five years. The planning commission would identify the priorities and thrust areas and the five-year plan would also indicate the resources that would be needed to achieve the objectives. Planning would form working groups on different themes/issues and these groups would produce the relevant policy document that would go in to the five-year plan. Working groups constituted by the Commission would also give inputs in terms of reports. For example a working group on Systems Biology and Synthetic, constituted during the process of developing the 12<sup>th</sup> Five Year Plan (2012-2017) gave specific suggestions on policy and regulatory aspects of systems and synthetic biology.

The NITI Aayog last year published a “S&T Vision 2032 Document”, consisting of seven years strategy and three years action plan. The document has identified disruptive technologies that could transform India into a S&T led society. There are also sectoral visions. It proposes setting up “National Science, Technology and Innovation Foundation” (NSTIF) for coordinating with various stakeholders and implementing the Vision and 3 Years Action Plan.

But it has no role in finalizing the allocation of resources, while the earlier Planning Commission had a wider mandate. On the other hand the science academies and various other bodies provide policy inputs and shape the debate on S&T in India. The three major science academies are Indian National Science Academy (INSA) (based in New Delhi), Indian Academy of Sciences (IAS) (based in Bangalore) and National Academy of Sciences (NAS) (based in Allahabad). There are many other academies and professional bodies in S&T but these three are the most prominent ones, representing all disciplines in science.

In recent years, given the thrust on innovation private sector and industry associations have evinced interest in S&T and I policy and have joined hands with different departments to launch initiatives to promote innovation and incentivize innovation thinking. For the first time, the 2018 Economic Survey of India had a chapter on Science and Technology titled as ‘Transforming Science and Technology in India’.

Over the years, there have been policy statements on S&T and the most recent one is the S&T and Innovation Policy of 2013. This policy for the first time recognized the importance of innovation and made important observations on sustainable and inclusive growth and public engagement. But it had been criticized for inter alia, technocratic and expertise led understanding of science, technology and society and framework. (Abrol 2013, Krishna 2013). The Policy has not been followed up with any strategy. Hence it is difficult to assess as to whether the objectives have been met and if so to what extent.

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<sup>3</sup> Niti Ayog (2018), “National Institute for Transforming India: Government of India” Accessed on July 10, 2018 from URL: [www.niti.gov.in](http://www.niti.gov.in)

The Department of Biotechnology (DBT) in 2015 came out with a National Biotechnology Development Strategy 2015-2020<sup>4</sup> with specific targets. Niti Aayog published in 2017 a National Action Plan that had chapters on S&T and Innovation Ecosystem.<sup>5</sup>

While these documents from different organizations provide an idea of their thinking, there is no national S&T strategy or action plan that covers the key fields in S&T and Innovation or the key components of the National Innovation System (NIS). Nor are any plans similar to the earlier five year plans. Thus the different actors in the policy system are active and contribute to the planning for S&T in their own ways. There are state level bodies, often called as State Councils for S&T and they provide policy support to state governments. But their impact at the national level is limited and even at the state level not many states have exclusive departments for S&T as S&T is often clubbed with education or higher education. Interestingly many states have policies/vision statements/strategies for IT and biotechnology. These are used to attract investments and promote industries and services and hence their role in development of science is limited.

But at the national level, the real task of translating policy into targets and outcomes is left to different ministries and departments. These departments and ministries perform many roles, including policy making, regulation and funding. Although today, the predominant role of science departments in policy making is evident; in the years to come other ministries will have a larger role to play. For example, intellectual property right and innovation are under the purview of Department of Industrial Policy and Planning which recently released a report of the task force on AI in India. Ministry of Electronics and Information Technology is the nodal ministry that deals with electronics and information technology with a broad mandate. With technological convergence taking shape, the old division in policy making may not hold and policy making might become a collaborative endeavor in at least few domains. For example in the times of big data and precision agriculture, policy making has to take into account inputs and views of other relevant agencies ministries and Department of Agricultural Research and Extension (DARE) may be the nodal ministry for such policy.

Under the federal system of governance in India, in most matters relating to S&T and Innovation, the law making and regulatory powers are with the central government. For example, as education is in the concurrent list, in matters relating to open access and science/education, the Central government and/or its agencies have the policy making and regulatory powers. So is the case with innovation policies or national policy on S&T. Hence it is no exaggeration to state that central government's role in RRI keys is pivotal and so will be its role in any issue related to RRI. Still RRI in India cannot be government centric as private sector is also emerging as a major player, particularly in innovation. Many MNCs have set up R&D centers in India and this is not confined to Information Technology alone. Another important development is the increase in the number of start ups, incubation centers and accelerators with venture capital playing a key role. In many institutions of higher education and research, there are incentives for techno-entrepreneurship and commercializing S&T research. All these point out the fact that the policy and practice on RRI, in India while focusing on government, cannot be confined to government departments and their policies.

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<sup>4</sup> DBT (2015), "National Biotechnology Development Strategy 2015-2020" accessed on March 26, 2018 from URL: <http://www.dbtindia.nic.in/national-biotechnology-development-strategy-2015-2020-announced-2/>

<sup>5</sup> NITI Ayog (2017), "India Three Year Action Agenda: 2017-18 to 2019-20", accessed on February 19, 2018 from URL: <http://niti.gov.in/writereaddata/files/coop/IndiaActionAgenda.pdf>

The key departments/agencies dealing with S&T are:

- 1) Council of Scientific and Industrial Research (CSIR) ( Under Ministry of S&T)
- 2) Department of S&T (Under Ministry of S&T)
- 3) Defense Research and Development Organization (DRDO) (Under Ministry of Defense)
- 4) Department of Atomic Energy (DAE) (Under Prime Minister)
- 5) Department of Space (DoS) (Under Prime Minister)
- 6) Department of Biotechnology (DBT) (Ministry of S&T)
- 7) Indian Council of Agricultural Research (ICAR) (Under Department of Agricultural Research)
- 8) Indian Council of Medical Research (ICMR) (Department of Health Research)

ICMR was set up in 1911 and ICAR was set up in 1929. CSIR was formed in 1942. Department of S&T was founded in 1971 while DBT was founded in 1985. DAE and DoS, since their founding have been under the control of the Prime Minister, given their strategic importance. In all the science departments, the Secretaries are technocrats or scientists and it has been the practice since 1950s. There is no scope for lateral entry here as they are selected from the persons serving in the science and technology establishment.

According to the latest “R&D Statistics 2017: At A Glance” released by the DST (2017), the Gross Expenditure on R&D (GERD) in India during 2015-15 was mainly driven by the government (public) sector (61.9%) . Of this, Central government (45.1%), state governments (7.4%), have a major share while, higher education (3.9%) and public sector industries (5.5%) have a limited share. The contribution of private sector in GERD was 38.1%. and this has increased over the years. Among the agencies/departments, DRDO had a share of 37.8% of R&D expenditure during 2015-14 followed by DoS (16.6%), DAE (11.6%), ICAR (11.4%), CSIR (9.5%), DST (7.7%), DBT (2.9%) and ICMR (2.4%). DST and DBT contributed about 66.4% of the extramural R&D support .

How adequate is India’s funding in S&T is a much debated question. The Economic Survey (DoEA, 2017) points out that India’s investment in S&T/GERD is not adequate and when compared to China, South Korea and USA, India has a long way to go. A key message from the Survey is, India is underspending even when related to its income level. According to the survey although GERD tripled between 2004-2005 and 2014-15 from 24,117 crores to 85,326 crores, in nominal terms, in real terms it doubled and it was between .6% to .7 % of GERD. While the private sector’s share in GERD is increasing, government is the primary funder and primary user of S&T funding. The Survey makes a strong case for more investments in S&T, commensurate with growth in GDP and needs of India. In terms of publications, the Survey and the one commissioned by DST, indicate that India is relatively doing well. In case of patents also, the numbers have increased significantly. According to the Survey:

“Clearly, India needs to redouble its efforts to improve science and R&D in the country first and foremost by doubling national expenditures on R&D with most of the increase coming from the private sector and universities. But the metrics also need to go beyond papers and patents to a broader contribution to providing value for society” (DoEA, 2017; P 126) .

If at all anything, the Survey was not the first to call for increased spending in S&T, the three Academies have called for investing at least 2% of GDP in scientific education and research.<sup>6</sup>

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<sup>6</sup> IAS, (2017), ‘Action Plan for Harnessing Science and Technology towards Indigenous Self-Reliance’ accessed on February 12, 2018 from URL: [https://www.ias.ac.in/public/Resources/News/Action\\_Plan\\_by\\_3\\_Academies.pdf](https://www.ias.ac.in/public/Resources/News/Action_Plan_by_3_Academies.pdf)

Similarly, recommendations have been made by a study that looked at S&T growth in China and Korea came up with a broad message “Though the growth trajectories are different, the rules of success that can be gleaned are reproducible. These are: targeted development and commensurate resource mobilization, continually evolving policies with strict enforcement and implementable instruments, a differentiation between success and failure, a will to acknowledge failures and efforts to correct them.”<sup>7</sup> (PSA, 2012; P 4) It has also been pointed out that among BRICS countries India spends the least in S&T, if measured in terms of its share in the respective GDPs.<sup>8</sup>

On the other hand a policy maker ,T.Ramasami, former Secretary of DST has pointed out that the issue is not that of increasing GERD to 2%. Arguing from a different perspective he says:

*“[...] if you look at the expenditure per capita, it's a very small number. but go back and see this number of gross expenditure of R&D as a ratio or the full-time equivalent on this column, this is expressed in thousands of dollars per year, and the United States is \$30,200. And there is this, let me say low-middle income group country or developing country which is percent investments, is \$33,000, \$2,000 less and purchase power parity terms. Therefore, a country like India cannot afford to get 2% because our number per scientist is already large. And if we've to increase at 2%, I must double the number of scientists, as simple as that. And scientists do not come in tap water, but anyway we don't get tap water also. But this is a long-term process on how do you develop an economy. Therefore, this question of investments has to be seen in a slightly a different context. If you go back and look at the sustainability of the model, of resource intensity, granted because of the technology being very important, a lever in power equations of the world. Today if you look at the data, you will see that the manufacturing grew at 20% but R&D investment went by 30% on a global space. So people wanting to invest. And today because of wanting to be competitive, there's a competitive excellence and multiplicity of investments. Each nation is making investments on the same segment. And with increasing costs of this R&D inputs, create a high cost, they price themselves as unaffordable for more than 65% of population and sustainability of resource-intensive models, I think we need to examine more critically.”<sup>9</sup>*

Thus the question of enhancing S&T funding as % of GDP has to be addressed with caution, without assuming that the more the money is, better will be the outcome in S&T.

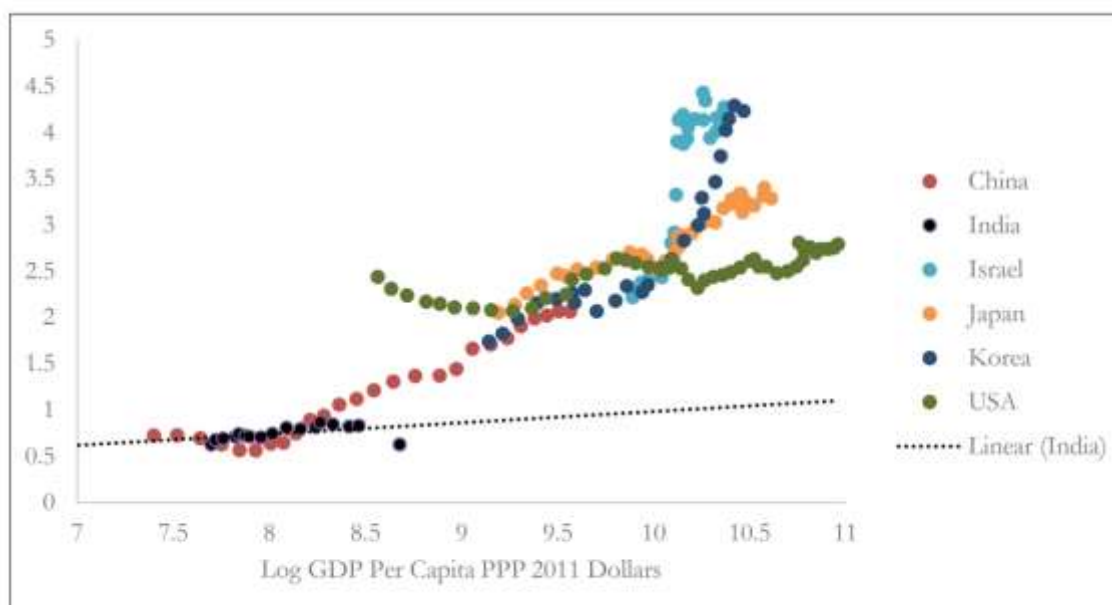
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<sup>7</sup> PSA (2012), ‘A comparative study on S&T, Innovation & Development Strategies of China & South Korea Vis-à-vis India’, accessed on December 24, 2017 from URL: <http://www.psa.gov.in/sites/default/files/inline-files/India-China-Korea-report.pdf>

<sup>8</sup> Sunderarajan Padmanabhan (2018), ‘India's R&D spending is up but least among all BRICS nations’, Business Standard: India, accessed on January 31, 2018 from URL: [https://www.business-standard.com/article/current-affairs/india-s-r-d-spending-is-up-but-it-s-not-all-that-matters-here-s-why-118011600162\\_1.html](https://www.business-standard.com/article/current-affairs/india-s-r-d-spending-is-up-but-it-s-not-all-that-matters-here-s-why-118011600162_1.html)

<sup>9</sup> Ford School (2017), ‘Policy Talks: The role of Science and Technology Policy in Developing Countries’, accessed on January 14, 2018 from URL: <http://fordschool.umich.edu/events/2017/dr-thirumalachari-ramasami>

Figure 2. R&D Expenditure as a Percentage of GDP (Development Time)



Source: UNESCO, World Economic Outlook (WEO), National Science Foundation(NSF).

Source: Economic Survey (2018; P 122)

Irrespective of controversies, it is obvious that funding for S&T will increase over the years. However the challenge lies in translating that funding in terms of indicators like publications, patents and innovations that can make a difference.

Science policy makers are attentive to the emerging challenges in policy making in AI, robotics, cognitive sciences and genomics/biosciences. Many new initiatives have been proposed in these. For example Niti Aayog came up with a report 'National Strategy for AI'<sup>10</sup> recently. The report of the DIPP Taskforce on AI has also been released. Economic Survey 2018 has suggested missions in selected technologies/applications such as genomics, dark matter and energy storage systems. DST had earlier launched Nanotechnology Mission that had enabled India to improve its ranking in publications and build capacity in nanotechnology.

From a RRI perspective it is important that developments in policy making on these new technologies are taken into account as these constitute potential areas for adoption/testing/promoting RRI and its keys. A big challenge is that as governance norms for these are under development and as there are no universal or accepted governance principles convincing about relevance of RRI in these will not be easy

To sum up, S&T in India is growing and enjoys support from Government and society. Although it is largely public sector driven today, in the long run, private sector spending may equal public sector spending, if not over take it.

<sup>10</sup> NITI Aayog (2018), 'National Strategy for Artificial Intelligence #AIFORALL', accessed on July 15, 2018 from URL: [http://niti.gov.in/writereaddata/files/document\\_publication/NationalStrategy-for-AI-Discussion-Paper.pdf](http://niti.gov.in/writereaddata/files/document_publication/NationalStrategy-for-AI-Discussion-Paper.pdf)



## 4.1 Legal and other binding normative frameworks

India is a republic and constitutional democracy is the governing principle. The legal and normative frameworks on research and innovation, in India thus have to be compatible with rights and values enshrined in the Constitution. As India is a party or signatory to many treaties, conventions and protocols, they have an impact, which is often indirect, on these frameworks.

Research involving human subjects is regulated by the ICMR Guidelines 2017<sup>11</sup>. The 2017 guidelines are comprehensive and are based on principles of bioethics including prior informed consent. The guidelines cover research including collection/acquiring samples and their use. It has a section on Responsible conduct of research. The current guidelines cover biological materials, including biobanking and datasets. Similarly, ICMR and DBT have come out with National Guidelines For Stem Cell Research 2017.<sup>12</sup> This addresses many of the concerns expressed about stem cell research in India. Another recent guideline pertains to research involving children (National Ethical Guidelines for Biomedical Research Involving Children 2017), brought out by ICMR. These three updated/revised guidelines in addition to changes in regulating clinical trials have brought into effect better ethical practices and procedures.

Regulation of clinical trials has been a controversial issue and over the years responding to criticisms and observations from Supreme Court, the Government has been revising the regulations, bringing in more transparency and accountability in conduct of clinical trials. As a result, the conduct of clinical trials has become more harmonized with globally accepted practices with adherence to ethical principles. For example India has adopted the ICH guidelines in clinical trials as the industry took the view that adopting international guidelines would be better for them. The current regulatory system for clinical trials mandates registration of Ethical Committees (ECs) in India was the requirement of registration with Central Drugs Standard Control Organization (CDSCO). Further the system has provisions for damages/compensation besides stricter rules on prior informed consent (PIC). There is now more transparency on number of clinical trials as an online portal providing information and on line registration has been created. The Clinical Trial Registry-India (<http://ctri.nic.in>) is an online system. Registration with CTRI is mandatory for conducting clinical trials.

According to Thatte and Marathe (2017), while much progress has been made on role and functioning of Ethical Committees in clinical trials much needs to be done, given the need for unbiased, peer supervision of research.

Regarding research involving genetic engineering, the guidelines issued under Environmental Protection Act are still in vogue and this involves more than one ministry. For example regulation of research and commercialization of GM crops involves Ministry of Environment, Forests and Climate Change (MoEF&CC), Department of Biotechnology (DBT), and Ministry of Agriculture. There are committees at different levels that monitor/oversee different processes and procedures relating to conducting experiments, field trials and recommendation for commercial release. The final approval for commercial release of GM crops rests with MoEF&CC.

In the recent years there have been a proposal to set up a regulatory authority that would replace the current system, with comprehensive mandate to cover research and commercialization and

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<sup>11</sup> ICMR (2017), 'Ethical Guidelines:2017' accessed on February 10, 2018 from URL: [https://icmr.nic.in/guidelines/ICMR\\_Ethical\\_Guidelines\\_2017.pdf](https://icmr.nic.in/guidelines/ICMR_Ethical_Guidelines_2017.pdf)

<sup>12</sup> ICMR-DBT (2017), 'National Guidelines For Stem Cell Research 2017'. Accessed on January 22, 2018 from URL: <http://ferci.org/wp-content/uploads/2017/08/stemcell.pdf>

undertake risk related research. However, the proposed bill to set up Biotechnology Regulatory Authority of India (BRAI) never saw the light of the day and unless a new bill to set up such an authority is brought the current system would continue. There are many challenges before the current regime and it is better that they are addressed sooner than later.( Srinivas 2017).

Given the developments like next generation GM crops and genome editing whether the current regime is adequate is an important question. Although there seem to be no move to bring in a new regulatory regime or set up an authority, commentators have called for changes in the current regulatory regime.<sup>13</sup> Similarly regulating genome editing and genome edited crops is emerging as an important issue

India is a party to Convention on Biological Diversity and the Protocols under CBD. Thus it has implemented access and benefit sharing (ABS) norms through Biological Diversity Act and National Biodiversity Authority (NBA) is the national authority for implementing ABS rules. The Act covers genetic resources, other than human genetic resources. Collection of resources/samples/specimens for any purpose including research is subject to rules framed under the Act and NBA is empowered to implement the Act, which has penal provisions.

Generally speaking Institutional Review Boards/ Institutional Ethics Committees are the bodies that function at institutional level. Almost all institutions that conduct research are expected to have established the appropriate mechanisms for review and approval of research proposals. In regulation of biotechnology there are bodies at the district and state level that monitor research/trials. Regulators like ICMR have developed mechanisms to assess and review proposals that involve ethical clearance. Major funding agencies like DST and DBT expect that the institutions that apply for research grants and studies do adhere to the appropriate rules and guidelines. However, given the number and diversity in institutions, range of research undertaken and lack of capacity in institutions in oversight and compliance, there could be instances of violations and non-adherence. Still it can be argued that the regulatory regimes for governing research and innovation have functioned well and there is scope to improve them. Keeping this in mind, in recent years, organizations like ICMR have embarked upon revision of guidelines and exercises in capacity building.

With the Supreme Court ruling that privacy is a fundamental right in *Justice K.S. Puttaswamy (Retd.) v. Union of India*, how to ensure data protection and privacy has become an issue. Although courts had given many judgments on privacy, particularly on health and privacy, till this judgement there was no binding judgment that affirmed privacy as a fundamental right guaranteed in the constitution. For an overview, particularly on health and privacy The unanimous verdict in this has ensured that there is no doubt as to whether privacy can be claimed as a fundamental right. The judgement said:

“Privacy includes at its core the preservation of personal intimacies, the sanctity of family life, marriage, procreation, the home and sexual orientation. Privacy also connotes a right to be left alone. Privacy safeguards individual autonomy and recognises the ability of the individual to control vital aspects of his or her life. Personal choices governing a way of life are intrinsic to privacy. Privacy protects heterogeneity and recognises the plurality and diversity of our culture. While the legitimate expectation of privacy may vary from the intimate zone to the private zone and from the private to the public arenas, it is important to underscore that privacy is not lost or surrendered merely because the individual is in a public place. Privacy attaches to the person since it is an essential facet of the dignity of the human being.”

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<sup>13</sup> <https://carnegieindia.org/2017/10/02/modern-biotechnology-and-india-s-governance-imperatives-pub-73253>

The significance of the judgment is that what is covered under privacy is wide and this includes autonomy and right to be left alone. The Government of India has appointed a commission headed by former judge of the Supreme Court B.N.Srikrishna to examine issues in data protection and suggest a draft law on data protection. The Committee has submitted a report and draft bill. It's recommendations and the draft bill have evoked mixed response.<sup>14</sup>

The civil society has been active in this, particularly in the case of Aadhar, an unique identification number related cases and has made proposals to the committee. The implications of the proposed regulations on data and privacy will be known when next steps are taken. Never the less on the basis of the Supreme Court judgement it is clear that in future privacy has to be given due recognition in any process in research and innovation, that impinges on privacy, directly or indirectly.

From a RRI perspective, we need to analyze the various regulatory regimes and examine as to whether provide scope for ethics, and, public engagement. While ethics is enshrined in regulations involving human subjects research, stem cells, clinical trials and research involving children, we need to understand that they have been developed over a period of time and the scope of ethics and role of ethics committees have expanded over the years. The policy frameworks and regulatory regimes have been sensitive to ethical issues and concerns of stakeholders and the policy makers have enhanced the scope and coverage of the regime and ensured that relevant ethical principles form the core values in regulation. Hence in comparing with rules/laws in other countries, these have to be borne in mind. Regarding public engagement, prima facie, it appears that there is not much scope in the current frameworks to facilitate that. This is because public engagement in theory and practice is yet to be considered important in research and innovation. Another issue is while public engagement may appear to be a fine concept translating that into practice is difficult in the absence of developed procedures and guidelines.

There are no specific rules on Gender and Science in India, but there are schemes to enhance women's participation in S&T. There are laws on sexual harassment and these are applicable for all institution.

To sum up, the legal and other binding normative frameworks in India are evolving and policy makers have been responsive to demands on making them more compatible with international norms and good practices. There is scope to do more and what role RRI can play in this, is not clear as while ethics is well enshrined in at least, health and human subject research , public engagement has almost no role in current regulations.

#### 4.2 Political and cultural values and discussions related to STI

In India there is almost a consensus among political parties that STI has a key role to play in socio-economic development and S&T has to be supported. The discourse on S&T for society and using S&T to modernize or reform society is old. As some aspects of these have been discussed elsewhere the points and arguments will not be repeated here. The continuity in science policy and support for new and emerging technologies could be attributed to this consensus. As a result, S&T is hardly critically examined by the political parties or law makers and controversial technologies such as nuclear energy are acceptable to most of the political parties. This is equally true of the society and except limited protests in few places, by and large, there is hardly any resistance or critical questioning of S&T among public at large. The opposition to GM crops and this has nothing to with S&T per se. It has more to do with other issues like seed prices, concerns over environment and ownership of technology. Green revolution faced little

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<sup>14</sup> <https://scroll.in/article/888365/the-draft-data-protection-bill-is-a-step-forward-but-nowhere-close-to-what-india-needs>

resistance because it was pioneered by government agencies and farmers had access to seeds, subsidized inputs and technical assistance through extension. Most of the green revolution varieties were open pollinated varieties. In case of GM crops, it was spear headed by private sector, and, farmers had to buy hybrids which were expensive. Still today about 95% of the cotton cultivated is Bt cotton indicating a faster adoption. In fact, farmers are cultivating unapproved herbicide tolerant varieties of cotton which are illegal.

About two decades ago Ashis Nandy observed that science and development have become reasons of state and in their name, sacrifices can be demanded from citizens and violence be inflicted upon. Nandy and few others developed a critique of modern S&T and the obsession with development executed through mega projects and massive industrialization (see Rajan 2005 for an over view and analysis). But these critiques have had limited impact on science policy. The opposition to large projects such as mega dams and irrigation projects, new thermal power plants and nuclear and hydro power plants and destruction of environment have impacted policy making and as a result, involving stake holders through consultations and public hearings has been mandated, at least, in case of large scale infrastructure and industrial projects. But for projects involving science and research, these norms are not applicable, except in cases that involve large scale alteration in ecosystems and landscapes and/or there is need for massive land acquisition. At the risk of over simplification one can argue that three approaches have been interacting and influencing each other on discourse on S&T and society in India. They are Nehruvian which sees S&T as a vehicle for societal transformation, Gandhian that stresses on ethical values, simple living and decentralized production and consumption and the progressive or leftist approach which considers science and technology as drivers for social revolution and stresses on the political economy of S&T and social control over R&D , markets and pursuit of S&T. ( see Abrol 2014 for a discussion , see also Chaturvedi and Srinivas 2015).

From a RRI perspective the Nehruvian approach with emphasis on scientific temper and science for societal development and application of S&T for common good and to meet societal needs is compatible with the idea of RRI. Although Gandhain perspective may seem to be outdated and not compatible with visions of RRI, there are certain aspects that are relevant for RRI and in the context of India this is important (Srinivas, and, Pande 2018). We have not come across any literature on RRI from leftist groups in India and it is obvious that they will look at it from the perspective of political economy and directing S&T for meeting peoples' developmental goals.

## 5. Aspects of responsibility in national science policy

The idea of responsibility per se or RRI is not found the national science policy in India. This need not be unique to India. In fact, the word responsibility or RRI does not even figure in The 2017 EC-OECD STI Policy Survey tool and in the six policy areas of EC/OECD (2017).<sup>15</sup> The most recent policy statement (STI Policy

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<sup>15</sup> STIP (2017) 'Compass Taxonomies: STI Policy data', accessed on December 25, 2018 from URL: <https://stip.oecd.org/assets/downloads/STIPCompassTaxonomiesV2017.pdf>

2013) talks about inclusion etc. but has no specific mention about responsibility or RRI. Similarly, the idea of responsibility is not found in Technology Vision 2035 (TIFAC) or DBT's strategy (2015-2020). 'Harnessing Science and Technology towards Indigenous Self-Reliance' an action plan proposed by the three science academies also makes no reference to it. Thus if one searches for 'responsibility' as a word or an overarching idea in the policy documents one would not find much scope to conclude that science policy is concerned with responsibility or RRI, in S&T in India. However as it has been pointed out earlier RRI or responsibility in the Indian context can be discussed in terms of Access, Equity and Inclusion framework. Still it is difficult to find direct evidence to this in policy per se although it is possible to identify programs/projects that deal with this. Having said this we should also bear in mind that science policy is not a matter of semantics or jargon and hence we should desist from over-interpretation or trying to see aspects of responsibility in 'places' where they are not.

Science policy in India has been concerned with national development, sovereignty and using S&T to achieve over all socio-economic development. The responsibility of the science policy making and implementation is guided more by these concerns than by science for the sake of science. On the other hand over the years the policy statements and the initiatives had reflected upon the challenges faced at those times and these often dovetailed with the objectives and priorities of the five year plans. These are well known and need no repetition here. In the recent years i.e. post 2014 many initiatives have been launched such as Make in India Program and Atal Innovation Mission. Review of their objectives and goals, through documents and websites shows that they also have not incorporated the idea of responsibility as envisaged as RRI or in RRI.

So we have to discuss as to what exactly is meant by responsibility in science policy in the context of developing countries like India. One way to think about is to check whether the RRI keys are indicated in science policy and practice and if so how and why. This report discusses this in detail in the subsequent pages. Or we can use the AEI framework as a guideline to assess the responsibility in policy and practice.

The other option is to acknowledge that while responsibility per se or RRI has not figured in policy documents, there are indications that in the near future that responsibility, directly or indirectly will be part of science policy. To substantiate this, we give two examples

- 1) Scientific Social Responsibility: In 2017 in the address to the Indian Science Congress Prime Minister Modi said "On the lines of Corporate Social Responsibility, the concept of Scientific Social Responsibility needs to be inculcated to connect our leading institutions to all stakeholders, including schools and colleges. We must create an environment for sharing of ideas and resources"<sup>16</sup>

This idea of Scientific Social Responsibility (SSR) was not explained further in the speech, nor elsewhere by the PM. DST had taken the lead to develop it further. As we will discuss in the section on DST, translating SSR into practice through specific mechanisms are being worked.

As an idea SSR has been discussed in the literature and at least one organization, Carlsberg Foundation is committed to it. According to the Foundation

"Even if the Carlsberg Foundation supports excellent basic research, it does not necessarily lead to direct societal value and progress. By focusing on SSR, however, researchers are motivated to

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<sup>16</sup> Indian Express (2017), 'PM Modi advocates scientific social responsibility on lines of CSR' accessed on January 19, 2018 from URL: <https://indianexpress.com/article/india/pm-modi-advocates-scientific-social-responsibility-on-lines-of-csr-4457584/>

assume shared responsibility for societal development and to consider how their basic research can help address the global Grand Challenges.”<sup>17</sup>

According to Bird (2014), scientists have the responsibility to oppose misuse of their work and be concerned and address the foreseeable impacts of their work. While lessons from CSR (corporate social responsibility) and its evolution are important, SSR will also face the challenges in defining it and applying it (Conley, J. M. et al, 2015) From a RRI perspective the development of SSR in theory and practice is worth watching, In fact RRI theory and practice can contribute to shaping the concept of SSR and translating it into practice. The PM has indicated that SSR is not restricted to research institution and the idea is to connect stakeholders with institutions. CSR is seen as an activity to affirm the commitment of the corporate sector to the broader society and assure that they behave and conduct themselves as socially responsible citizens. Profit making is the primary aim of corporate sector and CSR is a tool to contribute to society and this enables legitimacy and credibility. According to Companies Act it is mandatory for companies to allocate a certain portion of the profit for CSR. But in case of research institutions which do not make profit or their surplus is not distributed as dividends, what are the tools for SSR is an issue. Research institutions and universities need to connect with society but is the concept of SSR is the only way to do it or the best way to do it? There are many such questions. We hope that more clarity will emerge in the future as DST develops the idea of SSR further and puts forth measures to translate that into practice.

- 2) AI for obvious reasons has got the attention of policy makers in India and elsewhere. Often the debate occurs in the context of Fourth Industrial Revolution. The Government of India has taken steps to develop policy regarding AI and to identify it's potential. The industry associations are also active in this. For example, in the recent months there have been at least three reports on AI from Niti Aayog, DIPP and PwC (for FICCI) have been published. The report from Niti with the slogan 'AI for all' addresses many issues on AI including the concerns expressed about its wide ranging impacts on society. Interestingly the Niti report talks of 'Responsible AI' and suggests "Responsible AI Development and Ethical and Responsible Research in AI" among the key recommendations and role of government (P93). It states: "#AIforAll will aim at enhancing and empowering human capabilities to address the challenges of access, affordability, shortage and inconsistency of skilled expertise; effective implementation of AI initiatives to evolve scalable solutions for emerging economies; and endeavors to tackle some of the global challenges from AI's perspective, be it application, research, development, technology, or responsible AI. #AIforAll will focus on harnessing collaborations and partnerships, and aspires to ensure prosperity for all. Thus, #AIforAll means technology leadership in AI for achieving the greater good." (P5).

A closer reading of the document indicates that although the term RRI is not used, the idea of responsible AI comes closer to a RRI perspective on AI. Significantly it talks of ethics, privacy and security in AI and states that these are important for responsible AI. We will reserve a deeper analysis for a later occasion but what is clear is that Niti Aayog does not advocate a technocratic approach that ignores ethics with no consideration for values like privacy, in both development and deployment. This itself is an indication that responsibility is part of acceptable vocabulary, for at least, some policy makers. . Having said this, as there are initiatives on ethics and AI, and, RRI and AI/robotics, we can speculate that these will have an impact on the narrative on AI in India, resulting in RRI getting an attention on account of developments

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<sup>17</sup> Carlsberg Foundation (2018), 'Scientific Social Responsibility' accessed on April 20, 2018 from URL:<http://www.carlsbergfondet.dk/en/Applicant/Scientific-Social-Responsibility/Scientific-Social-Responsibility>

elsewhere. Given the fears that robotics and AI would result in widespread unemployment and displacement in jobs, applying RRI may become part of the strategy to deal with that.

To sum up we see SSR and Niti Aayog's advocacy of Responsible AI as significant developments on responsibility in science policy. As the Niti Aayog's report will be debated and considered, the scope for responsibility becoming a key theme in AI research and applications cannot be ignored.

Similarly, SSR which will be formulated and implemented by DST can kindle a debate on science and responsibility in India, particularly the responsibilities of institutions. But the development of SSR, in theory and practice need not end with DST. Instead others such as Science Academies may show an interest in this while institutions may come up with initiatives that go beyond the rules set by DST in this. To what extent these will have a positive impact on intake and acceptance of RRI in India is a question for which we may have no answers now. But the scope for innovations in this at the level of institutions is evident. This gives an opportunity to take forward the discourse in India without conflating it with SSR.

To sum up we see SSR and Niti Aayog's advocacy of Responsible AI as significant developments on responsibility in science policy. As the Niti Aayog's report will be debated and considered, the scope for responsibility becoming a key theme in AI research and applications cannot be ignored.

### 5.1 The conceptualisations of responsibility in national science policy

From the discussion in the previous section it is obvious that responsibility hardly has been conceptualized in the science policy, in sense of responsibility in RRI discourse. So the question is are we thinking in terms of responsibility in terms of other values/keys/principles rather than in terms of the keys in RRI. If so we might get interesting answers. Having said that one should point out that the policy statements or documents are couched in broad terms and so are the objectives. Hence it will be difficult to find references to open science or gender or ethics in them. But there are policies that promote them or consider them as important or at least address them in a larger context. So what we consider as science policy in a narrow sense may not give us the relevant answers. To be more specific one cannot find a one to one correspondence with the policy statements of S&T and I policy of 2013 vis a vis the policies and programs of DST or for that matter that of other institutions/departments.

Hence if we broaden the idea of science policy to include policies and programs and assess them in terms of RRI keys and examine whether responsibility is conceptualized in them and if so how and on what terms, we may get a better understanding.

### 5.2 The notion of 'RRI' in national science policy discussions

Based on the discussions in the above sections it is evident that the notion of RRI is not part of science policy discussions. But as indicated in the National Workshop Report and from the points in other sections of this report, RRI is getting noticed. It has to get more attention and efforts are needed to promote it among policy makers and other stake holders.

### 5.3 Ethics in the national science system

Ethics in the national science system is contextual. There is no overarching legislation or authority on this. Nor is there any policy that is uniformly applicable to all institutions or researchers. Primarily as pointed out elsewhere in the recent years there have been major developments regarding research involving human subjects, stem cell research, research involving children and clinical trials. For research involving animals broad guidelines are in place. Most of the institutions have institutional ethics committees or

review boards. So ethics as practiced in research in India depends upon the type of research and institution. As we will discuss regarding DST, there are guidelines. But these are limited to DST, it's institutions and institutions that have received DST funding. Other agencies like ICAR have them as part of rules and guidelines. For example according to ICAR rules and guidelines

"1.2.6 Ethics in scientific profession. Ethical considerations in all scientific pursuits should remain uppermost in professional conduct of ICAR scientists/staff. Therefore, a level-headed approach is expected from persons who matter in projecting/utilizing ICAR's R&D pursuits and professional strengths. It is pertinent, therefore, that before beginning of the meeting of the decision making Committee each of the member should sign a declaration that s/he does not have any specific interest in the Agenda items. In exceptional cases, a situation may arise when more than one member of the Committee are interested parties. In such cases, it would ideally require a decision through the next higher level of Committee/position." (ICAR, 2014; P5)

ICAR gives importance to ethics and welfare of animals in research and there have been few training programs on ethics in research. But a comprehensive policy seems to be missing. DBT has guidelines on research misconduct and it is expected that institutions supported by DBT would have placed statements on good research practices for public access (DBT, 2016). The guidelines have provisions for penalizing for research misconduct. The definition of research misconduct is broad enough to include plagiarism and irresponsible conduct in research. In addition to this there are DBT guidelines on biosafety and stem cell research. Generally speaking, ethics is either covered under guidelines for research ethics or ethics in doing science but not all institutions have specific guidelines on research ethics or ethics in doing science.

Issues like falsifying data, plagiarism and appropriating other's work and ideas have been discussed and there have been many cases of retraction. But as there is no overarching law or regulation, often the punishment or penalty varies and ultimately most of them are settled at the institutional level. What complicates matters is funding institutions do not have much say in this. In many institutions and universities, the governing laws and guidelines are the binding ones and not the practices followed by the Departments or Ministries of the central government. Another issue is that even when the misconduct is proved and punishment could be awarded, the institution can take a lenient view or award a lesser punishment. Moreover as these are considered as civil offenses and not as criminal offenses unless misconduct or unethical practices are done in conjunction with a criminal offense or crime, state agencies like police cannot intervene.

If at all anything there have been many controversies over plagiarism in science in India and on research misconduct. But there is no consensus on defining what is plagiarism and use of tools to detect it and punish on that basis. UGC, which funds, primarily universities came up with a policy that was criticized even by those who advocate values and ethics in science (Bagla, 2018).<sup>18</sup>. But the UGC guidelines issued recently have addressed the issue of plagiarism by specifying the level of plagiarism and the corresponding penalty/punishment.<sup>19</sup> This regulation mandates that institutions have to address plagiarism related complaints and matters and a mechanism has to be set up to deal with them. The penalties are applicable to all categories of faculty and researchers. It is expected that these will go a long way in reducing cases of plagiarism and instill a sense of academic integrity.

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<sup>18</sup> Bagla, P. (2018), 'India creates unique tiered system to punish plagiarism' Science Magazine:New Delhi. Accessed on April 11, 2018 from URL: <http://www.sciencemag.org/news/2018/04/india-creates-unique-tiered-system-punish-plagiarism>

<sup>19</sup> [https://ugc.ac.in/pdfnews/7771545\\_academic-integrity-Regulation2018.pdf](https://ugc.ac.in/pdfnews/7771545_academic-integrity-Regulation2018.pdf)



The Indian Academy of Sciences has published guidelines titled 'Scientific Values: Ethical Guidelines and Procedures' with steps for dealing with complaints<sup>20</sup>; preceding to the aforementioned, there were other set of guidelines.<sup>21</sup> The IAS has a Panel on Scientific Values<sup>22</sup> It will look into complaints passed on by the President.

In our view the guidelines are important as they go beyond research integrity and discuss about ethics in technology and dealing with policy issues. According to IAS guidelines "Ethics in technology-related issues", there are a number of Academy Fellows who are engaged in applied research, involving technology development and commercialization. These areas have their own characteristic ethical issues, having to do with sustainable development, technology acquisition, sale and transfer of technology, sharing of intellectual property rights, industrial safety, and other matters such as environmental loading. Existing ethical guidelines in specific areas should be identified and followed. One should also be sensitive to areas like dual-use technologies for which ethical guidelines are still being debated"

INSA also has a Panel on ethics. Similarly, many professional societies have panels and policies on ethics and misconduct. Moreover these will not have much impact as at the worst membership may be revoked or at best the violator will be admonished. Never the less there is hardly any data on the effectiveness of the guidelines and how they have impacted doing science in India. What we get to know, instead is a rough picture based on few evidences or news items based on sites like retraction watch.

But these developments and debate are not occurring in the context of RRI or responsible research. So from a RRI perspective we need more data and studies on perception and practices of responsible research in India.

What is needed is a mechanism that is legally binding, broad enough to cover various types of misconduct and unethical behavior with powers to punish and deter. That should also include office(s) of research integrity and system to protect whistle blowers and victims. The current fragmented system and approach has proved to be insufficient.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier here is lack of a mechanism that enforces minimum standards in research ethics and in maintaining research integrity and adherence to ethical norms. To be specific while there are issues in defining plagiarism, research misconduct and misappropriation, it is lack of law or legally enforceable mechanism that constitutes the main barrier. This is a structural barrier but has deeper ramifications. The cultural barriers pertain to institutional cultures and cultures of the professional organizations and academies that do not have sufficient mechanisms to enforce norms and punish for violation. The interchange dynamics here is the inadequacy of cultural and institutional factors to build an effective mechanism on ethics in science.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

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<sup>20</sup> IAS (2017), 'Scientific Values: Ethical Guidelines and Procedures', accessed on March 15, 2018 from URL: [https://www.ias.ac.in/public/Resources/Other\\_Publications/Overview/IAScEthics-20170101.pdf](https://www.ias.ac.in/public/Resources/Other_Publications/Overview/IAScEthics-20170101.pdf)

<sup>21</sup> IAS (2005), 'Scientific Values: Ethical Guidelines and Procedures', accessed on April 26, 2018 URL: [https://www.ias.ac.in/public/Resources/Other\\_Publications/Overview/scival\\_report.pdf](https://www.ias.ac.in/public/Resources/Other_Publications/Overview/scival_report.pdf)

<sup>22</sup> IAS (2018), 'Academy Committee on Scientific Values' accessed on August 10, 2018 from URL: [https://www.ias.ac.in/Initiatives/Committee\\_on\\_Scientific\\_Values/](https://www.ias.ac.in/Initiatives/Committee_on_Scientific_Values/)

The main drivers are the guidelines, mandatory norms under Acts such as Drugs and Cosmetics Act and the rules that mandate registration of trials. Basically the driver is the government, directly or indirectly.

The cultural drivers include pressure from courts and civil society, and factors that favour or push for harmonization with globally accepted practices. The interchange dynamics here is the pressure from above through laws and regulations and the necessity for gaining credibility. The evolution of globally accepted practices and principles acts as a major dynamic force in pushing the drivers further.

#### D. Best practices

ICMR guide lines, Guidelines on stem cell research, DST's rules and guidelines and clinical trial guidelines.

### 5.4 Societal engagement strategies in research

We presume that societal engagement and public engagement are the same. Societal engagement per se has not been part of science policy or any guidelines in research. The reason being, perhaps, the policy makers and those who pursue S&T assumed that society needs S&T and its outcomes and as scientists and technocrats are engaged in S&T or innovation activities that would meet the needs of society, there was no need to engage with society in the real sense of the word engage or engagement. Another reason perhaps was that public or society was in need of understanding and appreciating S&T and its outputs and lacked capacity to engage with scientists and policy makers. The same view is reflected in the idea that there is a deficit or gap in public understanding of science and science communication can be an apt tool to fill that or address the gap. Fundamentally societal or public engagement is based on the premise that public are stakeholders who deserve to be heard and consulted and engaging with them enhances credibility and provides inputs to policy. In addition it can also be used to gauge what the public wants/needs.

The STI Policy of 2013 gives importance to public understanding of science but stops short of elaborating the need for public engagement. The 2018 Economic Survey underscored the importance of public engagement by stating "If science is to garner greater support from the society, it will require scientists to engage more vigorously with society. Much of the science is- and should be-a public good, and hence that will always require substantial public funding. But the need for publicly funded science means that national laboratories and other publicly funded R&D institutions need to make much stronger efforts to engage with public and not make their research centers quintessential ivory towers". (DoEA, 2018, P 129).

But if we note carefully, it does not elaborate the idea of engagement with public but suggests that to gain support for science it is better for scientists to engage with society. This sort of utilitarian view on public engagement although is better than paying no attention to public engagement is not the public engagement as envisaged in RRI. Hence it will not be an exaggeration to state that public engagement in science/research is an emerging idea in India and is yet to be fully operationalized or translated in to practice.

However there has been instances where public engagement was tried but these were not for research or scientific projects. The first one was the initiative to get the views of the public on approval to Bt brinjal. While this was met with overwhelming response from the public, it resulted in government announcing a moratorium on release of Bt brinjal. Technically the reason for moratorium was not that the public response raised questions. The moratorium still holds. The second instance was the move to set up the 15 member expert committee in the context of Koodankulam Nuclear Power Plant to 'explain the factual position on various aspects of the project and... also [to] dispel apprehensions of some sections of the local people'. Contextualizing these in terms of expertise and quasi publics Varughese points out that

state led techno-science was willing to engage with civil society in Bt brinjal but not with villagers in Koodankulam. According to him

“Any technoscientific project in the country corroborates a similar treatment extended to the quasi-publics. This mode of governmentality coexists with an increased willingness of the state-technoscience duo to engage with the civil society as in the Bt brinjal consultations. The idea of scientific expertise was understood as more inclusive and socially distributed in the

first case. On the contrary, in the second case, expertise is understood as vested exclusively on the representatives of the state-technoscience duo, largely the nuclear scientists.”(Varughese, 2014). After examining the public engagement with emerging technologies (nanotechnology and agricultural biotechnology) Indrani Barpujari (2011) contends that public engagement in India is based on an uni-directional and deficit mode of engagement.

On the other hand, there have been some initiatives in citizen science and these have been taken up by academic /research institutions such as ATREE and civil society organizations such as Development Alternatives, Centre for Science and Environment (Goyal, 2016). Wellcome-DBT Alliance has been promoting public engagement. According to the alliance

“Besides its Fellowship Programme, the Wellcome Trust/DBT India Alliance aims to enhance the public understanding of science in India. It has become increasingly important for scientists to engage with the public to increase the awareness of science, technology and medicine (STM) research, and themselves get fresh perspectives on their research towards a larger picture. We, at the India Alliance, endeavor to bring the scientific community and the public together to share, debate and deliberate on important scientific and human health issues that have implications on the society at large”.<sup>23</sup>

From the website it seems that engagement activities lasted from 2009 to 2016. Nevertheless, it is an important initiative from the Alliance as very few institutions understand the need for public engagement and pursue it officially.

There are indications that public engagement is getting the attention of institutions and science academies. But they fall somewhere between science communication/outreach and public engagement. For example IAS organized a meeting last year to discuss science and society interface and launched a journal Dialogue: Science, Scientist, and Society.<sup>24</sup> Another meeting was held earlier this year. The journal has been published and the IAS site has a discussion forum called confluence.<sup>25</sup> These are laudable steps no doubt, but what is missing is the idea of public engagement that goes beyond scientists talking to society and trying to enlighten public. These seem to be tilted more towards science communication and creating spaces for scientists to communicate.

Civil society organizations are engaged in science communication and science popularization. In a way they promote public engagement. They also respond to various development projects and projects related to S&T but there is no national level movement that does these. Many movements/groups have come together and formed a Network of Peoples’ Science Movements. These, about 40, of them work in different states and publish and communicate in different languages, work with government agencies and engage in science popularization, communication and creating awareness among people. A well known movement among these is Kerala Sastra Sahitya Pasrishad (KSSP) which was established primarily as a science communication and popularization movement based in Kerala. Later it intervened in the Silent Valley Power Project and campaigned against as that Project would destroy tropical forest in an area

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<sup>23</sup> <https://www.indiaalliance.org/public-engagement>

<sup>24</sup> IAS (2018) ‘Dialogue’, accessed on August 23, 2018 from URL: <http://dialogue.ias.ac.in/>

<sup>25</sup> IAS (2018) ‘Confluence’, accessed on August 21, 2018 from URL: <http://confluence.ias.ac.in/>

which is rich in biodiversity. The campaign resulted in government appointing a Committee to review it and eventually it was abandoned as the committee suggested that it be dropped. Besides science, KSSP is involved in health and development issues and conducts studies and runs campaigns.<sup>26</sup>

Tamil Nadu Science Forum (TNSF) based in Tamil Nadu is another organization that is engaged in science popularization, science communication and science education. Like KSSP it also publishes books, magazines and is active in education and development issues.<sup>27</sup> It supports Neutrino Project in Theni district in Tamil Nadu and has been 'educating' public on this, to 'dispel' misinformation. This support has been questioned by groups which oppose this project. TNSF works on gender issues underscoring gender equality and its activities on this are done under the banner Samam (equal (ity))<sup>28</sup>

Organizations like KSSP, TNSF work with the government and also disagree with the government on issues and policies and hence it can be argued that they neither blindly support the government nor oppose it for the sake of opposition. Hence their activities in science education, communication and public engagement often overlap. KSSP and many similar organizations are known as Peoples' Science Movements and 'Science for Social Revolution' sums up their motto. Since we have written about Peoples' Science Movements (PSM) elsewhere with respect to their positions on science, development and ethics we will not repeat the points.

To sum up, the societal engagement or public engagement in research is not strong in India. It has not taken roots and remains as a practice that is not well developed. The recent initiatives may result in it getting more attention, perhaps, more support from policy makers. But issues on defining public engagement and how to translate that into programs and realize its potential have to be addressed. The civil society groups are working in public understanding of science and public engagement but their focus has been on science communication and popularizing science.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier is the non-recognition of the need for public engagement. This arises from the assumption that public needs one-way communication and has to be informed and educated rather than engaged. This is a structural barrier and lack of clarity on what constitutes public engagement is also a barrier. Absence of procedures and methods for public engagement in institutions is also a barrier.

Cultural barriers like privileging expertise over public's understanding, the culture of talking to rather than talking with and the view that public knows little and its fears are irrational constitute major barriers. The other culture related barrier is the inability or disinterestedness of the scientists to engage with public or hold a conversation with them treating them as citizens who have the right to participate and know.

Interchange dynamics: Changes in attitudes and understanding the need for engaging with public.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

There are hardly any drivers in this although recent initiatives encourage scientists to communicate with public, if not engage with them. The structural drivers are few and limited and these are scattered. The cultural drivers that push for engagement are not there except in few institutions or among few groups.

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<sup>26</sup> [www.kssp.in](http://www.kssp.in) ( please see topics listed under activities) [most of the content is in Malayalam]

<sup>27</sup> <http://www.tnsf.co.in/> (most of the content is in Tamil)

<sup>28</sup> <http://www.tnsf.co.in/category/equally/>

#### D. Best practices

Frankly speaking there are no best practices in this.

### 5.5 Gender equality and diversity strategies in the science system

The underrepresentation of women in S&T is an issue in India also. In the last decade or so this has gained much importance. Historically women have been always underrepresented in higher education and this had its impact in science. Historians like Aba Sur have documented how women even in 1930s and 1940s had to struggle with establishment and could not get recognition or appreciation for their work. Even C.V.Raman who was otherwise considered as an advocate for progress of women was no exception to this. In the recent decades initiatives have been taken to address some of these issues. The good news is that there is a widespread awareness and recognition that it had to be addressed and women should be given enough opportunities and steps are needed to remove some of the constraints faced by them. DST is doing much work in this. DBT had mandated women should constitute at least 30% of the committees that decide on grants etc.

The 2013 S&T and Innovation policy states

“Gender Parity Participation of women in STI activities is important. New and flexible schemes to address the mobility challenges of employed women scientists and technologists will be put in place. A broad scope for re-entry of women into R&D and facilitation mechanisms for special career paths in diverse areas will be sought.”

According to a statement made by the Indian Minister of State for S&T, women constitute around less than 20% of the scientific community conducting research in India (Lok Sabha, 2018). The latest data released by UNESCO Institute for Statistics in June 2018 indicates that the number of female researchers as a percentage of total researchers in India is only 13.9%, which is quite low than many other Asian countries listed (UIS, 2018). This is quite an interesting paradox because the female enrollment in science stream at graduate and post-graduate level has increased over a period of time, from 7.1 % in 1950-51 to 40% in 2009, with about 25-30% of science PhDs being women (AASSA, 2015). This also indicates that for women with a qualification in science, career options are limited or simply not available.

Many authors (Kurup, 2016; Godbole and Ramaswamy, 2015; Kumar, 2001, 2009; Beura, 2017) and reports (SSESS, 2017; NAM S&T Centre, 2010; NISTADS, 2008; IAS, 2008, INSA, 2004) have highlighted this issue of gender inequality. Though this is not unique to India, it is a matter of serious concern. The data and survey results, more or less, highlight the fact, the problem is not women, but with institutions, policies and societies.

On the positive side latest survey on higher education shows that gender gap is getting reduced, and Gross Enrolment Rate (GER) in higher education is increasing. While there are variations across states and communities in GER, women enrolling in large numbers in higher education, will, over the years ensure that their share cannot be denied solely on the grounds of gender. With right policies and incentives, it is possible that the increase in enrolment is translated in to increased participation by women in S&T.

According to All India Survey of Higher Education 2017-2018 released in July 2018

“There are 11 types of Universities and the Level-wise enrolment in each type of university, teaching departments and constituent universities/off-campus centres are given in Table 26. Total numbers of students enrolled are 72.65 lakhs. In State Public Universities number of Ph.D. students is largest (43959) followed by Institutes of National Importance (28383). Number of female students is lowest for State

Private Open Universities (7) followed by Institutes under State Legislature Act (2186) whereas the share is highest in State Public Universities. Share of female students is lowest for Institute of National Importance (24.06%) followed by State private Open Universities (26.92%) and Deemed Universities Government (28.9%), whereas the share of female students for Institutes under State Legislative Act is 58.93%. Share of female students in State Public Universities are 48.80% and Central Universities are 35.65%, respectively”<sup>29</sup>

Girl students are doing well in government sponsored scheme to encourage students pursuing education in science. According to latest figure, so far 13.86 lakhs INSPIRE Awards have been sanctioned, of which about 47 % of the awardees are girls and 26% SCs/STs (DST, 2017). Now even if 50% of these women awardees were to pursue higher education and do PhD the number of PhDs awarded would be significant.

Of the science departments, women have rarely occupied the highest post. DBT had had a woman scientist as secretary. The current secretary is a woman. But neither DST nor CSIR had had a woman at the helm. In terms of heads of institutions or directorships of institutes women are well under represented but head important posts in ISRO and DRDO. These are exceptions than the rule.

The problems are at two sides- demand and supply.

Demand Side : The system demands scientists but does not incentivize women much to become scientists. In the absence of quota there is no guarantee that a minimum no. of women would be absorbed in the system. This ensures that women do not attain the critical mass in the system to push for their rights and demand equal opportunities. The current schemes of DST try to address some of these and facilitate re-entry into the system. But that per se does not make a significant difference as the no. of women who benefit from it are less. While imbalances occur across disciplines/fields/institutions, the efforts have an impact but not sufficient enough to reduce the imbalance significantly. For example, in top ranking institutions like IISc and IITs, the percentage of women faculty among the total faculty is not even 20% and the number of women professors is insignificant. The situation is better in central universities like JNU and Central University of Hyderabad but there too the percentage of women professors among faculty is not high. On the other hand, the number of women joining these institutions has been increasing and the data shows that among institutions, institutions of national importance have the least percentage of women students. So this has to be addressed through special mechanisms as these institutions are well funded and have the best infrastructure in the country. According to a news report “According to a 2015 report by the Association of Academies and Societies of Sciences in Asia, nearly one in three PhDs in science is a woman; in engineering colleges and medical schools it’s as much as 35% and 45%, respectively. It’s only at the prestigious IITs that the percentage of women students drops to single digits.”<sup>30</sup>

Supply Side: Studies show that the % of number of women who choose science subjects at higher secondary level is quite high but it drops at graduation level and drops further at masters and Phd level. Post PhD the problem is that women find it difficult to get suitable jobs and if they enter, find it difficult to continue or have a career without a break. In engineering, the proportion of women in high at bachelor’s level but as most of them opt for employment particularly in IT sector, the proportion gets reduced at Masters and PhD level programs. Now thanks to INSPIRE program of DST this has been tackled to some extent. Since INSPIRE provides scholarship and support till getting PhD it is an incentive to pursue

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<sup>29</sup> <http://aishe.nic.in/aishe/viewDocument.action?documentId=245> at p. 24 (accessed on 15<sup>th</sup> August 2018)

<sup>30</sup> <https://www.livemint.com/Opinion/z2iFG8ol6jxVAXOWnwK5xM/The-mystery-of-the-missing-women-in-science.html>

a career in science. With enrollment rate increasing over the years, it is important to ensure that incentives and schemes are expanded to include the aspirations of these women. This can be done by ensuring that women who pursue post-graduation and PhD are made aware of opportunities available to them and how they can benefit from the schemes of the government. But more important is that the

Science Academies have shown interest in Gender and Science and in enhancing women's participation in science. The IAS has launched a program Woman in Science<sup>31</sup>

The three academies have also identified the gender issue in science as a matter of concern. In the plan they proposed they have stated

"Improve Gender equality and inclusiveness: Women constitute half of the human resource; without active engagement of women scientists and technologists, we cannot accomplish envisioned growth of Science and Technology in the country. It is necessary that a conducive environment is created for them and a conscious decision to include them into the main stream of activities. A slew of measures should be put in place to attract more women to science, ensure equal opportunities for women researchers in jobs, awards, funding and in leadership"

Action Plan for Harnessing Science and Technology towards Indigenous Self-Reliance submitted

By Science Academies to the Honorable Prime Minister of India (through Secretary, DST, Govt of India)<sup>32</sup>

Current initiatives are necessary but not sufficient. As most of the women students enrolled in STEM are in state universities or institutions affiliated to them, a comprehensive approach is necessary to ensure that women students are incentivized to pursue a career in research and science. The efforts by DST and other departments should be supplemented by initiatives at the state level, particularly in states where the enrolment of girls in higher education has increased in the recent decade, in contrast to the past.

For example state governments can replicate initiatives of DST at the state level targeting more women than now. Another important move that could make a difference is horizontal quota for women in employment. For example, the state of Tamil Nadu has been implementing 30% quota for women in government jobs and this has resulted in women joining government more than even before. Cultural barriers and institutional practices that hinder women's participation have to be addressed by state and central government.

In biosciences few women have made it to the top, but this is not adequate and much more needs to be done to ensure that women get equal opportunities. While both DBT and DST have programs that enable women scientists to pursue a career after a break, changes in attitude and training of men in gender sensitivity are also necessary.<sup>33</sup>

But if we go beyond general issues and observations, data shows that under representation of women is a stark reality but what is all the more worrisome is their under representation in institutions that are considered as the top ranking ones or proportion of women Principal Investigators in the projects funded

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<sup>31</sup> IAS (2018), 'Women in Science' accessed on July 4, 2018 from URL: [https://www.ias.ac.in/Initiatives/Women\\_in\\_Science/](https://www.ias.ac.in/Initiatives/Women_in_Science/)

<sup>32</sup> IAS (2018), 'Action Plan for Harnessing Science and Technology towards Indigenous Self-Reliance', accessed on August 3, 2018 from URL: [https://www.ias.ac.in/public/Resources/News/Action\\_Plan\\_by\\_3\\_Academies.pdf](https://www.ias.ac.in/public/Resources/News/Action_Plan_by_3_Academies.pdf)

<sup>33</sup> <https://www.biospectrumindia.com/features/73/8484/gender-disparity-in-biosciences.html> (last accessed on 12<sup>th</sup> July 2018)

and the disparities across disciplines. The data given below captures this. Although this data is old, one can assume that it has not changed drastically to think that women's participation or share has increased significantly.

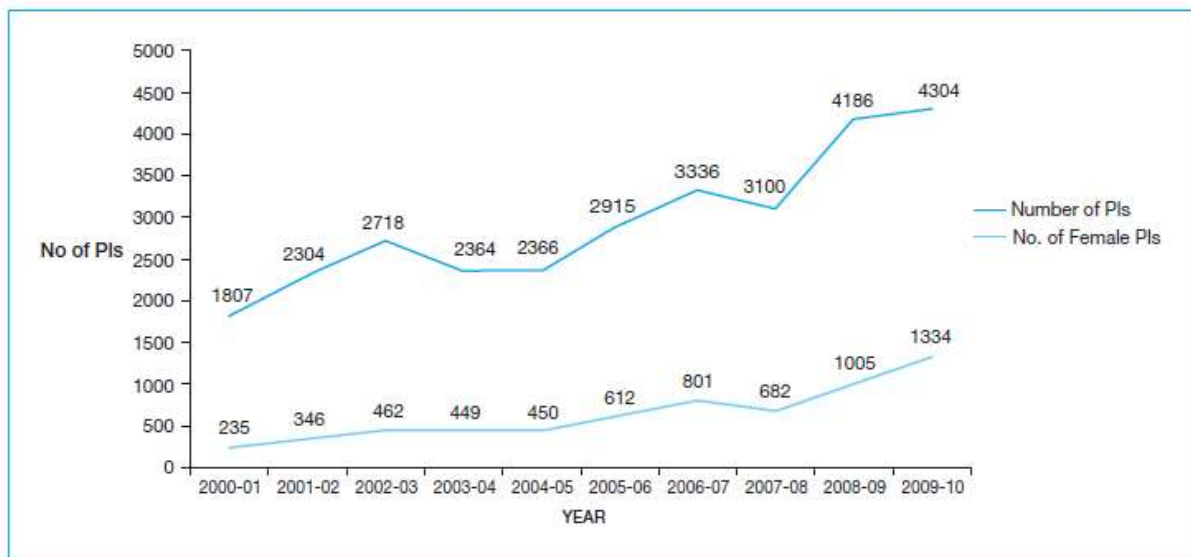
**Table 3. Women scientists in various organizations.**

Organization	2004		2008	
	Total scientists	Women (%)	Total scientists	Women (%)
CSIR	5,030	13.0	4,556	16.05
DST	-	-	659	20.8
DAE	436 (TIFR)	16.5	4,173 (BARC)	15.0
DBT	179	31.8	208	27.4
ICMR	615	27.3	561	29.0
DRDO	-	-	6,890	14.0
DOD	127	8.7	-	-
ICAR	2,000	8.5	2,378	14.3

**Table 4. Women faculty in select universities**

University	2004		2008	
	Total scientists	Women (%)	Total scientists	Women (%)
IISc Bangalore	Academic: 316	6.6	Total: 330	7.7
	Scientific: 113	9.7	Asst. Prof.: 91	9.9
			Assoc. Prof.: 92	5.5
			Professor: 147	8.3
University of Hyderabad	Total: 101	15.8	Total: 135	20
			Asst. Prof.: 41	31.7
			Assoc. Prof.: 32	40.6
			Professor: 62	8
Jawaharlal Nehru University	82	16	120	20
Delhi University	-	-	Sciences	
			Asst. Prof.: 184	37
			Assoc. Prof.: 22	6
			Professor: 85	10
			Maths: 38	34.2
			Asst. Prof.: 8	25.0
			Assoc. Prof.: 9	47.4
			Professor: 11	18.2





**Figure 7.** Gender participation in R& D projects supported by central S & T agencies, taken from the DST Annual Report 2011-2012 [14]

Source : Godbole and Ramaswamy (2015)

To sum up, there is an awareness about the lack of representation/under representation of women in S&T. Conscious efforts are being made and these need to be stepped up. How applying RRI can help in this is an important question.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

Main barriers are the biases, prejudices, entrenched vested interests, lack of policies to enhance women's participation and contribution and the least priority given to inclusiveness.

Cultural barriers include patriarchy in society and organizations, family pressure and lack of facilities and incentives and the low importance given to needs of women and their rights.

The interchange dynamics here is the combination of structural and cultural barriers and efforts to break them

#### C. Main drivers (structural, cultural or related to interchange dynamics)

Government's policies are the main drivers and awareness and acknowledgement of the problem are other drivers.

The cultural driver is the changing culture in institutions and organizations and increased participation of women in S&T and in higher education and jobs.

#### D. Best practices

KIRAN (DST), mandatory norm of 30% of committees(s) should be women

## 5.6 Open access and open science strategies in the national science system

Open Access is thriving in India and in the recent years it has received a boost from policy makers and others who are promoting it. Yet there are many issues that remain unresolved and the very success of open access is contributing to them. For example, the number and scope of policies on open access have increased but this has resulted more divergence than uniformity/convergence and proliferation of repositories that operate like silos than like a connected network. An overview of open access in India indicates that, open access has gained momentum in the last decade and there has been a steady increase in using and accessing open access publications and repositories (Das 2014).

The Indian Medlars Centre (IMC), established the database IndMed in 1998 and provides abstract level information for many biomedical journals. Indian Academy of Sciences and Indian National Science Academy publish many journals that provide open access to articles. Current Science, which is well known science journal from India is entirely open access with access to back volumes. Similarly many journals from academies and institutions are fully open access and follow double blind peer review and other standard procedures of academic publishing. They do not charge the authors for publication and often are supported by grants and subscriptions.

Government organizations like DST, DBT and ICAR have policies that favor open access or encourage researchers and those who received grants to share the publications through institutional repositories. Over the years the number of journals, repositories and initiatives on open access have proliferated. The Indian Academy of Sciences and the Indian National Science Academy are premier institutes that run vibrant publishing programmes and offer open access to their journals and papers. Among research institutions, Indian Institute of Science was a pioneer in providing access through eprints@Iisc. Though it is difficult to estimate the number of repositories in India, the table below gives an idea about their growth.

But the growth of fake or predatory journals, that publish papers on open access mode, upon payment for publishing has been a concern as they lure researchers by making false claims. These journals in fact have affected the credibility of open access journals and the idea of open access. So much so that, this has reached alarming levels with hundreds of journals publishing thousands of articles resulting in a situation as if Gresham's law has become operational in academic publishing.

According to Indian Express which did a series on fake journals

"India has emerged as a hub for the predatory publishing business. There are more than 300 firms in the country that claim to publish papers in "international journals" for a fee that ranges from \$30 to \$1,800. Indian publications, and academics, have been increasingly finding themselves at the wrong end of international investigations into the rise of bogus publishing. Last year, a survey by Canadian epidemiologist, David Moher, revealed that 27 per cent of the world's predatory journal publishers were based in India and about 35 per cent of the corresponding authors in these journals were Indians."<sup>34</sup>

In India the paradox is while open access is accepted as a good practice and organizations like DST and ICAR have policies to promote it or make it mandatory, the outcome is mixed. According to Scaria (2017), the policies lack clarity and there is no uniformity in the policies and often they mandate sharing

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<sup>34</sup> <https://indianexpress.com/article/opinion/editorials/omic-fake-research-ugc-peer-reviews-the-fake-academia-5268377/> Accessed on 10<sup>th</sup> august 2018

in/through repositories but many issues are not fully addressed.<sup>35</sup> Madhan *et al* (2016) have pointed out the sorry state of these repositories when they argued that *“unfortunately, many laboratories under these apex bodies have not taken the OA policy seriously, nor there seems to be any will on the part of the apex bodies to implement the policy forcefully.. There are also many institutional repositories, some of them well populated, but others are languishing, largely due to the indifference of scientists”*.

Similarly, Kumar and Mahesh (2017), based on their study argued that the open access institutional repositories in India are not functioning properly despite the policies and mandates. According to them 69 Indian repositories listed in the Directory of Open Access Repositories (DOAR) and Registry of Open Access Repositories (ROAR), only 12 added “at least one item during a month” during the period July 2016 to June 2016. Seventeen repositories did not add even a single item during the course of the year of study, while 40 were “irregular” in adding items to the repositories Seethapathy *et al* (2016) in their survey found that only 5% of authors are aware of common repositories in India like UGC’s Information and Library Network (INFLIBNET) and Shodhganga and stated that India is also among the major contributors of articles published in poor-quality predatory open access journals. The authors argued that the publication pressure among researchers as part of enhancing their Academic Performance Index (API) and lack of awareness are the major factors contributing to articles published in poor-quality predatory open access journals from India. Shen and Bjork (2015) have stated that 35% of publications in predatory journals is by Indians

So while open access is a well-accepted principle, in practice there are many challenges ranging from ambiguity in policies to repositories functioning as silos catering to a small group of users. Funding for publishing in open access journals is an important question. While researchers from India prefer fully open access journals like Current Science or PLoS Journals or similar journals with high ranking, the incentive structure is not uniform. Often unless there is a provision in the grant agreement that the payment for publishing in high ranking open access journals is covered, researchers have to look at their institutions for support. A good policy on this has been adopted by Wellcome-DBT Alliance that mandates publication in open access journals and assures that the amount paid would be reimbursed. It is mandatory that all publications from projects funded by the Alliance have to be made available under open access. According to the Alliance

“All the India Alliance Fellows are required, as part of Award conditions to publish results of their India Alliance funded research in an open-access format to make it available to the public. If the journal does not comply with the open-access policy, Fellows are expected to arrange for the article to be open-access by paying open-access fees to the journal. The India Alliance will reimburse the open-access charges that the Fellows may incur towards making the publication available through Pubmed Central & Europe Pubmed Central.”

“All research papers that have been accepted for publication in a peer-reviewed journal, and are supported in whole or in part by the Fellowship, shall be made available from PubMed Central(PMC) and Europe PMC Pubmed Central (Europe PMC) as soon as possible, and in any event within six months of publication, in line with the India Alliance’s open access policy. The IA Fellows must contact India Alliance to claim open access charge”<sup>36</sup>

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<sup>35</sup> [http://ris.org.in/pdf/DrArulGeorge\\_sessionII.pdf](http://ris.org.in/pdf/DrArulGeorge_sessionII.pdf)

<sup>36</sup> <https://www.indiaalliance.org/award-conditions> (last accessed on 15th August 2018)

In terms of cost, Indian researchers seem to be spending significantly on Author Processing Charges (APC) to get published in open access journals. According to Madhan *et al* (2016)

“We raise the financial and ethical issue of paying for getting papers published in professional journals. Indian researchers have published more than 37,000 papers in over 880 open access journals from 61 countries in the five years 2010-14 as seen from *Science Citation Index Expanded*. This accounts for about 14.4% of India’s overall publication output, considerably higher than the 11.6% from the world. Indian authors have used 488 OA journals levying article processing charge (APC), ranging from INR 500 to US\$5,000, in the five years to publish about 15,400 papers. More than half of these papers were published in just 13 journals. *PLoS One* and *Current Science* are the OA journals Indian researchers use most often. Most leading Indian journals are open access and they do not charge APC. Use of OA journals levying APC has increased over the four years from 242 journals and 2557 papers in 2010 to 328 journals and 3,634 papers in 2014. There has been an increase in the use of non-APC journals as well, but at a lower pace. About 27% of all Indian papers in OA journals are in ‘Clinical Medicine,’ and 11.7% in ‘Chemistry.’ Indian researchers have used nine mega journals to publish 3,100 papers. We estimate that India is potentially spending about US\$2.4 million annually on APCs and suggest that it would be prudent for Indian authors to make their work freely available through interoperable repositories, a trend that is growing significantly in Latin America and China, especially when research is facing a funding crunch. We further suggest bringing all Indian OA journals on to a single platform similar to SciELO, and all repositories be harvested by CSIR-URDIP which is already managing the OA repositories of the laboratories of CSIR, DBT and DST. Such resource sharing will not only result in enhanced efficiency and reduced overall costs but also facilitate use of standard metadata among repositories. Should Indian researchers pay to get their work published?”

But to make this effective it is important that a single platform should be created and resources across institutions should be shared. In this regard the recent recommendation from Indian National Science Academy makes sense and it states

*“Funding agencies should advise the concerned investigators to refrain from publication/participation in predatory and substandard journals (i.e., those that started publishing only as online journals in recent past, levy open-access or other charges, assure rapid publication and have ambiguous peer-review process and publication policies) and conferences. Such publications and participations must not be counted as research output. Payment of open access charges, except in case of publication in well established journals of repute, may be generally avoided. Articles placed on established pre-print archives, which provide perpetually free access to all, should be encouraged”<sup>37</sup>*

Despite many issues and hiccups open access will grow from strength to strength in India because the policy milieu is conducive and there is hardly any opposition. Yet to realize the full potential, rectifying inconsistencies in policies/guidelines, incentives for publishing in open access journals and better co-ordination among institutions and repositories on making repositories more accessible and interconnected, will be essential. But as Das (2014) points out sustainability of repositories in the long run is a big issue.

According to OECD “Open science encompasses unhindered access to scientific articles, access to data from public research, and collaborative research enabled by ICT tools and incentives. Broadening access to scientific publications and data is at the heart of open science, so that research outputs are in the hands of as many as possible, and potential benefits are spread as widely as possible.”<sup>38</sup>

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<sup>37</sup> <http://insajournal.in/insaojs/index.php/proceedings/article/view/544> (last accessed on 18th August 2018)

<sup>38</sup> <http://www.oecd.org/science/open-science.htm>

Open Science is relatively underdeveloped in India. The policy framework supports open data from government data sources including departments. But both as a concept and as a practice open science has a long way to go in India. If one takes the view that open science in India should include access and sharing of materials, facilities, applying open access, open source and open innovation principles in education and research, then, open science in India is under developed. Open Source Drug Discovery Project established by CSIR is an example of applying open source principles to drug discovery. It was established in 2007 with a focus on drugs for TB, a major disease in India.<sup>39</sup>

Open innovation and innovation challenges are promoted through a web portal <https://innovate.mygov.in/> and through this challenges are posed. <https://data.gov.in/> is a single point source for government data and also for open data sites. According to Rana

“The Ministry of Electronics and Information Technology has made some laudable efforts, including a policy around open data. India currently houses more than 1.6 lakh data resources and has published over 4,015 application programme interfaces (APIs) from across 100-plus departments. As a result, India’s global ranking by the Global Open Data Barometer has jumped.”<sup>40</sup>

He points out much more could be done to harness the data and enhance utilization and promote economic growth.

While open access has made strides, open science is restricted to few applications including data sharing. The complementarity between them is obvious and what India needs is formulation of a policy that links both with larger policy framework, particularly with the innovation policy.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

Main barriers are fake open access journals, lack of repositories and inadequate incentives. Another barrier is non-enforcement of norms on open access and archiving.

Cultural barriers include the perception that open access is not high quality publication and the importance given to top ranking publications and the pressures/incentives to publish in them

The interchange dynamics is the thrust towards open access and policies that favor open access

#### C. Main drivers (structural, cultural or related to interchange dynamics)

The key drivers are the policies and norms of funders and institutions. The move among scientists to support open access and prefer publishing in open access publications are key cultural drivers.

#### D. Best practices

The best practices are that of DST and DBT but in reality they have a long way to go.

### 5.7 Science education as integrated in research

Science education is a priority in the educational system in India. Ever since modern Science was incorporated in the curricula, right from primary school science is taught to all students. While students can opt for science streams which is typically a combination of Physics, Chemistry, Biology and

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<sup>39</sup> [www.odss.net](http://www.odss.net)

<sup>40</sup> <https://www.thehindu.com/todays-paper/tp-opinion/open-data-open-government/article24131779.ece>

Mathematics at higher secondary level, at degree level they can specialize in one of them and pursue higher education in science. Under the Indian constitution, education is in concurrent list which means that in matters relating to higher education, the laws and rules of the federal government have precedence over that of states. The Science education at higher levels is offered at different universities and specialized institutions. The top ranking institutions in science are Indian Institute of Science (IISc), the Indian Institutes of Science Education and Research (IISER), various Indian Institutes of Technology (IIT), Tata Institute of Fundamental Research (TIFR) and institutes sponsored or initiated by it such as National Center for Biological Sciences (NCBS), other specialized institutions under Department of Science and Technology, Department of Atomic Energy and Department of Space. Some of the universities like JNU, and Central University of Hyderabad are also doing well in science.

But mapping the activities in science education is difficult because they are too many and too diversified. Primary, Secondary and Higher Secondary education is largely funded by the state governments and they are the ones who fund a significant portion of the education in science in primary, secondary, higher secondary and college/university levels. Most states have colleges run by the state or funded by it, partially or fully. Similarly many state universities are funded partially by the state and partially by the central government through University Grants Commission (UGC). While state universities can apply to proposals called by DST and Department of Biotechnology a significant portion of the funding goes to institutes like IISc, IISER and IIT. DST has a scheme to promote research in state universities and this has helped them to set up research laboratories and improve the infrastructure.

At the national level National Council for Education, Research and Training conducts an annual National Science Talent Search Examination that enables school level students to participate and get scholarships for pursuing higher education and research in science.<sup>41</sup> Since its inception in 1963, it has enabled thousands of children to pursue higher education in science. In 2008 to incentivize students to pursue higher education in sciences DST initiated INSPIRE program . According to DST

**“Innovation in Science Pursuit for Inspired Research (INSPIRE)”** is an innovative programme sponsored and managed by the Department of Science & Technology for attraction of talent to Science. The basic objective of INSPIRE is to communicate to the youth of the country the excitements of creative pursuit of science, attract talent to the study of science at an early age and thus build the required critical human resource pool for strengthening and expanding the Science & Technology system and R & D base. A striking feature of the programme is that it does not believe in conducting competitive exams for identification of talent at any level. It believes in and relies on the efficacy of the existing educational structure for identification of talent.”<sup>42</sup>

This was necessary because since mid-1990s, many students opted for higher education in engineering and technology as the boom in software and information technology enabled services sector offered job opportunities to thousands of graduates with degrees like B.Tech/B.E and the increase in the number of engineering colleges on an unprecedented scale resulted in fewer students opting for higher education in science at bachelor level and post graduate level. As to join a bachelors course in engineering/technology, successful completion of higher secondary education was the pre-condition, many opted for this over traditional science courses in colleges. According to latest figure, so far 13.86 lakhs INSPIRE Awards have been sanctioned, of which about 47 % of the awardees are girls and 26% SCs/STs (DST, 2017). This is a

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<sup>41</sup> See for details [http://www.ncert.nic.in/programmes/talent\\_exam/pdf\\_files/Information\\_Brochure\\_2018.pdf](http://www.ncert.nic.in/programmes/talent_exam/pdf_files/Information_Brochure_2018.pdf) (accessed on 10<sup>th</sup> August 2018).

<sup>42</sup> <http://www.online-inspire.gov.in/>

significant achievement as it enables more women to choose education in science and as the program is also linked with employment opportunities it meets the twin needs of finding persons with the relevant qualifications for research in science and providing opportunities to those who have pursued PhD in science disciplines.

Ministry of Human Resources and Development (MHRD) is implementing a framework called Rashtriya Avishkar Abhiyan(RAA), to inculcate interest in sciences and mathematics among children, to nurture the spirit of inquiry and innovation, and, to encourage use of technology by children.<sup>43</sup> Targeted at the age group of 6 to 18 and with emphasis on class room and non-class room activities RAA envisages a whole range of interventions and initiatives.<sup>44</sup>

Niti Aayog has launched Atal Innovation Mission (AIM) and under this Atal Tinkering Labs(ATL) are to be set up in 2441 schools. These labs will give hands on training and enable students to experiment with design, learn to develop innovative solutions.<sup>45</sup>

In addition to these there are many schemes and initiatives sponsored by different agencies/institutions at the state level. Many states have state level S&T Councils which encourage science education related activities, manage museums and planetariums. They too numerous to list here. Besides these many NGOs and civil society groups are engaged in science communication and taking science to public through different media. We have described some of them elsewhere in this report.

## 5.8 Incorporation of AIRR dimensions into science policy discussions

### 5.8.1. Diversity and inclusion

The need for diversity and inclusion is very much there among policy makers and science academies. Regarding diversity in terms of gender and gender inclusiveness there is almost a consensus on the need to mainstream gender and provide women more opportunities in a milieu that does not discriminate against women. We have given examples of policies and initiatives in this regard.

Never the less women have a long way to go and still suffer from discrimination. Over a period, good practices and schemes have emerged and women can now talk of gender and science and call for inclusiveness and equality without sounding parochial or promoting self-interest.

### 5.8.2. Anticipation and reflexivity

Anticipation is a tricky affair but is inevitable. There are agencies like TIFAC that engage in foresight activities and prepare vision documents. On the other hand, anticipation is evident more in terms of actions and plans than in words. For example, recent thrust in cognitive sciences, alternative sources of energy, nanotechnology, cyber security, robotics and AI, and, advanced manufacturing systems, either through specific programs or missions, indicates that anticipation is part of science policy and practice. The SAC-PM produced a vision document calling to make India as a superpower in science. Nanotechnology mission was launched as a section of scientists felt that India should invest in nanotechnology and should not miss the bus. In the mid 1980s very few countries had departments for biotechnology. Anticipating the biotechnology revolution, a scientist, Dr.P.M.Bhargava persuaded the

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<sup>43</sup> <http://mhrd.gov.in/rashtriya-avishkar-abhiyan>

<sup>44</sup> [http://mhrd.gov.in/sites/upload\\_files/mhrd/files/raa/Order\\_of\\_RAA\\_Guidelines.pdf](http://mhrd.gov.in/sites/upload_files/mhrd/files/raa/Order_of_RAA_Guidelines.pdf)

<sup>45</sup> <http://www.aim.gov.in/overview.php>

then P.M, Rajiv Gandhi to establish a board on biotechnology and that was converted in to a department. In recent times, the evidence for suggesting initiatives anticipating that developments in selected technologies/applications would have significant Impact could be found in Economic Survey 2018.

India's space program is an example of anticipation led development. When it was conceptualized in the late 1960s and launched by early 1970s, developing countries embarking upon space exploration was unknown. Still the vision of Dr.Sarabhai and the support from the government enabled India to take this leap forward.

Reflexivity is difficult to measure and more difficult to discern directly in science policy in India. Review,s outcome and impact assessments and mid-term reviews are part of the practice of science policy. Hence one can state that reflexivity is part of the system. Never the less, whether that reflexivity comes with a deep reflection of responsibilities and duties and caution against negative impacts or unintended consequences is a big question. But when we go through the five-year plan documents and other policy related materials, it is clear that there has been reflexivity. This is evident in the changes in the direction, launching new initiatives and changes in the policies. For example, STI Policy 2013 reflects upon the past policies and makes a break by giving importance to innovation and role of private sector. In the 1990s the thrust on technological self reliance was less as import of technology was relaxed and made easier.

### 5.8.3 Openness and transparency

Right to Information Act had resulted in more openness as people now have the right and access to information. As most of the announcements and calls for applications for jobs and tender are made through the net, the openness has increased. Transparency is difficult to measure. Never the less, at least in few organizations like SERB there is transparency in processing applications for grants as the system is an on line one. The science policy system is not a closed universe but its interaction with the stakeholders and public at large is limited and is often uni directional. Hence although the system is not closed per se, it may seem to be opaque and operating mysteriously in its own terms.

### 5.8.4 Responsiveness and adaptation

The responsiveness and adaptation are evident in the changes in the policy. The policy focus in the 1950s reflected the visions of the then planners and policy makers who gave importance to public sector and establishing capacity in higher education and scientific research. Over the decades, the policies have given importance to different objectives such as attaining self-reliance, human resource development in selected sectors, promoting techno-entrepreneurship and investing in key technologies as response to the changed circumstances and demands. The STI Policy of 2013 represents both a continuity and change in the policy as it gives emphasis to innovation and suggests Public Private Partnership and greater role for public sector. Given the shifts in policies in different sectors, the policies and schemes have been adapted to meet the new demands and face the emerging challenges.

## 5.9 The integrated or fragmented nature of different responsibility related aspects

RRI is not part of the policy discourse, so we cannot directly map RRI against the keys In policies. As there is no national framework on ST&I that covers all science departments we cannot assume that thrtr is an integrated approach towards RRI keys. For example, while DST has taken the lead in Gender and Science and in Science Communication and has made them a key component, the same cannot be true of others. CSIR does not have policies similar to DST on gender and science. Similarly, although open access is promoted by policies in ICAR, DST and DBT, the policies and mechanisms are vastly different. Things are complicated by the fact that although there are many policies, the outcomes have not been great despite



proliferation of policies. In case of ethics as we pointed out it is of critical nature in health/life/biosciences as guidelines have to be followed and clearances are mandatory. This is not the case with research and innovation in other areas/disciplines. Strangely, open access has no direct linkage with science education as policies in both are dealt with by different ministries. In other words, there is no synergy.

Public engagement is not part of the official policy but science communication is. Often the latter is assumed to the former or stakeholder involvement. We can map the current position as below

Ethics- Integrated in some (life/biosciences, health) fragmented in others (few guidelines, lack of enforcement and lack of clarity)

Societal Engagement – is as good as absent but what is done in name of science communication is often equated with this.

Gender inclusion and diversity – Fragmented as there is no holistic or comprehensive approach . DST leads in this but as institutional policies are not uniform and as there are no binding reservations or rule that sets a minimum share for women it is fragmented. There is widespread concern and the need to address this is there.

Open Access and Open Science – Here also we find that there is enormous fragmentation and there is a lack of coherent policy framework. In case of repositories while their numbers have increased that has not resulted in a better collection. Instead most of the repositories are stand-alone units and institutions have created more silos in the name of open access.

Science Education- The preliminary conclusion is that science education is getting good attention but the idea of science education in India is different from the one indicated by European Commission. As this is a stand-alone key in the Indian context, the linkages are almost absent. For example ethics is part of science education but need not necessarily be at all levels.

These are not unexpected and perhaps such a situation is not unique to India. The fragmentation may hamper efforts to synergize but still the scope for integration will be better when responsibility or RRI becomes part of science policy discourse.

## **6. Organizational review and Outlook: Research Conducting Organization: JNU (India)**

### **6.1 Mapping of the organisation: JNU**

Jawaharlal Nehru University (JNU) was established in 1966 under the JNU Act, 1966 in New Delhi. Reflecting upon the visions, principles and ideals of the first Prime Minister of India, Jawaharlal Nehru the objectives were couched in terms such as ‘democratic way of life’, ‘social justice’, and, ‘a scientific approach to the problems of society’. It was established and made functional in the late 1960s and early 1970s. In the initial years the emphasis was more on humanities and social sciences and languages. Over the years the scope of learning and research was expanded. Now JNU is initiating courses in engineering and management courses are being proposed. Still it is considered as a university with left liberal ethos concentrating on arts, humanities, social sciences and languages. JNU being a university funded by the

Government of India as a central university has good infrastructure including vast land. No colleges are affiliated with it. It has only one campus. So in many ways it is an unique institution and that is its strength.

According to the JNU Act, the University's objective is:

*“to disseminate and advance knowledge wisdom and understanding, by teaching and research; and by the example and influence of its corporate life to promote the study of the principles for which Jawaharlal Nehru worked during his life-time, namely national integration, social justice, secularism, democratic way of life, international understanding and a scientific approach to the problems of society”.*

Admissions to courses in JNU are based on entrance examination conducted at 77 centres in different parts of India. There are many merit-cum-means scholarships and fellowships with support for research by faculty/students. The University follows reservation for 'socially and educationally backward classes' and for physically handicapped persons in admissions and jobs. The total reservation stands at 49.5% ( for Schedule Caste, Schedule Tribes, and, Other Backward Classes) and 3% for physically handicapped persons.

In terms of teaching and research, University has ten schools:

- School of Arts and Aesthetics (SAA)
- School of Biotechnology (SBT)
- School of Computer and Systems Sciences (SCSS)
- School of Computational and Integrative Sciences (SCIS)
- School of Environmental Sciences (SES)
- School of International Studies (SIS)
- School of Language, Literature and Culture Studies (SLL&CS)
- School of Life Sciences (SLS)
- School of Physical Sciences (SPS) and
- School of Social Sciences (SSS).

Besides there are four centers

- Centre for the Study of Law and Governance (CSLG)
- Special Centre for Molecular Medicine (SCMM)
- Special Centre for Sanskrit Studies (SCSS) and
- Special Centre for Nano Sciences (SCNS)

While every year about 2000 students register for different courses , being a University focussed in higher education and research, the number of undergraduates is limited to about 10%. Students in MPhil/PhD constitute 65% and those in Masters degree course constitute 25%.

The male/female ration is 1.09 indicating significant presence of women among students. The current student strength is 8732 and of these 4462 are women. Among faculty of 610, about a third are women. As the minimum entry qualification for Assistant Professor is PhD, it indicates that University is able to attract many women who have PhD or have PhD and experience in teaching/research. With more than 350 research projects being funded/sponsored by different organizations including international organizations, JNU has emerged as a major research university in India. This position is affirmed by it's ranking.

Regarding the governance structure, the University has certain regulatory bodies responsible for its functioning. These include the University Court, the Executive Council, and the Academic Council (JNU Act, 1966).<sup>46</sup>

To sum up, JNU has a formidable reputation built up over the years thanks to the visionary leadership provided by the founders, commitment to excellence in education by students and faculty, and support from Government of India.

## 6.2 Aspects of responsibility in organisational policy and practice

### 6.2.1 The conceptualisations of responsibility in the organisation

The University *per se* has no conceptualization of RRI. We do not want to over interpret few policies and the University Act to show that responsibility has been conceptualized in JNU and this is similar to what is envisaged in RRI. But what was clear from the interactions is that faculty are willing to think and conceptualize responsibility from their own experience, disciplinary discourses and practices and its relevance for JNU.

In the interviews, one senior professor at the School of Biotechnology, said that *“for a faculty member and researcher working in a University set-up, responsibility would mean conducting fair research in his/her lab and pursue their quest for deep knowledge, which would eventually lead to better research outputs for the society and country”*.

Another senior professor at the School of Physical Sciences stated that *“the most important responsibility for a faculty member of a public funded research university is to impart quality knowledge to the students and develop suitable manpower needed by the industry”*. This will be a great help to both society and country.

One Professor of Science Policy was of the view that *“any public funded research ought to have social relevance; be it a science research or social science research. It is responsibility of the researchers to see that their research has something to offer to the society and general people”*.

In other words, the responsibility dimension in addition to what they consider as their primary duty or commitment such as achieving excellence in teaching and research, commitment to research integrity has to be discussed and explained in the terms they are familiar with rather than through discussing only keys or idea of RRI.

For a Professor at School of Life Sciences, responsible research meant *“a research should be targeted towards solving some pressing societal challenges such as in healthcare. This is more important for a university like JNU which is a public funded university and thus has this obligation”*.

Similar views were expressed by another senior faculty of Science Policy, when he said in the interview that *“there should be relevance of the research for society and country. It should be ensured that the knowledge is used for benefit of under privileged sections for the society”*.

For the Dean of School of Computer Sciences, *“Research problems should be driven by societal problems”*.

For most of the PhD research students of the university, who were interviewed, responsibility meant responsibility of the researcher in a public funded university is to pursue a research problem which has relevance for addressing any existing societal challenge. They also view that such a responsible research

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<sup>46</sup> JNU (1966), ‘THE JAWAHARLAL NEHRU UNIVERSITY ACT 1966’ accessed on April 10, 2018 from URL: <https://www.jnu.ac.in/RTI/Act%20&%20Statutes/ACT.pdf>

system would be more effective and successful if it's undertaken in a participatory manner involving all the stakeholders.

In nutshell, in the discussions at both interviews and FGD, RRI was linked with the need for promoting socially-relevant research and innovation. It was also conceived as a means for ensuring “democratization of knowledge production”, where it was argued that all the stakeholders need to be consulted. The need for fostering Multi-Stakeholder Knowledge Platform to enable this was felt. There is a need to validate this argument in context to JNU. Examples like innovations which are socially relevant. (School of Biotechnology–Lal Path lab collaborations; patents and technology transfer, etc.). Each centre/department represented in the FGD or interview shall have some similar trend to validate this point. For example, the idea of democratization of knowledge production will include involving stakeholders, public engagement, gender and diversity and ethics. For some who are averse to commercialization of research it may mean thinking in terms of open access, open innovation and open source. To a faculty engaged in research in synthetic biology, issues like ethics, DIY bio and dual use can be relevant and these can be linked with RRI as there is literature on RRI and synthetic biology. How the university structure and bodies like academic council and board of studies can help in democratizing knowledge production is a good question to start with.

Many participants considered responsibility as inherent to one's personal ethos, which was rooted in moral values inculcated in the family as well as educational training. Terms like, ‘Socially Responsible Science’, ‘Socially Conscious Doctors’, were found synonymous to the contemporary RRI construct but these terms have been in vogue while RRI is very new. But defining such terms in the context of India is possible as we have civil society initiatives such as Medico Friends Circle, Indian Journal of Medical Ethics and vibrant peoples' science movements. But a beginning has to be made to take this discussion forward.

The need for responsible research was felt across by the faculty members, considering the negative impact of technologies on human health and environment. Also, it was opined that the benefits of research and innovation shall reach to the people in equitable manner, thereby accomplishing the mission of responsible research and innovation. It was also brought into notice that science fraternity, at large, is responsible and one cannot ensure responsible science, unless institutional mechanisms are set into work. Now whether the institutional mechanism is adequate for this can be discussed and if not what can be done can be discussed.

It is difficult to identify aspects of responsibility in the policy and practice of JNU. In terms of RRI keys some of the policies and practices such deprivation points can be considered to be relevant aspects of responsibility as they promote diversity. Since women are entitled to it in admissions it helps in getting women admitted to courses in sciences. Thereby this contributes to reducing gender imbalance in science.

On the other hand, a close look at the objectives of the University indicate that it has incorporated ideas of responsibility as understood by the founders, viz. Government of India, for example, *a scientific approach to the problems of society*. However, it will be difficult to correlate them with policy and practice. Another way to address this is to contextualize responsibility in the Indian context and see where does JNU fit in this.

JNU also has an Equal Opportunity Office which has undertaken several activities like organizing remedial classes, workshops, seminars, striving to create a barrier free campus for the disabled etc (JNU, 2017)<sup>47</sup>.

Thus it can be stated that while RRI per se has no mention in policy, there are schemes and initiatives that promote directly or indirectly, ethics, open access, science education and women's participation in science.

### 6.2.2 Ethics in the organisation

#### A. Description of the practice and its development and an assessment of how well it currently works

Ethics in JNU primarily means imbibing principles of academic integrity and research ethics (in case of dealing with human and animal subjects).

There is an Institutional Ethics Review Board (IERB) in JNU which is mandated to scrutinize the research proposal involving human and animal subjects. During the year 2016-17, IERB reviewed a total of 28 research proposals (JNU, 2017).

The IERB is responsible for reviewing research involving human participants at JNU, to ensure that subjects' safety, rights, and welfare are protected in conformity with applicable regulations and guidelines issued by the ICMR, UNESCO, WHO, Indian state and local laws and regulations. All studies on biological samples, stored samples, behavioural data samples and socio-cultural-psychological data samples involving human participants need ethical clearance by IERB. All such studies require IERB clearance before the commencement of the study. If the IERB is satisfied that the study is in no way harmful to the subjects under study, it issues an Ethical Clearance Certificate, valid for the period of study specified and ask the researcher to obtain 'informed consent' from the subjects, and to maintain 'confidentiality' of the subjects (IERB, 2018).<sup>48</sup>

In order to ensure academic ethics and check plagiarism, the University provides awareness and research support services in the form of regular seminars for the students and faculty members. It also provides certain software tools to check any plagiarism such as Turnitin, Grammarly, Urkund etc. It has also been made mandatory for all the PhD candidates to submit a plagiarism check certificate along with the Thesis at the time of submission.

In the interviews, one junior faculty member at the School of Social Sciences said that "*ethics is mostly related to doing one's research in a fair manner*". What the interviewee meant was that there should not be any act of cheating or stealing data and presenting them as their own.

Another senior professor at one of the science schools argued that "*ethics is actually a very personal sense of doing one's job in the righteous earnest way*". He further said that one cannot be forced to comply unless one is himself/herself not imbibe these principles within themselves.

One of the middle level faculty member was of the view for having strict policy in place to punish any unethical conduct and malpractice done by the researcher or faculty members.

Among the interviewed PhD students, the general opinion on ethics was that the academic and research integrity and ethics are core to JNU and this is ensured mostly.

In FGD also, participants brought in diverse views on ethics. It was pointed out that ethics was not merely about procedures and forms but that of principles and values, which should be integrated in pursuit of science. Many themes were discussed, which included relevance and reproducibility of scientific output, plagiarism, funding vis-à-vis passion for research, social relevance of science, going beyond

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<sup>48</sup> IERB (2018), 'Institutional Ethics Review Board (IERB)', accessed on August 5, 2018 from URL: <https://www.jnu.ac.in/ierb>

publication/patents, strengthening the basic research domain, defining research in context to its positive and negative implications and others.

This was not surprising as most of them were involved in funded research projects, while many were aware of debates within the broader science community on these issues. One faculty later referred to specific publications on reproducibility. The faculty discussed the roles, responsibilities and adequacy of Ethics Board in JNU. It was echoed by the group that Ethical requirements should not be just limited to signing a form, rather should be intrinsic and driven by values. It could be concluded that their understanding of ethics is closer to what is perceived so in RRI discourse.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier is the perception that ethics is a matter of fulfilling norms set by IERB and following procedures as mandated. The structural barrier is the lack of any serious research or teaching program on ethics in S&T or ethics in innovation and mandatory courses that bring the ethical issues and ethical dimensions in research and production and use of knowledge. Lack of awareness on the importance of adhering to the principles of ethical norms and practices.

The cultural barrier is the perception that ethics need not be the concern of all but should be a concern to only those who have to deal with IERB or similar mechanism.

The interchange dynamics can be the enhanced understanding and awareness.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

IERB helps in adherence of ethical principles of informed consent and confidentiality of the subjects involved in a research involving human subjects. This is a major driver. The mandatory submission of a 'plagiarism check certificate' by all the PhD candidates at the time of submission of their theses also acts as a structural driver for ensuring ethical conduct.

Culturally the main driver is the understanding even if it is limited that ethics cannot be ignored or set aside, at least, in some of the experiments and practices.

The realization that ethics has more to do with principles and challenging question than just a formality can be a driver. This is latent but not evident.

#### D. Best practices

Review of the research proposals involving human subjects by IERB and Standard Operating Procedures. Submission of a "plagiarism check certificate" by all PhD candidates along with their Thesis at the time of submission has been made mandatory by the University.

#### E. Current indicators (if any)

There are no such indicators to assess ethics at present.

#### F. All points of improvement

There should be a Policy of Academic and Research Ethics and mechanism to punish for violations and to deter misconduct and non-adherence. Strengthening IERB may be necessary. There should also be a mandatory Course on Academic Ethics and Research Integrity for all the research students of the university across all the disciplines.

#### G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	IERB but lack of integrating ethics in curricula	None	Capacity building and awareness
Potential drivers	Increased awareness about ethics, global practices and standards	Inculcating a concern for ethics	Translating concern and acceptance of global practices
Potential barriers	The limited scope within the structure to pursue ethics outside bodies like IERB	Indifference or lack of understanding	Acting within the research frameworks and project funding
Most important potential organisational actions	Expanding scope of ethics in research and innovation, giving importance to academic integrity	Bringing a positive approach to ethical issues	Contextualizing ethics in the university system and making it widely understood
Indicators for success	Inclusion in curricula, no. of faculty trained in ethics issues,	Measuring attitudes and values	As of now none

### 6.2.3 Societal engagement strategies in organisation

#### A. Description of the practice and its development and an assessment of how well it currently works

JNU does not have any specific policy or practice regarding societal engagement. As an institution, JNU, at different occasions make efforts to showcase the scientific works of the faculty members, to encourage public engagement with science such as on National Science Day. But this is mostly for awareness purpose.

According to the respondents of the interviews and FGD participants, Public Engagement is a crucial element, but lack of awareness among the population at large and inadequate science communication, may hinder science to reach a larger audience. However, it was stated that in an academic research, there is not much scope for engaging with public.

In the interviews, one of the senior professors at the School of Life Sciences said that *“given the highly technical nature of most of the research done at the science schools and departments, it is not feasible to engage with someone who do not understand the subject”*. Similar views were expressed by a faculty member at the School of Biotechnology when he said that *“Science researchers in general do not have any such mechanism to engage with public. They are mostly occupied in their labs and discuss their research problems with their colleagues and peers”*.

On the importance of having societal engagement, a Professor of Science Policy argued that *“there should be ways to involve stakeholders while conceiving and discussing a research topic. This will make the process more democratic”*.

It was brought to notice that the ‘definition of public’ should be the pre-requisite for deliberating on public engagement in sciences. As one faculty member said *“it is ok to engage with fellow researchers”* But engaging with public at large is a different game in which the scientist is expected to inform and educate the public. This is more of a one way communication, than a two way dialogue or engagement. Similarly involving stakeholders or making research and knowledge production more democratic are ideas that

have to be debated as these involve conceptual issues and problems in translating them in practice. How conducive is the structure to these is another question?

As one senior faculty at the School of Social Sciences stated in the interview that “*the scope of engaging general is more in social sciences research than in those related to basic sciences*”. This also reflects on the issue of broadening the idea of societal engagement taking into consideration the scope and feasibility.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The absence of policy and incentives for engagement. The fragmentation in terms of schools may be a functional necessity but makes engagement difficult as these are more like silos that are not interconnected.

The cultural divide between experts and lay public, on one hand, and the notion that public has to be educated and informed are the cultural barriers. This approach of talking to than talking with or lecturing and not conversing is not limited to scientists. This found among social scientists also.

Changes in perception and making an institutional policy on engagement can make a difference.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

Currently there are hardly any drivers at the institutional level .

The cultural driver is the interest and commitment of faculty to communicate and engage with public and interest in science communication.

If there is a policy that promotes societal engagement that can alter the situation.

#### D. Best practices

The voluntary practice of holding “Open Houses” by certain science schools annually. For instance, on National Science Day, School of Physical Sciences (JNU) conducts an Open House, where members of general public are invited to participate and ask questions. Faculty members explains them certain important scientific development in very simple and lucid language.

#### E. Current indicators (if any)

There are no indicators as such to assess societal engagement key.

#### F. All points of improvement

There should be an incentive mechanism to promote societal engagement by the faculty members more often. However, since not all research are usually applied types, it’s a difficult proposition to engage people or promote societal engagement every time. But, at least those research topics which have a bearing on certain societal section, it would be enriching to involve that section as well.

#### G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	It’s unique mandate and values enshrined in the Act	The liberal ethos and milieu	Linking engagement with broad academic work and research



Potential drivers	The scope for engagement in a liberal university	The academic culture that fosters debate and engagement with public issues	Linking engagement with broader values and concerns for society
Potential barriers	The lay person-expert divide, attitude that public needs 'education' and 'one way communication'	The value system in universities	Dismantling the barriers to engagement
Most important potential organisational actions	Starting with small initiatives in public engagement, dialogs and stakeholder meetings	The view that university is bound to be socially responsible and relevant	Informal steps towards engagement, consensus conferences/meetings
Indicators for success	No. of events, participation by faculty and public	No. of faculty involved and number of students and no. of departments/schools	Issues addressed and participation of stakeholders

#### 6.2.4 Gender equality and diversity strategies in the organisation

##### A. Description of the practice and its development and an assessment of how well it currently works

JNU uses “deprivation points” in its admission policy to provide extra marks to weaker and disadvantaged sections and this is applicable to women candidates as well. “ A woman or transgender candidate can get a maximum of 12 deprivation points in total including gender and backward district points and all female/transgender candidates belonging to SC/ST/OBC/PH, who have education from districts that are not Backward would get 5 deprivation points. All other candidates from backward regions would get 3 deprivation points “(JNU, 2017).

There are total of 8732 students at JNU, drawn from all parts of the country and representing various linguistic, religious, caste, and economic sections of the Indian society. Out of the total, more than 50 percent (i.e. 4462) are female students (JNU, 2017). This is by any means a very impressive trend and much of this owes to the policy of imparting deprivation points at the time of admission.

But the issue of drop outs figured in the discussion at both interviews and FGD. It was pointed out that, there were more dropouts among female students, due to societal pressure of marriage, pregnancy, relocation, etc.

One senior female faculty member said that “*women candidates who enroll for PhD programme leave it in between once they get married or after child birth, as there are no support system to encourage them pursue their research career*”.

Another junior faculty member the School of Biotechnology “*gender equality should also be achieved in the faculty positions as well and it should not be only seen as terms of female representation at the student level*”.

Despite such constraints, women are encouraged to pursue education and research in JNU and JNU is known for the liberal vibrant milieu in which there are opportunities for women to interact, lead and excel in academics. Incentives and schemes implemented by, inter alia, DST have given a fillip to women to pursue research.

A senior professor rightly stated in the interview that *“In India, it’s not only about the gender equality, but also the challenge lies in providing proportional representation to the underprivileged sections to allow them pursue their education and career in the best of the universities”*.

In addition to gender equality, the representation of weaker and disadvantaged sections belonging to backward class are also been provided in the university in accordance with the reservation laws on the country, to ensure diversity. B. Main barriers

Beyond this, there are no policies in JNU to promote gender equality in research and education. The question is whether there is a need to do more. The answer is, perhaps, yes and policies that mandate that committees should have a minimum no. of women or quotas for women in recruitment can make a huge difference.

Still there is more to gender equality than giving preference in admissions and jobs. The issue of drop outs figured in the discussion at both interviews and FGD. It was pointed out that, there were more dropouts among female students, due to societal pressure of marriage, pregnancy, relocation, etc. Although there is a provision that a student can deregister if she is not able to submit dissertation and later complete PhD by registering again and submitting dissertation, this alone is not sufficient.

Despite constraints and pressures from families and society, a positive aspect is that women are encouraged to pursue education and research in JNU and JNU is known for the liberal vibrant milieu to which women contribute. It is not that issues like sexual harassment are not in JNU but the point is the institutional milieu is not a one that covers up these or justifies them. More than the rules and procedures, it is the cultural ethos and spirit of equality that sustains women’s greater participation. B. Main barriers (structural, cultural or related to interchange dynamics)

Absence of a comprehensive policy to promote gender equality and greater participation is a major barrier. Culturally speaking while the milieu is conducive to women, there are aspects that hinder women’s participation and contribution as not all in the university can be considered to be progressive with respect to attitudes to women. The dynamics in JNU may tilt in one way or another, depending upon whether those who favour gender equality gain an upper hand or not.

C. Main drivers (structural, cultural or related to interchange dynamics)

JNU Act which envisioned for an inclusive academic environment for all; JNU admission policy of providing extra deprivation points to women and these are structural drivers. The cultural drivers are as described in the previous paragraphs. The interchange dynamics is the increasing participation in terms of numbers of students and faculty and the election of more women to bodies that represent student and faculty.

D. Best practices

Providing Deprivation points system

E. Current indicators (if any)

% of women among faculty and students. But we need more indicators and qualitative assessment.

F. All points of improvement

There should be an explicit gender and diversity promotion policy.

G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
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Aspects of organisations	Higher % of women in faculty, and, students. Sensitivity towards gender issues	Women friendly milieu (largely), equality in day to day practices and academic life	Furthering gender sensitivity and more inclusiveness
Potential drivers	Indirect quota for women, critical mass of women in faculty and students	Using the favourable policy milieu	Linking policies together as a framework
Potential barriers	Lack of specific efforts and status-quoist thinking	Assumption that nothing needs to be done as women are already about 50% in faculty and students	Absence of programs that go beyond the ones run by the university
Most important potential organisational actions	Quotas and incentives	Making it more women friendly and conducive for enhancing women's roles	Translating the ethos and concerns into tangible actions
Indicators for success	% of women in faculty and students., % of women professors among professors	% of women engaged in activities and their leadership in committees etc.	Increase in women leading in schools and departments in terms of positions
<i>Potential indicator for improved performance</i>		<i>Overall increase in faculty, students, positions of power and prestige, increase in projects led by women academics</i>	

### 6.2.5 Open access strategies in the organisation

#### A. Description of the practice and its development and an assessment of how well it currently works

On open access, JNU has launched an initiative to make theses and dissertations available through open access. This has come after the UGC Notification (Minimum Standards & Procedure for Award of M.Phil./ Ph.D Degree, Regulation, 2016) dated 5th May 2016, which mandates submission of electronic version of theses and dissertations by the researchers in universities with an aim to facilitate open access to Indian theses and dissertations to the academic community world-wide.

The idea is that the online availability of electronic theses through centrally-maintained digital repositories, not only ensure easy access and archiving of Indian doctoral theses but will also help in raising the standard and quality of research. Following this, an online portal has been established and maintained by JNU Central Library, where all the PhD theses can be accessed freely by anyone. JNU Central Library also provides free access to the students and faculty members of many open access journals and databases.

More than 21,000 theses and dissertations are now available online. The University has launched an ambitious program to digitize and make them available as open access resource.<sup>49</sup> This is a significant support to open access. JNU library actually gives access to open access publications to students and

faculty as a centralized facility. Thus although there is no open access policy as such , university has schemes to promote open access.

However, there is no Open Access policy which would make open access publication by faculty members and researchers as mandatory. Since, it is costly to publish in good open access journals without any budgetary support, the incidence of open access publications is found to be low.

Respondents of the interviews and FGD participants considered open access as a novel and praiseworthy concept. However, concerns were raised to regulate and control this mechanism, by addressing issues related to predatory journals, clarity in government policies, the cumbersome documentation process, ethical breach, lack of financial support, etc. One Professor at the Centre for Science Policy said that *“open access publication by a faculty member should be encouraged, as it provides more visibility for the faculty.....however, there should also be some financial support given.”*

Often there are no funds available for open access publication in the public funded projects. In lack of this, it's very expensive to get it published in a good open access journals. This has been stated by one of the faculty members at the School of Biotechnology when he said that *“open access publication by faculty members and researchers are low as it is costly to publish in good open access journals and there is no budgetary support to do this”*.

One of the faculty members also mentioned that *“the Indian funding agencies should also budget open access publication while giving grant, similar to the foreign funding agencies”*.

In fact, one of the senior professors at the School of Life Sciences said in the interview that *“the need of scoring higher academic points for career advancement does not encourage open access publication.... there should be some kind of mandatory guidelines to make publication of at least open article based on public-funded research grant, in an open access journals”*.

The issue of quality of most of the open access journals was also mentioned by a faculty of Science Policy. He said that *“Quality of open access journals is a major concern and those which are good, they charge a lot”*.

Among the PhD students, the opinion on open access was that it's a good thing and should be promoted with adequate budgetary support.

The broad consensus was that open science and open access deserved more institutional support.

B. Main barriers (structural, cultural or related to interchange dynamics)

Lack of policy and high cost to publish in reputed open access journals.

The cultural barrier is the prestige associated with publishing with high impact journals.

The policy to promote open access through incentives and financial support for publishing in open access journals can alter the dynamics.

C. Main drivers (structural, cultural or related to interchange dynamics)

The driver is that the awareness that access to quality journals is limited and open access provide a wider reach and increases visibility. The cultural driver is the spirit of sharing and dissemination and importance given to access. These two factors working in tandem change the dynamics in favour of open access despite constraints.

D. Best practices

JNU has made all of its PhD freely available online for open access by anyone.

E. Current indicators (if any)

None

F. All points of improvement

There should be a Policy of Open Access which should encourage open access publications by faculty members and provide budgetary support for them.

G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisation	Facilities and initiatives taken	Support for open access	Encouraging open access
Potential drivers	Policies of funding bodies, UGC and JNU	The support for open access and sharing	Better infrastructure and incentives
Potential barriers	Repositories remaining under accessed and not linked with others	The presumption that open access depository has all dissertations and documents	Creating awareness
Most important potential organisational actions	Incentives, dissemination of documents and easy access	Spreading open access culture	Linking repositories and students/faculty
Indicators for success	Additions over a specific period, access over a period	Increase in scope of coverage	Increase in usage including exchange and no. of documents added
<i>Potential indicator for improved performance</i>	1) Additions 2) Usage 3) Linkages 4) Sustainability		

### 6.2.6 Science education as integrated in research

A. Description of the practice and its development and an assessment of how well it currently works

Through seminars and exhibitions at some occasions every year, JNU does undertake some outreach initiative to make general public aware of certain scientific developments. By and large, programs are organized in the campus and outside to communicate scientific research of students. Science Day celebrations, public talks and exhibitions, school students' visit to science departments and many such endeavours are undertaken to encourage science communication and also to instate scientific temper among school kids.

For instance, on National Science Day, School of Physical Sciences (JNU) conducts an Open House, where members of general public are invited to participate and ask questions. Faculty members explain certain important scientific development in very simple and lucid language. Sometimes articles are published in newspaper and some public lectures are delivered in order to communicate science.

In the interviews, a senior faculty member at one of the Science School, said that *“given the science-society disconnect at times, it would be nice to have certain mechanisms to communicate science to general people”*.

Similar views were expressed by most of the PhD students also. They also mentioned that there should be a continuous science-society dialogue through means of communication in regular basis in order to expels any doubts and misunderstandings.

Since 2016, JNU has started a campaign titled “JanJanJNU” which is an annual open day event to engage with the nearby school children and show them the accomplishments of JNU by showcasing JNU history and current activities through a number of media such as movies, lectures, posters and guided visits to different schools and centres of JNU.<sup>50</sup>

Though science communication and education has been considered significant, it was also found that faculty members realized that scientists may not have the ‘talent’ to communicate their research, and hence a probable solution is to identify science communicators in respective science communities to take up such tasks. The group also voiced the need for communicating science in vernacular/local language for more impact.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

Societal engagement is not part of the official responsibilities or duties of the faculty members. The cultural barrier is the idea that public

#### C. Main drivers (structural, cultural or related to interchange dynamics)

Lack of time and resources to engage in such activities in a regular basis

#### D. Best practices

At some occasions, there are Open Houses being conducted where general people are invited and made aware of the advances in S&T.

#### E. Current indicators (if any)

None

#### F. All points of improvement

There should be some provision and incentive for the faculty members to devote some of their time for imparting science education and communication at a regular basis.

#### G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
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<sup>50</sup> SciWhyLab (2018) ‘Introduction: JanJan JNU’, accessed on June 27, 2018 from URL: <http://www.sciwhylab.org/janjanjnu/>

Current organization al practices	Limited to few activities	Conducive milieu	Diversity in activities and the target audience
Potential drivers	The capacity among faculty and students and policies	Promoting a culture that values such activities	Incentives and recognition
Potential barriers	Lack of clarity and resources	The tendency to give them least importance	Lack of promotional policies and support
Most important potential organisation al actions	Enhancing current ones, identifying new types/categories	Better engagement from faculty and students	Support from university system and stakeholders
Indicators for success	No. of events, No. of participants	No. of faculty/students involved	Response from stakeholders
Potential indicator for improved performance	1) Diversity in engagement 2) Stakeholder involvement in terms of gender, educational level 3) Impact of engagement		

### 6.2.7 Incorporation of AIRR dimensions into policies

#### Anticipation and reflexivity

It is not possible to identify policies that incorporate these directly. As a university JNU has academics and formal and informal groups that provide inputs and suggestions.

#### Openness and transparency

JNU has no specific policy on this. It is covered by Right to Information Act if that is taken as a measure for transparency .

#### Responsiveness and adaptation

Various new programmes, courses and centres have been established over the period and this has resulted in expansion, growth and diversity in the university in terms of schools and centres.

A “Group JNU Vision 2020 and Beyond” has been constituted in 2015 and is entrusted with the responsibility to assess University’s strengths and to indicate areas of improvements and suggest changes, of needed, in tune with the future teaching, research and other requirements the University.

### 6.2.8 Other concepts used to characterise responsibility in the organisation

As indicated earlier, responsibility is understood broadly but not in terms of RRI. Further, there is no any concept as such that is being used to characterize responsibility in the organization.

### 6.3. Reflection on Review findings, Outlooks developed and ways forward

#### 6.3.1 The integrated or fragmented nature of different responsibility related dimensions

Since there is no conceptualization of RRI per se in the organization, there is no integrated nature of different responsibility related dimensions. The various RRI keys are being pursued in their own way without having an overarching framework in place. There are various initiatives or practices that address these keys in some or other way. But not through any specific policy intervention.

#### 6.3.2 Common barriers or drivers

Primary barrier is lack of awareness about RRI. As it is not part of policy or practice, nudging and more interaction are needed. Since there is no in-built incentive mechanism either, there is lack of thrust to actually intensify actions related to some of the responsibility dimensions.

All these factors are responsible for the good performance of the organization in general.

#### 6.3.3 Final reflections and plan for follow-up

RRI as a framework model was introduced to the selected members of the organization and they were found to be quite appreciative of such a framework for their organization. However, they expressed the need for more detailed and wider deliberation to find in what form this can be incorporated in their policy. There are suggestions for making it more context specific to suit Indian scenario and social realities, in general and to infuse the idea of RRI in JNU, in particular.

We will follow it up with few more FGDs and by involving faculty and students from JNU in the proposed consultations. The follow up plan includes the following

- 1) Group meetings at different schools and centres
- 2) Identifying faculty members who can talk about RRI to others and who can help in diffusing this concept
- 3) Form a group from JNU to work on contextualizing RRI in the context of JNU and promote RRI as well as RRI keys in policy making and practice
- 4) Organize a consultation at JNU on RRI in which VC, Deans, and, Senior Professors will be requested to participate.



## **7. Organizational review and Outlook: Research Funding Organization: DST (India)**

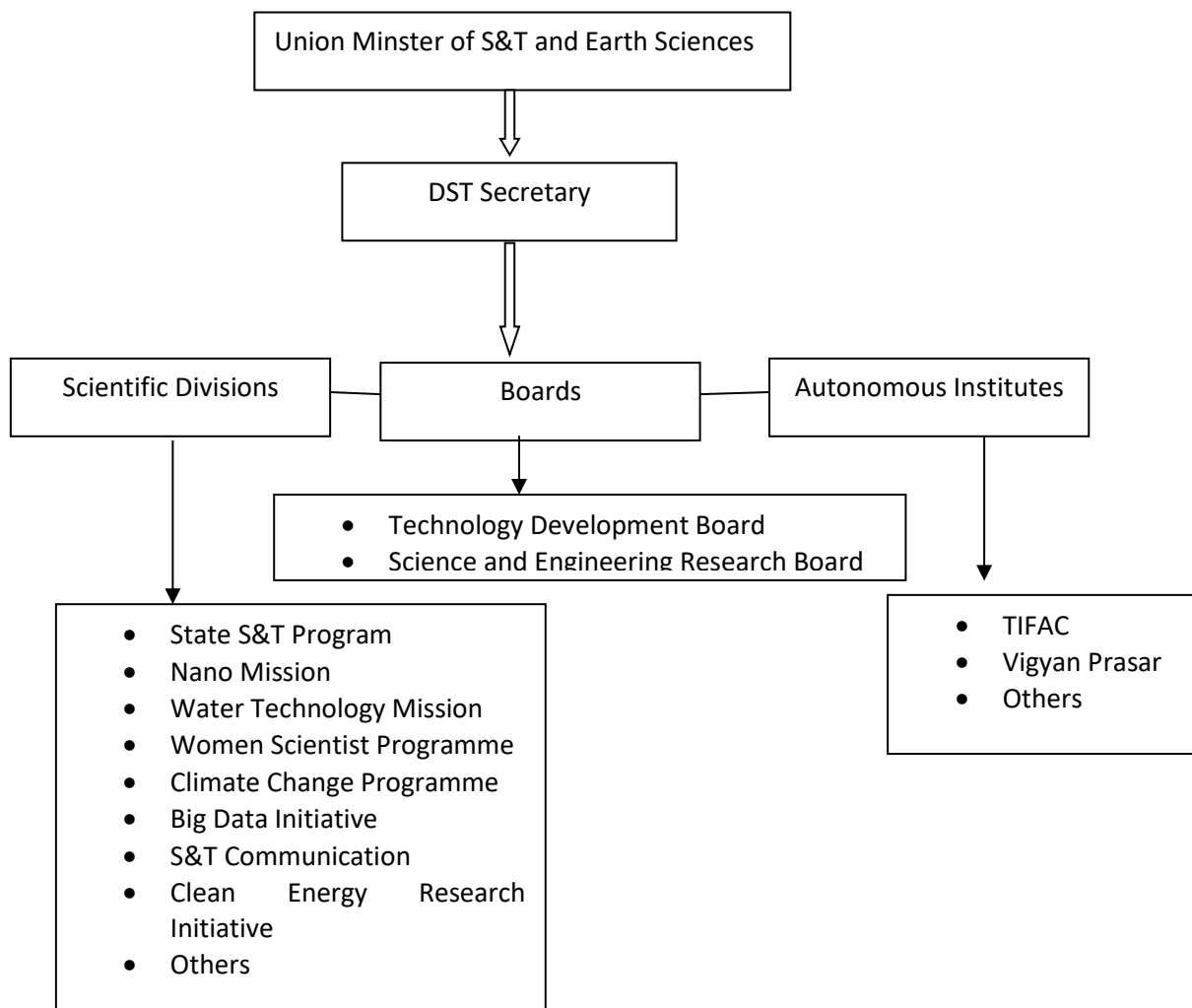
### **7.1 Mapping of the organisation: DST**

Department of Science & Technology (DST), established in May 1971 was the first Department dedicated to function as nodal department and in S&T, promoting new areas of science and technology. It has a broad mandate<sup>51</sup> and to fulfill that it has different divisions and autonomous organizations.

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<sup>51</sup> DST (2018), 'Mandate', accessed on July 12, 2018 from URL: <http://www.dst.gov.in/about-us/mandate>

## Organizational Structure:



The Science and Engineering Research Board (SERB), within the DST, is a statutory body established through an Act of Parliament, to support basic research in emerging areas of science and engineering. A regular faculty / researcher in an academic / research institution can seek research support to carry out his/her research. SERB has various funding schemes and fellowships towards this end. SERB is also entrusted to draft a framework for Scientific Social Responsibility (SSR) which can be said to have some resemblance with the RRI framework.

## 7.2 Aspects of responsibility in organisational policy and practice

### 7.2.1 The conceptualisations of responsibility in the organisation

There is no reference of the term 'responsibility' in the policy documents. The ST&I Policy Of 2013 hardly discusses this. But as discussed in the earlier paragraphs we have to go beyond the traditional

understanding of responsibility and contextualize it. When we do that it becomes clear there are policies and practices that promote some of the RRI keys and this has nothing to do with RRI or any other idea of responsibility.

Recently, there has been discussion undergoing within the DST on drafting of a framework of “Scientific Social Responsibility (SSR)”. Please see the earlier section on ethics in S&T on SSR. The details on SSR are yet to be publicly available, however, the discussion with some scientists during the interviews and FGD, revealed that the following elements are going to be the part of the SSR:

- the idea of promoting equipment sharing,
- mentoring of young scientists,
- ensuring public outreach by the scientific fraternity through popular media publications

As mentioned earlier, there is no explicit reference to the term ‘responsibility’ in the policy documents, however, the elements of responsibility are very much evident in the programmes and practices of the organization.

Among the respondents of the interviews and FGD participants, conceptualizations of responsibility varies from individual to individual. Different viewpoints were expressed.. Such as

*“Responsibility means that the research and innovation should be driven by the motive of providing technological solutions to the needs of people and society for both social and economic development of the country”;*

*“Responsibility also means that scientists should adhere to ethical and good practices in their discharge of duties”;*

*“Responsibility also implies that the senior scientists should also be actively engaged in mentoring young scientists and take some time out to communicate with general public, students and explain them any new scientific development in simple terms. This would help in developing scientific temperament of the society at large”;*

*“responsible research is producing and providing technological solutions that are accessible, affordable and available to general people”.*

Thus basically responsibility meant doing “science for societal good”.

It is true that DST funds projects that reach the vulnerable and marginalized. It also funds research to find technological solutions needed by the differently abled and senior citizens. However these are not done with any idea to prove that DST has conceptualized responsibility and these are practical examples for the same.

On the other hand as in other science funding organizations, responsibility of the persons in DST is governed by rules and by code of conduct.

### 7.2.2 Ethics in the organisation

A. Description of the practice and its development and an assessment of how well it currently works

To address conflicts of interest and ethics in scientific research DST has issued a Policy on Conflict of Interest<sup>52</sup> and Code of Ethics

The objective is to protect the integrity in decision making and to minimize biases. More over the policy is expected to maintain transparency, enhance accountability in funding processes, and to assure that processes for awards of grant are fair and non-discriminatory.

Under this policy DST can take against scientists or institutions, if the policies are violated. However we have no access to data to determine how effective this policy has been and what have been the impact. As no official data is available it will not be proper to make observations on it's effectiveness.

In the interviews and FGD also, following opinion were expressed on ethics by the officials and scientists of DST.

*"Ethics is regarded very high among the scientists".*

*"scientists are required to follow ethical and good practices in their labs and writings. There are guidelines such as ICMR which are to be followed in case the research involves animal and human rights".*

*"There are Institutional Ethics Committees which look after the complaints on unethical acts such as plagiarism".*

*"Any act of unethical practice is strictly dealt by the DST and his/her affiliating institution. He/she can be black-listed for any further project funding".*

It is important to note that DST does not have any Policy on Ethics. Only Conflict of Interest Policy exists. The need for an Ethical Policy was felt to ensure research integrity and check any misconducts in a formal manner.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier is lack of clarity on what ethics is and how it is directly relevant for a funding organization. The other barrier is the notion that rules that govern the conduct of employees and Policy on Conflict of Interest and Code of Ethics are enough.

The cultural barrier is shared understanding on ethics and the need to go beyond the prevailing rules and Code. The move for a comprehensive policy on ethics can make an impact. Changes in perception can play a key role.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

The main driver is the need to avoid conflicts of interest and to ensure that processes are fair and adopted in a fair manner. The structure is such that such policies are driven from above and are showcased to create an impression that DST is an organization that is committed to fair and ethical practices.

The notion that funding for science should be done in a professional manner and should be free of biases is a cultural factor that gives legitimacy to such policies. The adoption of this policy is necessary but not sufficient. Only a comprehensive policy will make a difference and be a game changer.

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<sup>52</sup> DST (2016) 'POLICY ON CONFLICT OF INTEREST' accessed on July 22, 2018 from URL:<http://dst.gov.in/sites/default/files/DST-Conflict-of-Interest-Documnt%20Approved-Final%20Version-07062016.pdf>

D. Best practices

There is a Policy on Conflict of Interest and Code of Ethics which ensures that there is no biasness or favouritism takes place in funding decisions.

E. Current indicators (if any)

None

F. All points of improvement

Code of Ethics can be expanded or replaced with a comprehensive policy on ethics.

G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	Policies and regulations and new thrust areas	Importance of ethics as a norm	Familiarizing organizations and scientists
Potential drivers	Importance of integrity in S&T , increasing importance to ethics in global S&T	Mertonian norms in science	Making ethics more relevant and acceptable
Potential barriers	Reducing that to procedures and data to be provided without implementing in letter and spirit	Lack of awareness and indifference	Ethics reduced to a matter left to few/committees to handle
Most important potential organisational actions	Broadening the scope and better enforcement	Inculcating a culture of respect to ethics	Integrate as an essential part of doing and funding science
Indicators for success	No. of institutions adhering to norms, no. of instances of violation vis a vis outcome of enforcement	Levels of awareness and acceptance	Incorporation in the institutional functioning
<i>Potential indicator for improved performance</i>	<i>Effective implementation and no of institutional committees or other bodies</i>		

### 7.2.3 Societal engagement strategies in organisation

A. Description of the practice and its development and an assessment of how well it currently works

DST is not active in public engagement but promotes science communication. But if we consider application of S&T for socio-economic development of weaker sections and marginalized communities then schemes of SEED (Science for Equity, Empowerment & Development) Division, such as Technological Advancement for Rural Areas (TARA) and Technological Interventions for Addressing Societal needs (TIASN) are good examples of such engagement.

- Technological Advancement for Rural Areas (TARA): This scheme aims to develop and deliver S&T based solutions through the adaptive research for rural and remote areas.
- Technological Interventions for Addressing Societal needs (TIASN): It also involves technology development through adaptive R&D for the benefit of the society.

Among the interviewees and participants of FGD, the idea of societal engagement was discussed and following viewpoints were elicited.

*“The idea of public engagement in terms of having face-to-face interaction and discussions with general people on various scientific developments is quite tedious”.*

*“in some issues the discussions with important stakeholders are arranged”.*

*“In general, the practice is to float a notice on a draft policy in newspaper or website, inviting public comments and suggestions”.*

*“public has been incapable in the past to understand science and research outcomes. Rather pressurizing scientists to engage public, it was asserted that the public needs to make efforts in understanding science”.*

*“Under SEED divisions, there are programmes which involve science-based NGOs to conceive and deliver the local rural technological requirements”.*

It can be observed from the various opinions expressed, that there is a kind of apprehension in engaging with the general public in matters of technical science, given the low level of scientific understanding among the general public. However, the DST has taken initiative to involve communities while developing some innovative technological solution for them keeping in mind their local requirements. This kind of ‘adaptive R&D’ has helped in successfully deploying the required technological interventions in the society.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier is that societal engagement is not perceived as an important task for the entire organization

As DST is organized in terms of divisions and as there are autonomous bodies besides institutions that are funded by DST, the cultural milieu does not prioritize societal engagement. The change can occur if it is prioritized.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

The mandate of the DST for using S&T for socio-economic development of the society drives the functioning of certain divisions of the DST towards societal engagement. The cultural driver is the one that sustains such funding within DST. But to make this to mainstream and to expand the scope and scale of funding should be ambitiously enhanced.

D. Best practices

Adaptive R&D by the SEED Division of DST which foster inclusive innovation. DST has taken initiative to involve communities while developing some innovative technological solution for them keeping in mind their local requirements. The needs of the target community members are studied and based on interactions, a product is designed and developed. This kind of 'adaptive R&D' has helped in successfully deploying the required technological interventions in the society.

E. Current indicators (if any)

None

F. All points of improvement

The scope and scale of activities supported by DST in SEED. At present, such activities are rather target based such as for rural population or for elderly people. This sort of approach should also be scaled up to include other general sector specific R&D also.

G. Agreed points of improvement, with action plans and indicators for success NOT APPLICABLE

H. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	Importance to gender, indigenous communities	Understanding the needs of vulnerable sections	Scope of coverage and funding
Potential drivers	These programs relevance in S&T for development	Impact on communities and needs met	Contributing to society
Potential barriers	Tokenism and limited funding	Lack of fuller understanding and ignorance about the scope	Lack of new approaches and schemes
Most important potential organisational actions	Concern for women and needy resulting in appropriate solutions	Established schemes and continuation	Increase the scope and coverage, more funding
Indicators for success	Economic impacts, socio-economic indicators	Diversity in groups benefitted	Coverage, acceptance by target groups
<i>Potential indicator for improved performance</i>	<i>Long term impacts, contribution to sustainable development</i>		

## 7.2.4 Gender equality and diversity strategies in the organisation

### A. Description of the practice and its development and an assessment of how well it currently works

Taking cognizance of the issue of fewer women uptake in science research in India, in 2002, for the first time, DST initiated exclusive schemes to enable women to pursue a career in scientific R&D, when it launched DISHA Programme for Women in Science, to address concerns related to the break in their career due to familial issues like marriage, child birth and so on. Before that, only sporadic attempts were made in this direction (PIB, 2016).

Subsequently, in 2014, DST restructured all the women specific programmes under one umbrella called “KIRAN (Knowledge Involvement in Research Advancement through Nurturing)”. It is primarily aimed at gender parity in S&T sector by inducting more women talent in the research and development domain through various programmes, mainly, fellowship schemes. Since 2016-17, a new programme namely Mobility Scheme has been also launched under KIRAN to address relocation issue of working women scientists (PIB, 2016).

The budgetary allocation under KIRAN for the year 2014-15 was 5.5 Million Euros. This was enhanced to 7.2 Million Euros in the year 2015-16, 7.5 Million Euros in 2016-17 and to 9.3 Million Euros in 2017-18 (Lok Sabha, 2018). This shows a constant increase in the budgetary allocation over the period of time, which is a positive indication.

A recent Vision Document on Women in S&T released by Inter-Academy Panel<sup>53</sup> on ‘Women in Science in India’ (2016) has stated that under KIRAN, about 3000 projects have been already been awarded under the fellowship component and about 400 projects sanctioned to train women scientists in the area of patents and IPR. The Document further mentioned that these DST programmes have led to increase in the number of projects proposals from women PIs.

However, it can be observed that there are fewer women scientists at the higher decision making positions such as in funding decision panels or key policy decision committees. The issue of the ‘glass ceiling’ effect has been debated and discussed for quite some time (Bal, 2005; Dogra and Jayaraj, 2018). Kaiser Jamil, former President, Third World Organization for Women in Science (TWOWS) also stated that there can be seen a *“drastic drop in the percentage of women from the doctoral level to the scientist/faculty position (in India) suggesting a bottleneck at the employment stage due to recruitment procedures and family responsibilities”*. She further highlighted the lack of women at the senior administrative and policy making positions in scientific institutions and brought forth the issue of the attitudinal barrier *..”the belief that men are better suited for highly skilled tasks and advanced technologies”* (Jamil, 2011).

The Vision Document of the Inter Academy Panel had also acknowledged this serious issue and argued for increasing the number of women scientists in key management and decision making positions to promote their leadership roles (NASI, 2016).

This concern was also voiced by the participants at the FGD, where the participant from SERB (DST) informed that SERB has recently started inducting about 30% of women experts in their project funding

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<sup>53</sup> Inter-Academy Panel comprised of Members drawn from all the 3 National Science Academies of India viz. Indian Academy of Sciences (Delhi), The National Academy of Sciences (Allahabad) and Indian National Science Academy (Bangalore).



decision committees, but there is no such policy or legal obligation in place so far, to make this a mandatory exercise.

Recently, to intensify greater representation of women in science, a Standing Committee for Promoting Women in Science has been constituted by the DST in 2016. This Committee will make endeavours to create gender enabling environment in S&T institutions and recommend special measures to ensure growth of women in science.

Thus DST is playing a key role in promoting gender equality and opportunities for women and over the period of time the budgetary allocation has also been increased. However, given the scale, the level of funding beneficiaries needs to be enhanced further to meet the needs of many women who aspire to pursue science. DST alone cannot solve this problem. But unless DST is funded sufficiently it is difficult to meet even a significant portion of the need for supporting women to participate and contribute to science. There is also a need for a more focused and dedicated approach required to address the lower representation of women in higher decision making positions.

Among the respondents in the interviews and participants of the FGD, the following expressions were made on account of the issue of gender equality.

*“the number of women scientists in the country and at DST is low, but this scenario is similar elsewhere in the world too”.*

*“DST has launched many schemes to promote women scientists in the research field in India”.*

It is important to note that there is no gender policy at DST as such. The need to have such a policy was felt by the participants.

B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier is the limited scope of activities on gender and science and insufficient funding. The cultural barrier is such initiatives are perceived to be the work of the relevant section and they are not considered as mainstream activity. Scaling up such initiatives, more funding and creating new schemes can make a change and mainstreaming gender is also important.

C. Main drivers (structural, cultural or related to interchange dynamics)

The main driver is DST's commitment to this program. The cultural drivers are the realization that such programs are needed and increasing participation of women in S&T and in funding organizations.

D. Best practices

Programmes such as KIRAN by DST help women to return to science after a break.

E. Current indicators (if any)

% of women in S&T as faculty and researchers

F. All points of improvement

There should be a Gender Policy of the DST. There is also a need to develop indicator to measure the progress of various DST women-centered schemes.

G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	Established program, now restructured	Consensus on giving importance to gender	Past impact, future impact and meeting a genuine objective
Potential drivers	Thrust by government, science academies and other organizations	Recognition that there is much scope to intervene	Policies that cater to various needs
Potential barriers	Limited funding, limited no. of beneficiaries	Gender becoming yet another issue without understanding its importance	Lack of imaginative schemes and new approaches
Most important potential organisational actions	Integration of schemes	Acceptance across departments and institutions	New schemes and diversity in meeting new needs and expectations
Indicators for success	% of women scientists benefitted, no. of appointments/jobs, funding as % of overall budget	Level of awareness and acceptance,	Impact on targeted sections of women
<i>Potential indicator for improved performance</i>	<i>Demands vs needs met</i>		

### 7.2.5 Open access strategies in the organisation

- A. Description of the practice and its development and an assessment of how well it currently works

In order to enhance the accessibility of research output from the publicly-funded research, DST promulgated a National Data Sharing and Accessibility Policy (NDSAP) in 2012 to facilitate the access to Government of India owned shareable data and information in a proactive and periodically updated manner, thereby permitting wider accessibility and use of public data and information. This policy applies to all data and information created, generated, collected and archived using public funds provided by the Government of India directly or through authorized agencies by various ministries and departments (DST, 2012).

Subsequently, the Department of Science and Technology (DST) and Department of Biotechnology (DBT), jointly formulated a “DBT-DST Open Access Policy” in 2014 for providing free access to the information and knowledge generated through the use of DBT and DST funded research, subject to Indian laws and IP policies. For this, each institution (where the DBT/DST funded research is undertaken) is encouraged to set up its own inter-operable institutional open access repository for its research papers and review articles published in peer-reviewed journals. The Ministry of S&T has set up a central harvester

([www.sciencecentral.in](http://www.sciencecentral.in)) that harvests the full-text and metadata of these publications. This central harvester has link to each institutional repository (DBT, 2014).

The twin objective as envisaged in this Policy was to maximize the distribution of the research publications by providing free online access by depositing them in an institutional repository and; to ensure the quicker availability and accessibility of cutting edge research to other researchers to foster a richer research culture.

But as pointed out in the earlier section on Open Access, there is a gap between policies and implementation in terms of setting up institutional repositories, updating them and encouraging open access publication in non-predatory journals.

The participants at the interviews and FGD, though viewed open access publication as a right endeavour, expressed concerns regarding the nature of these open access journals, as most of them are of predatory in nature. Some of the opinions expressed by the respondents are as follows:

*“the idea of publishing in Open access journals is good; however, a word of caution is for the predatory journals”.*

*“the pressure to publish more for promotion is leading many scientists to get in the trap of such fake journals”.*

*“if a scientist is found to have published in such fake journals, he/she would have to bear the disciplinary actions”.*

*“DST is coming out with a new policy which will allow open access to instrumentation facilities created by the DST funding for private sector as well”.*

*“Open access should not be limited to publication in open access journals or open science research, but it should also cover open access to technologies as well”.*

They also highlighted the issue of high Article Processing Charge (APC) being levied by the good open access publications, which discourages many Indian researchers thus opting-out of these open access journals. This scenario can be addressed if DST in its funding decision allows for budgetary allocation for such open access publications. The participants also expressed the need to encourage the institutions to utilize the mechanism of institutional repositories in a dynamic manner, by bringing some sort of mandatory clause in the Policy itself.

DST has also been mulling with the idea of providing open access to the infrastructural facilities for some time and has recently contemplating, a national policy on ‘Scientific Research Infrastructure for Maintenance and Networks (SRIMAN)’ for ensuring accessibility of expensive scientific equipments based in public institutions for all the stakeholders who need them (DST, 2017).

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The main barrier is ineffective implementation of policies. The cultural barrier is the perception that open access publications are not publications that carry quality and reviewed articles. The change will occur when the policy is implemented effectively and a new policy is in place to promote a wholistic development of open access.

#### C. Main drivers (structural, cultural or related to interchange dynamics)

The key driver is the realization that open access and open data are critically important. The cultural milieu that favors open access is a driver. A key driver can be better implementation and DST monitoring performance of repositories and implementation in institutions funded by it

D. Best practices

National Data Sharing and Accessibility Policy (NDSAP) formulated in 2012 by the DST facilitate the access to Government of India owned shareable data and information in a proactive and periodically updated manner, thereby permitting wider accessibility and use of public data and information.; Central Data Harvestor has link to each institutional repository, thus providing free access to the publications.

E. Current indicators (if any)

None

F. All points of improvement

The institutional repositories are needed to be made fully functional. AT present many of such repositories are not working or not being updated regularly.

There should also be some incentive mechanism and budgetary support to enable researchers publish in good open access journals. There should also be a orientation course for scientists on Open Access, so that they don't fall prey to fake open access journals.

G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	It is part of broad policy thrust on open access and data	Importance given to open access	Linkage with other policies
Potential drivers	Wider acceptance and need for open access and open data	Culture of sharing and curating	Policies of other departments
Potential barriers	Lack of clarity, lack of enforcement	Managing repositories and updating	Not part of regular research or funding
Most important potential organisational actions	Incentives, resource allocation	Create awareness and capacity building	Enabling framework
Indicators for success	No of institutions adhering to policy, no of documents, repositories, access ration	Diversity in repositories in terms of subjects, collections and sharing	Impact of open access on research
<i>Potential indicator for improved performance</i>	<i>No of repositories and documents, long term sustainability</i>		

## 7.2.6 Science education and communication as integrated in research

A. Description of the practice and its development and an assessment of how well it currently works

The broader goal of imparting science education and communication in India is to encourage younger population to pursue career in science. Various policies over the period of time, starting from the Scientific Policy Resolution of 1958, have stressed upon the need for this.

In 1976, through a Constitutional Amendment of the section on Fundamental Duties, a clause *‘To develop the scientific temper, humanism and a spirit of inquiry and reform’* was added in the Article 51A. Subsequently, a nodal agency, the National Council of Science and Technology Communication (NCSTC), was set up under the DST to take necessary measures to inculcate scientific temper in the citizens.

NCSTC has initiated various schemes and launched many initiatives over the period of time for science communication and education. Some of the key initiatives are Science Express, National Children’s Science Congress, India Innovation Initiative etc.

Vigyan Prasar, an autonomous entity under the DST, has also been quite actively engaged in science popularization activities across the countries, mostly targeting the students at school and colleges.

In order enhance participation of girls in higher education and careers in S&T, DST has conceived a new programme ‘Vigyan Jyoti’ to be launched in 2018 for intervention at school level, which will comprise of a residential programme of 3 weeks duration for selected meritorious girls studying in Class XI. This is aimed at mentoring and motivating the girl school students to pursue higher studies and careers in science and engineering (Lok Sabha, 2018).

There are various schemes and programmes launched by the DST in order to enhance students’ enrollment in science streams and encourage them pursue careers in science R&D.

DST has launched a national programme, INSPIRE (Innovation in Science Pursuit for Inspired Research) to tap students early in life and nurture them to take up science and pursue a career in research. In the context of Start-up India initiative of the Government, INSPIRE Awards-MANAK (Million Minds Augmenting National Aspiration and Knowledge) scheme has been revamped to foster culture of innovation among school children of class VI to class X. According to latest figure, so far 13.86 lakhs INSPIRE Awards have been sanctioned, of which about 47 % of the awardees are girls and 26% SCs/STs (DST, 2017).

The participants at the interviews and FGD highlighted the role of science communication and education in the era of knowledge society and commended the efforts of DST in this regard. Though, the need was felt to enlarge the scope and scale of such initiatives to cater to wider population.

DST has recently come out with a new scheme titled “AWSAR (Augmenting Writing Skills for Articulating Research)”, to encourage popular science writing by young PhD Scholars and Post-Doctoral Fellows during the course of their higher studies and research pursuits in newspapers, magazines, blogs, social media, etc. There is a provision for cash rewards for publishing in a popular media.<sup>54</sup>

On the significance of having an effective science education and communication mechanism, one of the senior scientist, in an interview said that *“given the all-pervasive character of technologies these days, the common people must be provided with true picture and basic understanding of these developments and this task should be taken by the scientists in a more pro-active manner”*.

#### B. Main barriers (structural, cultural or related to interchange dynamics)

The understanding of science education and science communication are barriers. The cultural barrier is the perception that science education means teaching science with students as passive learners and

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<sup>54</sup> <http://www.awsar-dst.in/>

science communication as a uni-directional issue. The dynamics will change when the perception changes or the policy undergoes a radical shift

C Main drivers (structural, cultural or related to interchange dynamics)

The thrust on science education and communication are the drivers, The cultural driver is the understanding that science education is a must and science communication is crucial to enhance public understanding and to gain legitimacy among public. If science education and communication are given more importance and access to science is increased that will change the dynamics.

D. Best practices

Science Express initiative: It is one of the most popular, mega outreach programme of NCSTC in the last ten years. It is an innovative mobile science exhibition mounted on a specially designed 16 coach AC train, which has been travelling across India since 2007. This has received an overwhelming response and has reached out directly to over 18.1 million visitors so far, mostly the school and college students.

E. Current indicators (if any)

None

F. All points of improvement

Given the large and diversified population, the efforts needs to be scaled up and use of vernacular medium should be promoted more often. Social media should also be tapped in to provide effective science education and communication among young population.

G. Resulting matrix

	Structural issues	Cultural issues	Interchange related
Aspects of organisations	Autonomous bodies and programs that have a clear focus	The culture of communication and popularization and meeting needs of knowledge thirsty population	Programs and initiatives to be integrated
Potential drivers	Policies, positive response received and better resources	Use of various types of media targeting different types of audience and in many languages	Technology and dissemination
Potential barriers	Lack of content, human resources, costs	Top down communication and messages lost in translation	Reaching the right audience and creating an impact
Most important potential organisational actions	More thrust in communication and education	Developing content for various age groups and in many languages	Better use of technology and understanding user needs

Indicators for success	% of population covered, impact of communication	Diversity in terms of media and languages	No. of programs, effective use of media
<i>Potential indicator for improved performance</i>	<i>Impact and coverage</i>		

### 7.2.7 Incorporation of AIRR dimensions into policies

#### **Anticipation and reflexivity**

TIFAC under DST conducts foresight exercises in S&T and prepares vision documents. DST being the key S&T policy making institution has internal mechanisms that anticipate and also makes use of feedback and inputs. These are not in public domain. But there is anticipation. This is evident in DST establishing nanotechnology mission and other initiatives on emerging sciences and technologies.

DST has mechanism to assess the projects and schemes funded by it. The impact analysis and evaluation exercises provide inputs for reflexivity.

#### **Openness and transparency**

DST is covered by Right to Information Act. To promote integrity and transparency Code of Conduct was introduced.

#### **Responsiveness and adaptation**

DST as a funding and policy making body is responsive to developments and expectations. This can be discerned from various policy statements and initiatives. Similarly responding to developments elsewhere and realizing the importance of cognitive sciences, DST launched a major initiative in this field.

### 7.2.8 Other concepts used to characterise responsibility in the organisation

Recently, there has been discussion and deliberation undergoing within the DST on drafting of a framework of “Scientific Social Responsibility (SSR)”, in lines of Corporate Social Responsibility (CSR). The details are yet to be shared publicly. So far, SSR has discussed the idea of promoting equipment sharing, mentoring of young scientists, ensuring public outreach by the scientific fraternity as mandatory.

### 7.3. Reflection on Review findings, Outlooks developed and ways forward

#### 7.3.1 The integrated or fragmented nature of different responsibility related dimensions

There are different divisions in the DST, which have their own mandate and work allocation such as Gender division, S&T communication division, technology mission division, international cooperation division, funding division etc. Thus, the different responsibility related dimensions are being dealt in a fragmented nature. As mentioned earlier, this has nothing to do with any conceptualization of responsibility or RRI as such in the DST.

#### 7.3.2 Common barriers or drivers

Primary barrier is lack of awareness about RRI. As it is not part of policy or practice, nudging and more interaction are needed. The progress on responsibility dimensions are generally driven by the national S&T policies, that the DST formulates from time to time and guidance from NITI Aayog.

#### 7.3.3 Final reflections and plan for follow-up

RRI as a framework was introduced to the selected members of the organization and they were found to be quite appreciative of such a framework for their organization. However, they expressed the need for more detailed and wider deliberation to find in what form this can be incorporated in their policy. There are suggestions for making it more context specific to suit Indian scenario and social realities.

We will follow it up with few more FGDs and by involving more scientists and policy makers from DST in the proposed consultations. The follow up plan includes the following

- 1) Group meetings at different divisions of the DST
- 2) Identifying scientist who can talk about RRI to others and who can help in diffusing this concept and
- 3) Organize a consultation at DST on RRI in which Secretary and senior officials will be requested to participate.

## 8. Summary of findings on each responsibility dimension

### 8.1 The concept of responsibility

The concept of responsibility is not directly evident and can be discerned if we redefine it as responsibility to further national development goals and socio-economic development. The concept of Scientific Social Responsibility is being explored by DST which is attempting to translate that into practice. The NITI Aayog report on AI with the idea of AI for all discusses responsible AI and gives importance to ethics, privacy and security. So responsibility or RRI is not directly traceable in science policies.

### 8.2 The notion of 'RRI'

It is not in science policy. It is known to a few although many can recognize the keys and are familiar with the issues being addressed through them. RRI per se is almost unknown. But as most of the keys are related to policies and rules in one way or other people could relate to them and through them try to understand RRI.



### 8.3 Ethics

Ethics is recognizable and is the cause for regulation in research (including treatments under trial) in biosciences/life sciences/biosciences. The norms in this are comparable with the best in the world, if not 100% compatible. DST has a code and guidelines and few other organizations have. But many issues like research integrity, plagiarism, misappropriation remain largely unresolved or poorly addressed as there is no overarching framework or law.

### 8.4 Societal engagement

This is not part of S&T policy and in recent times attention is being paid to. The core issue is this perceived in a top down approach thinking that public need to be informed, educated and made to understand than to be engaged with. The idea that expertise can give legitimacy which public has to accept is a barrier in genuine public engagement.

### 8.5 Gender equality and diversity strategies

The inequality is recognized and efforts are made to address it. DST has taken many steps in this and the three Science Academies have also called for steps to increase women's participation and contribution. The good thing is Gender equality is considered an important issue and is not seen as an issue that only women should be concerned. The diversity strategies are not effective as there are no reservations for women but the current ones are being expanded and in future more steps will be taken to increase diversity.

### 8.6 Open access and open science strategies

Open access policies are in place but implementation is not effective. The peril of fake open access journals that charge for publication and indulging in dubious practices has had a negative impact. Although many institutional repositories have been established, issues in updating collection, absence of linking with other repositories and lack of uniformity in policies have hampered their effective utilization.

### 8.7 The inclusion of science education into research

While science education has been given the due importance in the education system, many schemes have been launched to ensure that children are incentivized to pursue higher education and research in science. These schemes have resulted in thousands of children opting for higher education in science and thereby created a critical mass of students pursuing PhD in the sciences.

### 8.8 Incorporation of AIRR dimensions

If one looks for direct and explicit statements for Anticipation and Reflexivity in policy statements there can be disappointment. But anticipation and reflection are part of the policy making process and there are evidences to show that policy makers do engage in anticipatory activities and reflective practices. There are no specific institutions mandated to do them.

### 8.9 The integrated or fragmented nature of different responsibility related dimensions

As responsibility is not mentioned explicitly in the policy statements and since RRI is not part of policy discourse, we after analyzing the presence or absence of keys conclude that there is fragmentation and there is hardly any synergy. Moreover even in keys that have been included in policies there are many issues in implementing them and by and large they remain unconnected with the larger policy framework

nor form part of the core practices. But this can be addressed by initiatives that can bring in synergies and through moving the keys to center stage in policy making. But how to do that is the big question.

## 9. Discussion of findings

RRI is relevant for Indian science policy and some of the keys have been included in policies. But the core question of contextualizing responsibility or developing an Indian vision for RRI and Indian version of RRI cannot be evaded if RRI has to gain acceptance in India. Our research shows that RRI as a concept is novel and the keys are relevant for India. But what should be the vision and mission of RRI in India or RRI for India. The RRI theory and practice have to be made more relevant and meaningful for the Indian context. We think that we have to bring in Access, Equity and Inclusion, as important values/keys for this. For example, the dimension of ethics can include accessibility to innovations or pursuing R&D that enhances equitable distribution of benefits from innovations. Similarly, public engagement in the Indian context will have to be built upon the current laws and rules than on abstract principles or borrowed models. Regarding open access and open science, there are many initiatives that are important but they do not stem from RRI discourse. We find that gender and diversity issues are addressed and they are addressed on the basis of ground realities in India than on abstract notions of gender and diversity. What we perceive is that there are common aspects between science policy and practice in India and RRI, there are differences as well. RRI may perhaps has to be 'translated' for India, to make it more relevant and acceptable. In such a case a review of science policy and practice, analysis of institutional structures and processes and understanding of factors that are unique to India such as caste, enormous diversity in terms of language and culture, and, India's experience with modern S&T can be useful to make a beginning.

Thus the discussion and translating RRI into practice cannot be a one-way street but a two-way process. While India has lot to learn from RRI theory and practice, it has lots to offer as well. If this happens it will be mutually beneficial.

## 10. Conclusions

These are interesting and challenging times for RRI in India. There is scope and opportunities are opening up and the novelty of RRI can be appealing. So it is time to take forward the idea and practice of RRI in India. But in the end RRI in India may not be identical to RRI in Europe. They cannot be twins nor be distant cousins, but they may be siblings that look differently sharing some features and with unique differences.

### 10.1 Policy recommendations to national policy makers

1) Examine how RRI is relevant for India and how India can benefit from that

Instead of adopting RRI, lock, stock and barrel, from Europe as an idea and practice, the relevance of RRI should be examined. For example if it is shown that some of the measures taken on account of implementing RRI have been effective in addressing some issues then it is worth exploring as to what is the role of RRI as a concept and practice in this. Any concept however useful it may be, has to be

understood in the context in which it is proposed to be applied and only then it will be more acceptable. Science and Technology may be universal but science policy contexts, national priorities, values and expectations from S&T are not. Hence even if it is assumed that RRI has been uniformly accepted and adopted in Europe that alone will not be a reason for India to adopt RRI. Hence examining RRI in the context of India, applicable principles and practices, and, evaluation of RRI in theory and practice are important.

- 2) Learn from the best practices in different RRI keys from Europe and elsewhere and adopt the relevant policies.

Literature indicates that RRI has resulted in many studies and initiatives on promoting responsible innovation and in addressing concerns over ethics, public acceptance and utility. As issues like increasing participation of women in S&T, enhancing public understanding of science and responsibility in science are common, the best practices can be studied and adopted. Although RRI has been defined in many ways, there is a consensus on RRI keys. Hence this should be used to make a good use of the theories and practices relating to RRI keys. This will also help in comparative analysis of using different policies to achieve a goal.

- 3) The AEI (Access, Equity, Inclusion) framework, Scientific Social Responsibility (SSR) and similar ideas can be used to understand and contextualize RRI in India.

DST has taken the lead in translating into practice the idea of SSR. This will help in linking ethics key of RRI with SSR and how responsibility can be defined and measured. The Niti Aayogs' report AI although does not specify RRI, has interesting parallels with debates on RRI and AI and AI for good society. The Access, Equity and Inclusion (AEI) Framework developed at RIS is another interesting concept that has relevance for RRI. So these can be used to understand what RRI would mean in India and for India and contextualize it.

## 10.2 Policy recommendations to European policy makers

- 1) RRI is bound to be adopted differently in India

Given the differences in institutional structures, norms, priorities and experience with modern S&T, adoption of RRI in India is bound to be different from that of Europe. Certain keys like ethics, gender and science education may be considered more relevant than others like societal engagement. Hence in adoption the priorities may be different. It is also premature to expect that funding agencies, policy making departments and research institutions will agree on agenda or action points, merely because they have learnt about RRI or worked with an institution that does research on RRI. Instead it is better to realize that if RRI has to be accepted and adopted, it has to be made relevant and appealing.

- 2) Understand that there is something for Europe to learn from Indian discourses and practices in science policy and that can enrich RRI without affecting the core principle of RRI

There are initiatives and examples from India in science communication, gender and diversity, and, science education that may be suitable for adaption. Similarly the Indian discourse on science and society is rich and the three main discourses have also been complemented by experiments, initiatives and practices. Hence a better understanding of them can help in enriching RRI in theory and practice. For example, Srinivas and Pandey (2018) point out how Gandhian principles and frugal innovation are relevant for RRI. Science Communication in India is an example for communicating science when the literacy rates are not high and linguistic diversity is a challenge.

### 10.3 Recommendations to research conducting and funding organisations:

- 1) Try to understand RRI and the keys and examine their relevance
- 2) Don't be attracted or repelled by the novelty of the RRI, instead consider RRI as a concept that can be adapted for India without any need for blind adoption, but on the basis of its merit.

### 10.4 Best practices scalable to European or national level

Some of the novel initiatives taken at the research conducting organization (JNU) as well as at the research funding organization (DST) in India can be viewed as best practices that can be scalable to the European and national levels. For example, the DST initiative (KIRAN) to help women researchers join back in their scientific research career after a career break due to marriage or child-birth, has led to many women researchers pursue their careers even after a break.

Similarly, there are remarkable schemes launched by the Science for Equity, Empowerment & Development (SEED) Division of the DST such as "Technological Advancement for Rural Areas (TARA), which aims to provide technological interventions at the rural setting based on the 'adaptive inclusive approach'.

The effort made by DST in the domain of science communication is also noteworthy. As part of its mega outreach programme, DST has launched a Science Express, an innovative mobile science exhibition mounted on a specially designed 16 coach AC train, which has been travelling across India since 2007. This has received an overwhelming response and has reached out directly to over 18.1 million visitors so far, mostly the school and college students.

In JNU, there is a policy of awarding extra "deprivation points" to the weaker and disadvantaged sections including women at the time of admission. This has enabled the access and inclusion of women and candidates from diversified communities to pursue research study programmes at the premier university. The impressive gender parity witnessed in the university owes largely to such a policy.

In the domain of open access, JNU's initiative to digitize all the PhD theses and make them freely accessible to all; can also be termed as a best practice worth noting.

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