OPERATIONAL NOTE

for implementing

SCIENCE, TECHNOLOGY, AND INNOVATION (STI)

for

SDGs R⬤ADMAPs

Implementing Science, Technology and Innovation (STI) for SDGs Roadmaps

Operational Note

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Implementing Science, Technology, and Innovation (STI) for SDG Roadmaps at the Country Level: Operational Note

The purpose of the Operational Note is to provide simple introductory and practical materials on STI4SDGs Roadmaps. For further information on this Note, contact Wei Liu (liuw@un.org), UN DESA.

Contents

1. What is the STI for SDG Roadmaps?

The world is committed to the SDGs in 2015 with the ambition of reaching them by 2030. However, large global gaps are unlikely to be addressed by a business-as-usual approach in the remaining 11 years. There is tremendous potential as well as urgency to leverage STI to achieve the SDGs. The capacities, focus, and financial resources to exploit this potential are not there yet.

This operational note aims to help countries and governments at all levels effectively utilize the Guidebook of STI for SDG Roadmaps more systematically to help achieve the SDGs, as well as to help mobilize the global community to assist in that endeavor.

2. Why focus on STI for SDG Roadmaps?

Human progress has been based on advances of science, technology and innovation. This was clearly seen with the dramatic increases in growth and productivity from various technological revolutions. There has been a great divergence in uptake between countries that led these revolutions and the rest of the developing world. As a result, these revolutions have created additional pressures on the environment and manufactured new social costs such as disruption of traditional life and increased inequality within countries.

We now realize the need to also consider social and environmental factors when developing strategies that reflect the SDGs goals. We are also entering a new period characterized by rapid development and convergence of emerging technologies in the physical, digital, and biological spheres. These emerging technologies and their convergence offer tremendous opportunities and risks.

Historically, some countries (such as Japan and the Republic of Korea) have been very successful at technological catch-up and have become leaders through explicit strategies such as development of their science base, human and institutional capital, and effective government policies working closely with the private sector. Countries need to put in place effective strategies to use STI to further their economic and social development to reach the SDG goals. They need to take advantage of technologies that already exist as well as to make effective use of new emerging technologies and to mitigate the risks they present. That is why developing effective STI for SDG roadmaps is so critical.

3. Who are the Key Actors in the Intersection of Development, STI, and SDG Plans?

STI for SDG roadmaps are at the intersection of national development plans, STI plans, and SDG plans. Effective STI for SDG roadmaps need to be integrated into these plans. See Figure 1 for the main agents and interactions.

STI for SDG roadmaps may be developed at the national level by a central agency or ministry in charge of national development plans; by the Ministry of Science and Technology or other agencies in charge of STI plans; or by line ministries, or a specialized agency or taskforce with the specific mandate to develop SDG plans.

Figure 1: Integration of National, STI and SDG Plans and Key Actors
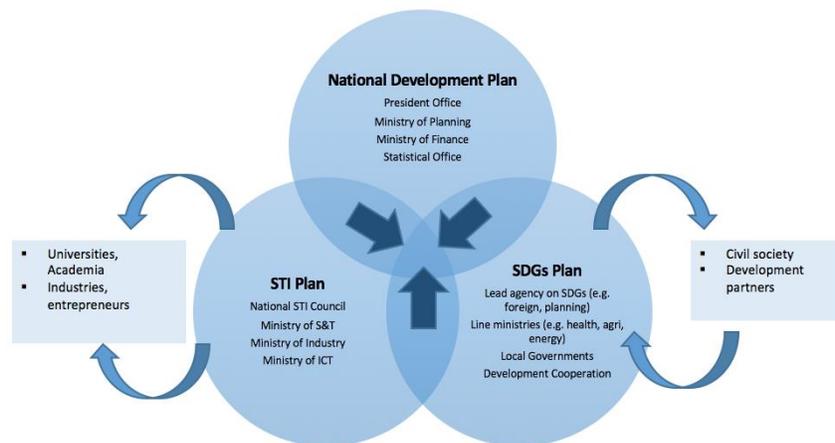
Ideally, the process would be coordinated at the highest level by the President's Office or the Ministries of Planning or Finance or some other specialized high-level agency tasked with this responsibility. However, the initiative may also come from the Ministry of Science and Technology or its equivalent. Alternatively, the initiative to use STI to accelerate the achievement of SDG goals may be led by a line ministry or local government as part of its SDG plans. The key point is that whatever its starting place, developing effective STI for SDG roadmaps requires interaction across a broad range of actors from different parts of government, academia, industries, entrepreneurs, civil society, development partners, and other stakeholders.
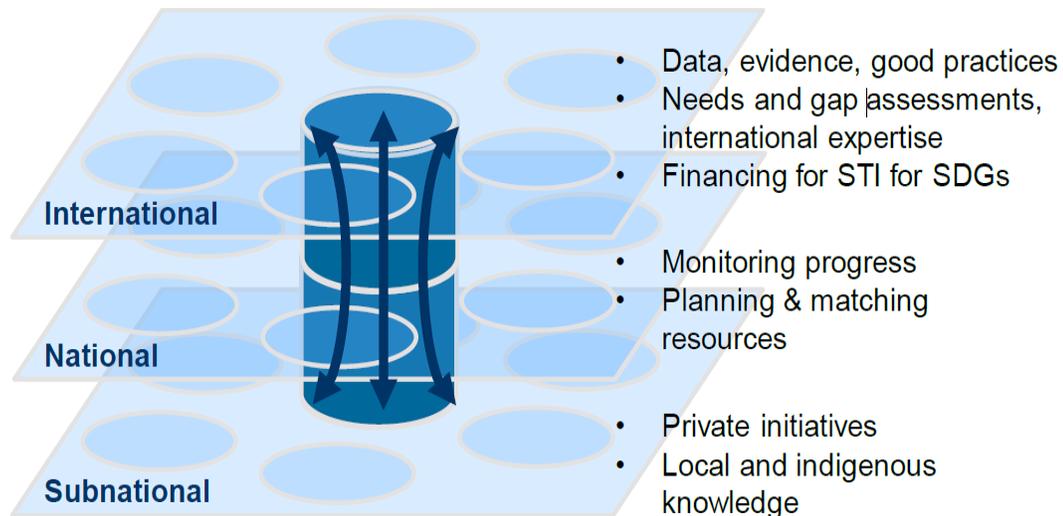
4. What are the scopes for the various levels of roadmaps?

The roadmap suggests **three levels:** subnational, national, and international (see Figure 2). The international community can assist in providing methodologies and technical assistance for developing the plans as well as support for implementation through **market channels** (e.g. private

investments) and **non-market measures** (e.g. collaborative public research, development assistance for STI infrastructure, human capital), and concerted efforts on STI for SDGs as **global public goods**.

Figure 2: Three levels of STI for SDG Roadmaps

• Data, evidence, good practices
• Needs and gap assessments, international expertise
• Financing for STI for SDGs

• Monitoring progress
• Planning & matching resources

• Private initiatives
• Local and indigenous knowledge

International

National

Subnational

5. What are the six steps involved in the STI for SDG Roadmaps process?

This operational note proposes that governments follow **six steps** in developing STI for SDG roadmaps as indicated in Figure 3. They are presented as a circle because the steps are interdependent, and it is important that lessons learned from implementation are fed back into the whole process.

It also emphasizes that **three core inputs**: stakeholder consultations, expertise and experience, and data and evidence base are critical to all steps. The roadmaps requires not only science and technology but also an understanding of the whole deployment system. At each step of the process, there needs to be clear implementation plans and actions as well an explicit provision of finance.

Figure 3: Six Steps in the Development of STI for SDG Roadmaps and Three Core Inputs for Roadmaps
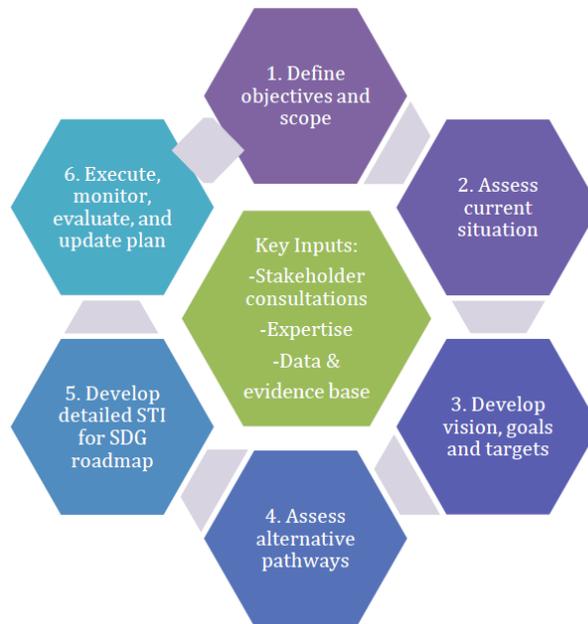
Three Core Inputs

1. **Stakeholder Consultations:** It is critical to get various stakeholder perspectives and to get stakeholder alignment. The consultation process can help resolve conflicting interests as well as secure greater buy-in from key stakeholders that will ensure the successful implementation and monitoring of the STI for SDG roadmap. The broader the scope of the STI for SDG roadmap, the greater the need to receive input about stakeholder needs and priorities in order to find a balance and ensure no group is left behind, especially the poor, indigenous, or disabled.

2. **Expertise and Experience:** Scientific, technical, managerial, and political expertise is crucial to help define objectives and scopes, develop visions, goals, and targets, and assess the current situation along with alternative pathways. Expertise is also needed to develop the specifics of the STI inputs into the SDG roadmap, monitoring progress on implementation, and evaluating what is and is not working for continuously improve the roadmap.

3. **Data and Evidence Base:** A strong data and evidence base is needed to better understand the development situation in the country or sector, the possible future development of technology and its application, and what specific indicators should be measured to track progress. Collecting accurate data and building the capacity to assess that data will be necessary in order to develop, implement, and monitor the roadmap.

Six Steps in the Development of STI for SDG Roadmap

1. **Define Objectives and Scope:** Roadmaps can be used for a variety of purposes and objectives (e.g. vision building, technology advocacy, stakeholder alignment, etc.) as well as at different levels and scopes (e.g. international, national, subnational, etc.). It is important to establish the objectives and scopes first as those will help countries prioritize their efforts and identify potential synergies and trade-offs among the SDG goals and targets.

Australia is a great example of a country that had a clearly defined objective for its STI for SDG Roadmap. Their Australia 2030 plan established five strategic imperatives along with 30 recommendations that would help them thrive in the global innovation race. The five strategic imperatives provided a strong foundation that guided Australia's efforts to utilize science, technology, and innovation to prepare and train its citizens to have the necessary skills to thrive in the future.

Australia's Five Strategic Imperatives:
1. Education
2. Industry
3. Government
4. Research and Development
5. Culture & Ambition

It is imperative that the necessary time and consideration is taken to initially develop the vision, objectives, and scope of the STI for SDG Roadmap. Having a clear vision will help make the rest of the process more efficient as a solid vision can guide efforts in later steps. It is also imperative that all relevant stakeholders are included in the formation of the vision, objectives, and scope. Stakeholders can range from government, universities, non-profit organizations, private businesses, community groups, individual citizens, and many other groups. All voices should be heard to ensure that the STI for SDG roadmap helps everyone and ensures that no one is left behind.

2. **Assess Current Situation and Emerging Trends:** It is important to first establish a baseline because it is necessary to know where a country is in order to set realistic goals and targets. Additionally, assessments should be made to identify what are the current capabilities for key stakeholders (e.g. government, private sector, NGO, civil society) and what areas need to be developed in order to achieve their goals and targets. The World Federation of Engineering Organizations (WFEO) has developed guidelines for producing national infrastructure report cards that evaluate the state of key infrastructure systems for railways, water, electricity, and many others.

3. **Develop Vision, Goals, and Targets:** There are various tools and methodologies already in place to develop visions, goals, and targets. Which to use will depend on various factors (e.g. level of detail, willingness of stakeholder participation, etc.) and each will have its own benefits as well as trade-offs.

4. **Assess Alternative Pathways:** There are many different innovations and pathways that countries can devote STI inputs to accelerate the achievement of SDGs. How countries utilize the combination of existing, emerging, and new technology/innovations will be highly dependent on their unique situation. Countries will have to determine which technology/innovations will most effectively solve their problems while also bringing the most benefit to the biggest possible audience. A key focus for many developing countries will be how to acquire and disseminate new technology that will help them achieve their goals. The choice of innovation pathways in STI for SDG roadmaps need to consider the existing STI capabilities and the extent to which they are aligned with the SDGs.

5. **Develop STI for SDG Roadmap:** Key instruments and priority actions need to be developed to accomplish the vision and contribute to the SDGs. A roadmap document, a long-term action plan, that builds on the previous steps needs to be created that introduces key findings of the baseline analysis and give an account of the roadmap deliberation process. An appropriate policy mix and instrument portfolio will need to be determined that will efficiently and effectively accomplish the SDGs.

6. **Execute, Monitor, Evaluate, and Update Plan:** After the development of the STI for SDG roadmap, execution or implementation is the key step to realize it. Additionally, for the plan to be credible and effective, there should be provisions for monitoring progress to determine whether it is on target or whether there are problems in implementation that need to be addressed. Plans for who will conduct the evaluation of the plan are also important and need to be addressed while mechanisms need to be established that will allow for the continuous horizon scanning for new and innovative technology. Lastly, an effective pathway needs to be established that will allow lessons generated from the evaluation of progress to be fed back to adjust the roadmap.

6. What are the objectives of road mapping and examples?

Vision building: Building a long-term vision of desired future expressed as statements and images. (e.g. TIFAC 2035 Technology Vision in India, ICC's Green Economy Roadmap)

Exploration of innovation and technology pathways: Exploration and assessments of alternative technology, innovation, or policy pathways to achieve a vision. This is often expressed as scenarios. (e.g. energy road mapping by CSIRO in Australia).

Technology advocacy: Technology and innovation advocacy supporting technology areas or specific technologies, often including research and innovation agendas with priority technology areas. (e.g. SPIRE in the EU, Forest products industry roadmap in the USA).

Stakeholder alignment: Building or strengthening stakeholder alignment to support the vision and technology, innovation, or policy pathways. (e.g. ICC's Green Economy Roadmap, Forest products industry technology roadmap in the USA).

Support for policy design and planning: Providing support for design and planning of policy portfolios or programs by elaborating selected technological and innovation pathways, often using milestones and quantitative targets. (e.g. Japan's New Low Carbon Energy Plan, EU SET-PLAN, RISEnergy in Sweden)

Support for policy implementation: Providing support for implementation and management of ongoing policy programmes or other initiatives. (e.g. EU SET-PLAN and underpinning roadmaps, Jamaica's National Energy Policy 2009-2030, Power Africa by USAID).

7. What are the key mechanisms on STI for SDGs under the 2030 Agenda?

Figure 4 below summarized the key mechanisms on science, technology and innovation and mapped the main channels for engaging multi-stakeholders in the UN process.
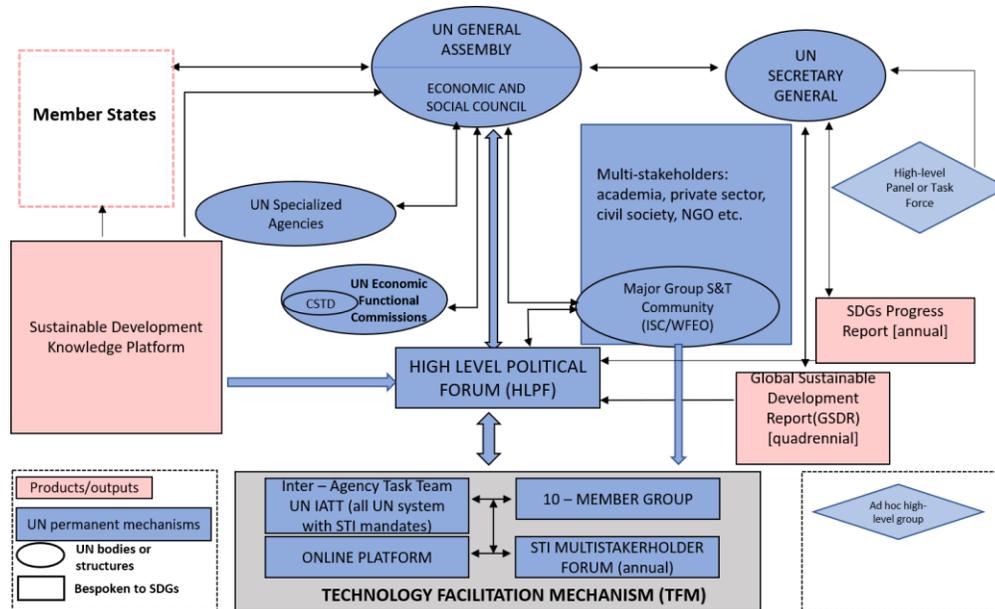
The UN Technology Facilitation Mechanism (TFM) was created by the Addis Ababa Action Agenda to support the implementation of the Sustainable Development Goals (SDGs) and launched by the 2030 Agenda on Sustainable Development in September 2015.

Throughout both the intergovernmental negotiations on the post-2015 development agenda as well as in the preparatory process for the third International Conference on Financing for Development, taking place in 2014 and 2015, Member States clearly indicated that technology development, dissemination and transfer, as well as strengthening the scientific and technological capabilities of all countries represent key elements of the Means of Implementation of 2030 Agenda for Sustainable Development.

The creation of the TFM was of historic significance, as it brought back substantive STI discussions to UN Headquarters in New York, after decades of political gridlock over intellectual property rights and technology transfer issues. In the past three years, the TFM has explored a new multi-stakeholder model of work for the UN system, which to-date has engaged 42 UN entities, more than 100 expert staff of the UN system, and thousands of scientists and stakeholders to facilitate STI for the SDGs. The TFM's STI Forum also holds a special role, as it reports formally to the High-level Political Forum on Sustainable Development (HLPF) in support of its formal review of SDG progress and its explicit function to "strengthen the science-policy interface".

Figure 4: Mapping Key Mechanisms on STI under the 2030 Agenda

Source: authors.

8. What kind of support from the international community is needed?

A.   Support market mechanisms for increasing the supply of existing STI elements

- Online platform supported by the UN's Technology Facilitation Mechanism – DESA
- More effective use of advances in technology and innovation in projects with multilateral finance in developing countries
- Work with key stakeholders to promote the deployment of critical technologies for important sectors such as water and energy
- Using public procurement to solicit innovative ways to deliver better goods and services more cost effectively to address SDG needs
- Increasing the overall volume of financing available for development of STI projects (e.g. grant money and soft loans from Official Development Aid (ODA)) to take the first level of risk in projects in order to make them more attractive to private financing[1]
- Promoting the use of alternative financing mechanism for STI projects such as crowdfunding and social investment funds

B.   Support non-market mechanism for increasing the supply of existing STI elements

- Bringing students, scientists, and engineers from low income and developing countries to study and gain experience in developed or high-income countries. Alternatively, professors

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[1] See BSDC, http://s3.amazonaws.com/aws-bsdc/BFT_BetterFinance_final_01192018.pdf

and students from advanced countries can teach local students face to face or through various digital media, such as Massive Online Open Courses (MOOCs), YouTube videos, podcasts, and computer-based learning systems.
- University collaborations in teaching science, technology, engineering, and math (STEM) subjects and cooperation in research to ensure graduates have the required skills
- Bilateral and international collaboration of public research institutes and researchers on joint interdisciplinary research programs focused on sustainability challenges.
- Supporting and increasing open data systems for scientific and technical publications and databases. (e.g. Launching an African Open Science Platform)
- Transferring frameworks, tools, methodologies, and technical assistance to help policy makers in receiving countries develop STI for SDG roadmaps.
- Developing communities of practice and other networks for sharing approaches and experiences.
- Improving the effective use of limited funds available for STI for SDGs by assisting countries undertake public expenditure reviews on STI for SDGs.

C. Strengthen the capability of developing countries to access and make effective use of existing technology and innovations and to develop their own technology and innovations

- Developing STI planning capacity in developing countries (e.g. government, private sector, and civil society organizations) to search, acquire, adapt, and disseminate technology and innovations. This may be an area where international assistance can have the most immediate impact. However, this does not involve only simple training but also includes higher education, technical assistance, and hands-on experience and twinning arrangements.
- Training policy makers on how to develop, implement, monitor, evaluate, and improve STI for SDG roadmaps. This includes education, technical assistance, twinning arrangements, design workshops, and sharing of experience across countries.
- Training scientists, engineers, entrepreneurs, managers, venture capitalists, and all other relevant stakeholders in technology and innovation through educational programs, foreign training, work and research experience, and twinning arrangements.
- Support the strengthening of STI-related infrastructure in developing countries (e.g. R&D labs, metrology standards and quality control systems and institutions, science parks, technology transfer agencies, accelerator labs, technology business incubators, etc.) Also share research between developed and less developed countries.
- Supporting international experimental STI projects by co-developing and demonstrating innovative approaches and projects along with social and business practices that have high impact potential on the SDGs. The lessons learned from these pilot projects should be shared internationally.
- Increasing STI-related technical assistance on projects for international development finance institutions, ODA, and commercial lending to more systematically leverage STI to help achieve the goals (STI for SDG roadmaps).

D.   Create demand for new STI solutions for SDG needs and develop international coalitions and/or partnerships to create innovative systemic solutions and technologies to accelerate the attainment of SDGs in developing countries.

This has three levels:

- ***Challenge-led mission-oriented research and innovation.*** Examples include**:** Gates Foundation Grand Challenges in health and education, X Price Grand Challenges, Horizon 2020 (EU) Grand Challenges, Grand Challenges Canada, and UK[2].
- ***Develop coalitions to create global technology public goods in areas that can help the achievement of important SDGs, particularly those where there are big gaps in demand and supply.*** Some historical examples such as the Green Revolution, Vaccines against HIV/AIDS, as well as some ongoing programs tackling large developing country challenge such as PEPFAR (USAID led international program to eliminate AIDs), Feed the Future (US government-wide program to reduce hunger, malnutrition, and poverty through STI initiatives) and the international consortium to reduce ocean plastics. Other initiatives include guidance by international organizations like WFEO on the responsible use of data for artificial intelligence.
- ***Build partnerships to strive for a better STI policy integration towards a global STI system that enables collaborative STI efforts for SDGs.*** This is an ambitious goal to develop a new global STI system as a global public good. An example of what could be done are the ITU's AI for Good. A key challenge is that cross-national research efforts are inherently difficult to orchestrate and finance.
- **Examples of areas that would benefit from international partnership support are:**
    - SDG goals which are handicapped by low demand for STI and scarce supply SDG goals 1 (no poverty), 5 (gender equality), 10 (reduced inequalities) Multiple areas related to climate change and
      green economy (notably low-carbon energy) Health (see recently launched anti-microbial resistance R&D hub[3])
    - Safe water
    - Marine (including blue economy)
    - Electricity for all
    - Green chemistry (e.g. work on safe chemicals)
    - Natural disaster risk mitigation – collaboration on monitoring risks such as the International Meridian Circle Project (IMCP)
    - Natural disaster risk mitigation – 100 Resilient Cities
    - WASH Agenda for Change, NGO partnerships for implementing water and sanitation policies in developing countries

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[2] See https://www.xprize.org/, https://ec.europa.eu/programmes/horizon2020/en/h2020-section/societal-challenges, https://www.grandchallenges.ca/, https://www.gov.uk/government/publications/industrial-strategy-the-grand-challenges/industrial-strategy-the-grand-challenges

[3] See https://www.gesundheitsforschung-bmbf.de/en/GlobalAMRHub.php

9. What are the Key Recommendations on Governments' Role from the G20 Development Working Group?[4]

- For governments seeking to develop a STI for SDG roadmap, their role is to set the strategic direction for the roadmaps through dialogue and input from all relevant stakeholders, while aiming for policy implementation coherence. Whenever possible, roadmaps on all levels should be assembled for monitoring overall progress and identifying underlying issues with political, social, economic, and scientific ramifications. Progress should be measured, as much as possible, using various reporting measures, in line with national processes and priorities.

- Promotion of "STIs for SDGs" should be aligned with national development strategies and STI policies for achieving sustainable and inclusive development. Governments should consider necessary preconditions for encouraging the advancement of science, technology and innovation, including mechanisms that protect intellectual property rights. The G20 should promote development of the underlying infrastructure that will enable STI for SDGs (e.g. digital infrastructure, ICT networks, research and development infrastructure, etc.). Due consideration should be given to investment in and promoting the active role of women and girls in STEM fields.

- To this end, governments should, as appropriate, allocate resources and encourage private sector investment to facilitate and implement the roadmaps.

10. What Governments Need to Do?

Assessing the capacity of the country's national innovation system

- Assess to what extent the country's innovation system can identify and match relevant STI inputs from the global system and to acquire and make effective use of them. This includes the capacity of government and other agents in the innovation system, firms and other critical implementing agents.[5]
- Review current laws and regulations and work with key stakeholders in the private sector to make adjustments that will allow businesses to thrive.
- Assess any potential gaps and roadblocks between the development of new technology and its deployment into the market. A key focus area can be identifying and eliminating corruption at all levels of government.

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[4] Source: Guiding Principles for the development of STI for SDGs Roadmaps, G20, Tokyo.

[5] In a broader analysis of the STI system, it should also include an assessment of STI specialization and the competitive positioning of the country's key sectors and areas of research.

- Assess how well the national innovation system is drawing on relevant global STI inputs. What types of inputs is it getting or not getting through market and non-market channels? Is the national innovation system making full use of what can be obtained from abroad? If not, what are the obstacles and what is necessary to resolve them?
- Examine how well the country's policy and regulatory framework encourages rather than inhibits access to global technology and innovation. In addition, it is important to assess the adequacy of the country's social policies and policies that promote environmental sustainability as many technologies that can help with environmental sustainability require a favorable policy environment for them to be effective.
- Examine constraints in the country's infrastructure. One critical element is the country's STI infrastructure. This should include its R&D capacity and infrastructure to undertake relevant research to help track, monitor, and acquire global technology and innovation while also carrying out its own research.
- R&D to adapt and develop technologies/innovations relevant to its own needs. It should go beyond the STI infrastructure to include the ICT infrastructure (which is now so critical to take advantage of what digital technologies can offer), education and skills to use new technologies, and depth and flexibility of financial and labor markets.

Considering priority areas and required resources

The government should also consider priority areas where elements of STI can most usefully be obtained from abroad and what that requires in terms of changes to the national innovation system. There may be options which require fewer international inputs, but this may mean longer lead times. There may also be seemingly easy options of "quick technology transfer" which may mean faster results, but less building up of local capability. A critical issue here is also that of policy coherence. This is complex but is important because some STI roadmaps for the attainment of specific SDG goals may work at cross purposes with others. Explicit consideration should be given to what is expected in the short term (next 1-2 years) versus the medium term (3-4 years), and long term (more than four years).

- Interventions that may be possible in the short term are getting better access to information about what is available internationally; changing policies and regulations that may constrain that access, high impact training and awareness building among policy makers and key actors in the non-government sectors; accessing and deploying innovations that allow leapfrogging, such as smart cell phones rather than fixed line phones and computers, off-grid solar and wind electricity rather than central electric grids to reach dispersed rural areas, many preventive medicine practices and vaccines as opposed to more expensive treatment, etc. This should also include how to strengthen the ability of local researchers and research institutions to participate in international programs that are developing technologies relevant to attaining SDG goals.
- Programs that can be launched in the medium term (3-4 years) are strengthening key infrastructural elements as well as the broader innovation ecosystems that will be necessary to mobilize and deliver STI elements that can contribute to accelerate the SDG goals targeted in the country, strengthening some key STI infrastructure institutions than can help deploy relevant knowledge to meet the SDG goals, etc.

- Initiatives with a long-term horizon include investments in domestic R&D capacity to develop new technologies and effectively deploy them to where they are needed, developing world class research centers and universities; however, some actions to get the medium- and long-term outcomes have long lead times and need to be started even in the short-term.

Strategic development with the support of donor countries

On the government side, it will necessarily involve the ministries of foreign affairs, development, science and technology, telecommunications, industry and commerce, finance, and many others as well as relevant agencies and committees of Congress or Parliament and the head of government. It should also involve the mass media to build public support for the plans. It should also consider the STI needs of developing countries that the government aims to assist.

11. Self-check Guiding Questions for the Six Steps of Implementing STI for SDGs Roadmaps

Step 1: Define Objectives and Scope

- What is the objective of the roadmap?
- What is the scope of the roadmap?
- What specific SDG goals and objectives are targeted?
- How does it relate to the overall national development plan and other strategic documents?

Step 2: Assess Current Situation

- What is the current situation regarding the targeted SDG goal(s) and objectives?
- What financial resources are available or can be made available to meet those goals?
- What capabilities are available or need to be developed to meet those goals?

Step 3: Develop Vision, Goals, and Targets

- What is the overall vision for the STI for SDG roadmap?
- How ambitious is the vision?
- How will the vision be developed and how will ownership be sought?
- What are the specific goals and targets over the short (3-4 years), medium (5-8 years) and long-term (8-12 years to 2030)?

Step 4: Assess Alternative Pathways

- What technologies exist to help attain those goals?
- What does the STI system have to offer to enable the dissemination of the innovation?
- What emerging technologies may help to attain those goals?
- What new technology development possibilities may be available from new global development efforts?

- What alternative innovation pathways are there to reach those goals?

Step 5: Develop Detailed STI for SDG Roadmaps

- What will be the role of government vs the private sector or civil society?
- What will be adequate policy mix?
- Who will do what over what time period?
- What capacities will be necessary?
- What financing will be necessary and how will it be obtained and delivered?

Step 6: Execute, Monitor, Evaluate, and Update Plan

- How will the roadmap be executed?
- What monitoring mechanisms will there be?
- Who will do the evaluation?
- What mechanisms will there be for continuous horizon scanning for changing sub-national, national, and global and conditions?
- How will the lessons from the evaluation of progress on meeting targets and changing conditions be fed back to adjust the plan?

12. What are the Roles of Donor Countries?

There are many things that policy makers can do to more effectively support the systematic use of STI inputs to accelerate the achievement of SDG goals in developing countries:

- **Increasing its ODA to support STI inputs:** This includes reallocating resources from some other ODA activities to STI initiatives, and, when possible, increasing overall ODA resources to provide more support to STI in developing countries.

- **Leveraging activities being done by other agents or institutions in the country:** This includes providing incentives to increase the STI support given by other agents or institutions in the country such as matching research grants, scholarships, co-founding technical assistance, underwriting some of the risk in financing ventures; as well as providing leadership and coordination of activities in the country supporting greater STI inputs to help developing countries reach the SDG goals.

- **Taking or sharing a lead role in developing global coalitions and partnerships to develop global STI public goods for helping the attainment of SDGs:** Examples include initiatives such as PEPFAR and Feed the Future led by the U.S. government, or Disaster Preparedness led by Japan and the Digital Moonshot for Africa.

13. What are the existing methodologies to support country STI for SDGs roadmaps?

There are currently no existing methodologies; however, knowledge and expertise are currently scattered and can be compiled to formulate new methodologies to support STI for SDG roadmaps. STI roadmaps that help to realize the SDGs are central in the work of UN agencies. The UN Inter-agency Task Team (IATT), including the World Bank, UN-DESA, UNCTAD, UNESCO, UNIDO, UN-ESCAP, ESCWA, FAO, WIPO and UNU, among others, works towards developing STI for SDGs roadmaps. Expert consultations in New York, Tokyo, Brussels, and Nairobi led to the development of a joint guideline and shaped cooperation with selected countries in this field. The UN-IATT has also developed joint UN courses that strengthen countries' capacities in STI for the SDGs. The recent G20 outcome package (Osaka Leader's Declaration, 2019) contains guiding principles for this work. There is now a need to expand and involve more countries in developing STI roadmaps for the SDGs.

The rationale to facilitate a multi-stakeholder collaborative approach is clear. At present, the efforts supporting STI roadmaps are fragmented at international, regional, national, and sub-national levels, and do not necessarily have the SDGs as a focus. While several countries have, in the past, developed STI roadmaps with the support of various UN-system agencies, these have not been directed specifically towards the SDGs. There is a lack of a coherent framework that guides policymakers and development practitioners to better achieve the SDGs through STI.

At the same time, there is important knowledge and experience scattered across the international stakeholders. Therefore, this initiative by the IATT is aimed at adding value through facilitating a common approach and developing coherent frameworks to examine gaps, synergies, and trade-offs that will help prioritize actions in order to strengthen national STI systems, promote cross-sectoral collaborations, and Goal-specific "deep dives" for the SDGs.

Initially, the primary focus was on exchanging views and best practices on guidance, principles, and frameworks/methodologies for country and international level STI for SDGs roadmaps. This IATT effort resulted in the publication of a joint guideline which is available on the web at https://sustainabledevelopment.un.org/TFM#roadmaps. The guideline will now be used in a collective effort by the IATT to support a group of champion countries to develop STI for SDGs roadmaps with all relevant stakeholders.

The summary table in the Annex I on STI roadmap tools and methodologies is a coordinated effort led by UN DESA to inform STI policy makers and stakeholders working on STI for SDGs roadmaps on resources and expertise available to them. The inventory of methodologies in the table provide a one stop shop to guide policymakers and development practitioners to better achieve the SDGs through STI. It will be a living document, to be updated periodically based on evolving knowledge and experience with its use.

14. What support to get from the Pilot Country Programme?

The objectives of the Programme include the following:

- Test out the draft Guidebook on building STI for SDGs Roadmaps as a policy- making and communication tool for Member States;
- Build capacity for and scale up adoption of the Member States' STI for SDGs Roadmaps;
- Promote good practices, knowledge sharing, peer learning, international cooperation and partnerships on design and implementation of such roadmaps;
- Maximize opportunities and mitigate risks of STI and frontier technologies to accelerate the achievement of the SDGs; and institute mechanisms to continuously scan the horizon, analyze the gaps, track progress, and inform corrective measures.

Following the broader TFM mandate within the Agenda 2030 framework, the Programme is designed as a non-intergovernmental and multi-stakeholder engagement process. The Programme will initially focus on demonstrating concrete value-added for Member States as part of their national processes to design and implement such roadmaps as integral elements of national sustainable development strategies. For IATT agencies and other contributing partners, the Programme will create stronger synergies and complementarities in the field of STI policy, technical assistance and related capacity development and investment to Member States. Beyond 2019, the Programme will aim at mobilizing dedicated support funding, upon Member States' early experiences and demands for further support, including for enabling arrangements such as online platforms and offline forums for matchmaking, knowledge, and experience sharing.

Pilot activities can constitute, but are not limited to, any of the below:

- Define objectives and scope of national STI for SDGs Roadmap
- Evaluate current situation, gaps in achieving SDGs and opportunities/risks related to STI
- Assess alternative pathways of utilizing STI toward achievement of the SDGs
- Develop vision, goals, and targets related to utilizing STI toward the SDGs
- Develop a detailed STI for SDGs Roadmap
- Execute, monitor, evaluate, and update current STI for SDGs Roadmap

Pilot programmes are expected to build on existing, ongoing, or planned activities as part of national processes, and are not meant to necessarily produce a new set of "Roadmap" documents. The Programme rather aims at strengthening countries' ownership and momentum on STI for SDGs, by surfacing and connecting country-by-country practices and advancing good practices and peer learning. Building on pilot experiences, the Programme after 2019 will aim at instituting mechanisms to continuously scan the horizon, analyze the gaps, track progress and inform national and international corrective measures. Pilot countries are invited to join the policy advocacy efforts in 2019, including through STI Forum, HLPF and UNGA, to elevate STI for SDGs agenda and step up international efforts and collective action in support of STI for SDGs Roadmaps.

Figure 5 Current Timeline of the Pilot Country Programme

15. What early pilot experiences on adaptation of the step-by-step guidance?

- Step 1: Defining objectives and scope takes time – 6 months to reach consensus in Kenya even with the clarity of its "Big Four" agenda;
- Step 2: Assessing current situation, both on SDGs demands/gaps and STI supply/capabilities, requires competent agencies (few countries would have one). Assessing emerging trends is likely a challenge and international partners could consider how best to support this analysis in real time given the fast-changing global environment;
- Step 3: Developing a vision, goals and targets varies widely across the pilot countries because of their different institutional set. The analysis of potential synergies and trade-offs among different goals are also inadequate. More country specific advice on trade-offs and complementarities in the framework of the six entry points provided by the GSDR2019 would be useful;
- Step 4: Assessing alternative pathways is arguably most complex step, requiring stakeholders representing different stages in innovation chain (e.g. new R&D vs diffusion and adaptation). Scarcity of foresight analyses adequate to developing country contexts adds to this challenge. This is another area where assistance from international partners could be beneficial;
- Step 5: The pilots are at different stages of their development of STI roadmaps. Important elements that most pilot countries still have to address are how the actions of government and other key actors will be coordinated and how to arrange financing issues for the plans. It is an important opportunity for the international community to provide support on stimulating the coordination and the implementation;
- Step 6: Few ongoing pilots has put monitoring and evaluation systems in place or considered learning and feedback mechanisms as an explicit component of the STI for SDGs roadmaps (arguably, with an exception of India), which is a critical step to make adjustments and corrections while implementing the roadmap.

16. What does a proposed joint template on development of STI Roadmaps for the SDGs look like?

A successful STI roadmap contains several key components. The UN Inter-agency Task Team aims to promote a common approach and develop coherent frameworks to examine gaps, synergies and trade-offs, and prioritize actions in order to strengthen national STI systems, promote cross-sectoral collaborations and Goal-specific "deep dives" for the SDGs. With this objective, for the purpose of discussion, it is proposed a joint template for development of the STI Roadmaps for the SDGs below.

Items	Brief Description
Country/Region	
Overview of national technology and innovation eco-system	*Overview and mapping of the STI initiatives,* *Legal system related to STI* *National R&D agencies* *Public support to incubators, innovation parks etc.*
Vision and Goals: a clear and concise set of quantified goals and targets, as well as desired timeline	*Vision and mission statement* *What does country want to achieve in STI for the SDGs?*
Milestones: interim performance targets for achieving the goals	*Interim performance targets for achieving the goals, pegged to specific dates*
Gaps and barriers	*A list of any potential technology gaps, market structural barriers, regulatory limitations, culture acceptance or other barriers to achieving the goals and milestones*
Action items	*How are countries or other stakeholders going to use the roadmaps? What actions to be taken by when?* *It will include a list of the most important actions that need to be taken in order to achieve the goals and the time frames.*
Case studies	- *Health and human well-being* - *Clean energy and climate* - *Agriculture and food nutrition* - *Urban and peri-urban development* - *Education* - *Environment and global commons*
International cooperation (optional)	*Expected and on-going international cooperation and collaborations with partners*

Annex I: Overview of the main methodologies to support STI for SDGs roadmaps

METHODO-LOGICAL STEP/ ORGANISATION	SMART SPECIALISATION (EC-JRC)	STI POLICY REVIEWS (OECD)	STIP (UNCTAD)	GO-SPIN (UNESCO)	SIIG (UNIDO)	TIP (TIPC)	PERs in STI (WB)
DEFINE OBJECTIVES AND SCOPE	Systemic approach: STI in the context of economic, societal and environmental challenges.	Modular approach: focus on STI policy data collection, analysis, reporting and dissemination	Systemic approach: STI in the context of economic, societal and environmental challenges.	Modular approach: focus on STI governance, explicit and implicit STI policies, legal frameworks, policy instruments and indicators	Sectorial approach: focus on the STI component in the industrial policy, includes social inclusion, economic competitiveness and environmental protection	Systemic approach using innovation to address societal, economic and environmental challenges	Modular approach: main focus is on STI policy expenditure and its impact
ASSESS CURRENT SITUATION	Based on existing policy frameworks, requires inter-institutional cooperation. Quantitative and qualitative analysis of economic, STI and SDG indicators	Detailed analysis of the STI performance in the macroeconomic context and societal needs. Quantitative STI indicators plus in-depth analysis of specific sectors	STI policies instrumental for economic growth and development. Wide collection of qualitative data supported by overviews of literature and quantitative analyses.	description of the political, economic, social, cultural and educational contextual factors; analysis of the explicit STI policies, policy cycle and STI organizational chart; study of R&D and innovation indicators.	Based on existing development plans and strategies. Includes in-depth quantitative and qualitative analyses of the industrial landscape in the context of country's development goals	Based on wide qualitative process and review of existing policies. Case study approach and learning histories are used	The quality of public spending on STI and R&D is assessed based on a mix of qualitative and quantitative indicators with the objective to understand how governments can spend better on STI or how they can improve the impact of STI expenditures on economic development

DEVELOP VISION, GOALS AND TARGETS	Vision for sustainable socio-economic development of territories developed jointly by external and internal stakeholders	Vision developed individually by each country based on the analysis and recommendations	Synergic vision for transformative change developed jointly by internal and external stakeholders	Looking at impact of the existing STI policies and based on a survey allowing to create country profiles with comprehensive assessments of STI policies	Vision developed individually by each country with the wide participation of stakeholders	Wide vision for transformative change achieved with STI policies and other elements of systemic change	The development of vision for change can result from the PERs
DIALOGUE AND CONSULTATION WITH STAKEHOLDERS	Entrepreneurial Discovery Process requires permanent involvement of public and private sector, academia and civic society in the development, implementation and monitoring of the strategy and associated activities	Stakeholders are interviewed during the fact-finding missions. International community involved in reviews	Multiple stakeholders involved in the STIP review process	Internal and external stakeholders involved in providing the survey responses and discussing the results	Stakeholders are involved in a participatory policy-making process throughout the policy cycle	Wide stakeholder participation, including the local and grassroots innovators	Stakeholder involvement is a part of data collection, in the form of interviews, access to data etc.
ASSESS ALTERNATIVE PATHWAYS	Recommended foresight and similar exercises, yet not obligatory	Countries can develop scenarios for the enhancement of national STI ecosystem	Technology foresights are strongly recommended	This step can be included but is optional	Possibility of developing scenarios for industrial policy	Foresight and future studies activities are considered valuable but optional	Based on the analysis, the team discuss different options
DEVELOP DETAILED STI FOR	Clear intervention logic with implementation	Not explicit, recommendations provided	Specific guidance on implementation,	The methodology provides an overview of STI	Developed individually by governments but	Strong focus on experimentation. The policy mix is a	The assessment results in a set of recommendations

SDG ROADMAP DOCUMENT	action plan, policy mix and instruments, and financing instruments are required		policy instruments and financial instruments is provided	policy instruments but does not prescribe specific solutions – they can be developed at country's request	based on recommended policy instruments	part of TIP development and the guidance on financing can be provided	that support stronger alignment of innovation policy instruments with the national development objectives, improved quality and higher efficiency of instruments used, and an evidence-based framework to track results and map expenditure to outputs and outcomes.
MONITOR EVALUATE AND UPDATE PLAN	Monitoring and evaluation frameworks are essential in S3 approach, with clearly defined metrics and indicators	Monitoring and evaluation considered very important but not included. Post-review analyses are possible on request	Monitoring and evaluation frameworks are strongly recommended, and additional support is possible on request	The regularly updated country profile can be a useful monitoring tool	Monitoring and evaluations are a part of the methodology	Monitoring and formative evaluation are required with the focus on learning and improvement	M&E is a core part of the methodology. A unique feature of PER in STI is the inclusion of impact evaluations in the effectiveness stage.

Source: (Matusiak et. al, 2020)

Annex II: Five Countries Participating in the Global Pilot Program for STI for SDGs Roadmaps

	Ethiopia	Ghana	India	Kenya	Serbia
Leading Ministry(ies)	Ministry of Innovation and Technology (MINT) is lead agency; Ministry of Science and Higher Education (MOSHE) interested in joining; Working on modalities of collaboration.	Min. of Environment, Science, Technology, and Innovation (MESTI) & CSIR-STEPRI (policy research institute); Technical oversight committee co-chaired by President's SDG Advisory Unit and National Development Planning Commission; Involves Ministries of Finance, Planning, etc.	Office of Principal Scientific Advisor (PSA) of Prime Minister and NITI Aayog (main policy think-tank of the government).	State Department of Planning in National Treasury and National Commission for Science, Technology, and Innovation (NACOSTI) in Ministry of Education; in partnership with Ministries of ICT, Foreign Affairs, Agriculture, and Industry, and is supported by African Center for Technology Studies (ACT)	STI for SDGs roadmap being developed by two WGs: the Interministerial WG on Smart Specialisation and Industrial Policy led by Prime Minister's Cabinet and the Interministerial Group for Agenda 2030 (26 Ministries) under the lead of Minister for SDGs; The Roadmap is operationalized by Ministry of Education, S&T; Participation of multiple ministries, private sector, and academic community.

	Ethiopia	Ghana	India	Kenya	Serbia
Objectives & Scope	Effort so far has been based on Science Technology and Innovation Policy (STEP) Review concluded in 2019; Key SDGs that appear to be planned targets are 1, 2, 3, 8 and 10.	Stakeholder consultation meeting in Dec. 2019 and 1st mtg of Technical Task Team considered priority on SDGs 1, 2, 4, 6, 7, 8, 9, 10, and 13. SDG 3 and 5 will also be considered.	Focusing on SDGs 2,3,6, 7, and 17 (because of India's strong STI capability and interest in partnering with developing countries).	Main objective is plan for implementation of STI policy and support for delivery of President's Big Four Agenda, which focusses on agriculture, manufacturing, health, and housing and therefore includes SDGs 1,2,8, and 9.	Serbian STI for SDGs roadmap is to be detailed action plan of the Serbian Smart Specialisation Strategy (4S) with the main goal to is to foster socio- economic development and transformation based on 6 knowledge-intensive priority sectors (food, creative industries, manufacturing, ICT, key enabling technologies, energy); SDGs include: 2, 7, 8, 9.
Assessment of Current Situation	Has been done as part of the STEP Review; Included collection of data and knowledge on development situation of country, status of national innovation system including 22 sectoral technology roadmaps.	Largely based on STI Eco survey; SDG baseline report 2018; Additional STI situational analysis ongoing, including desktop research by University College of London MSC student team as part of partnership with UNESCO.	Detailed R&D assessment at subnational and national level (2019); NITI Aayog constructed SDG India Index for 13 of 17 SDGs on set of 62 priority indicators in 2018; In 2019, it was updated with 100 indicators covering 54 targets across 16 Goals except SGD17; Mapping of some key sectors completed	Used indicators from various international and national databases on SDG gaps and country situation; Is undertaking STI Public Expenditure Review aiming to promote R&D and technology adoption and diffusion with increased efficiency and effectiveness.	4S plan involved detailed assessment of economic, innovation, and research potential of Serbia; EC JC supported mapping of 17 SDGs, statistical baseline analysis and identification of STI inputs focused on specific SDG goals; After this analysis SDGs 3, 4 and 12 are under discussion as an additional priority.

	Ethiopia	Ghana	India	Kenya	Serbia
Alternative Technology Pathways	Discussion so far has focused on preparing an implementation plan covering several of 22 sectoral technology maps prepared for Ethiopia.	Focusing on university-based technology incubators working on emerging technologies.	Analysis of alternative technologies being done as part of developing roadmap.	Within SDG 2, focused on increasing productivity and income for smallholders and technologies for maize, rice, and potatoes; Methodology being tested for maize.	Entrepreneurial discovery process framed the discussion of alternative targets and solution; This is documented in separate workshop reports.
Timeframe and Key Milestones	COVID-19 delayed process of preparation.	Assessment studies of the current situation of the policies, strategies, implementation plans; March- August 2020 - Sensitization of key stakeholders; Jan- Dec 2020 - Preparation of the STI Roadmap for the SDGs by the Technical Task Team with support by a consultant and research assistance team: July-Dec. 2020 - Mobilization of Resources, Implementation of programs/projects/activities, Monitoring and Evaluation; Jan 2020- Dec 2030	Deep dives into specific programs is next step; Monitoring and evaluation platforms planned. IATT Workshop with Japan held June 2020.	Team will expand scope to and hold consultations to identify what technologies can be delivered, mobilize resources, and incentivize private sector participation.	Detailed STI for SDGS roadmap will have detailed indicators and timeframes. Expected to be completed by end 2020. Progress has been slowed due to the COVID-19 crisis.
Execute, Monitor Evaluate, Update Plan	Not yet applicable.	Not yet applicable; Ministry of monitoring and evaluation is part of the technical task team and is involved in process.	Not yet applicable, but planning includes monitoring and evaluation and strategic decision system	Not yet applicable as plan is still under preparation.	Not yet applicable, but the S4 Strategy includes the outline of the monitoring and evaluation system, which will be further developed in the STI for SDGs Roadmap based on input, output, and outcome indicators.

	Ethiopia	Ghana	India	Kenya	Serbia
IATT Focal point	UNCTAD	UNESCO	World Bank	World Bank	EU-JRC, UNIDO
Challenges/ Problems/ Lessons	Challenges: 1) lack of specific budget for the implementation of the STI for SDGs roadmap (UNCTAD has been able to mobilize some support for the preparation), 2) establishing a smooth mechanism for collaboration across stakeholders that ideally would be involved in the preparation of the roadmap 3) COVID-19 crisis has slowed the whole process	Challenges: 1) Involving broad range of stakeholders for definition of priorities 2) Better alignment of STI policies to sectoral priorities 3) Inter-ministerial cooperation key to avoid duplications 4) Capacity-building in STI governance	Challenges:1) Obtaining updated data 2) Coordination among agencies 3) COVID-19 crisis has slowed down progress	Challenges: Inadequate data for baseline of SDG targets or to link government programs to SDG targets; Lessons: 1) Importance of Technical Committee to provide guidance, 2) need for external support to develop STI for SDGs roadmaps due to limited skills and funding 3) Need for increased stakeholder consultation 4) Most difficult and expensive step is assessing alternative technology pathways	Challenges: lack of sufficiently disaggregated data, building trust and involving stakeholders, overcoming government silos, and getting focus on SDGs, balance between setting strategy and actual implementation; Lessons (keys for success): 1) mobilizing own funding for implementation of 4S with additional EU funding, 2) formation of permanent public-private dialogue platform for involvement of high-level stakeholders. 3) Winning approval of PM.
Detailed roadmap	Under preparation: So far implementation plans have only been prepared for 3 of the 22 technology roadmaps.	Under preparation	Under preparation but various interventions ongoing in agriculture, digital connectivity, health, energy, e-governance, tinkering labs, digital ID, digital banking, health insurance. Plus, PM has announced 8 major innovation missions.	Under preparation, but team has identified needs and gaps along six agricultural value chains, and current gaps in STI system.	Under preparation; Detailed STI for SDGS roadmap will be the action plan for S4; Will focus on specific actions to achieve the prioritized SDGs and will include monitoring, financing and implementation system.

Source: IATT, 2020.