Science, Technology and Innovation (STI) for SDGs Roadmaps

PROGRESS REPORT:

The Global Pilot Programme
on STI for SDGs Roadmaps

July 9, 2020

Full version

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Chapter 1. Introduction

Background

The 2030 Agenda, adopted at the United Nations Sustainable Development Summit in September 2015, positioned Science, Technology and Innovation (STI) as key means of implementation of the SDGs, and launched the UN Technology Facilitation Mechanism (TFM). The Annual Multi-stakeholder Forum for Science, Technology and Innovation (STI Forum), supported by the Inter-Agency Task Team on Science, Technology and Innovation for the SDGs (IATT) , has been the main fora for TFM to discuss topics of common interests of Member States and STI stakeholders in the context of the 2030 Agenda.

STI roadmaps and action plans to help realise the SDGs have been among the central topics through the first three STI Forums. In the Addis Ababa Action Agenda, Member States had committed to "adopt science, technology and innovation strategies as integral elements of our national sustainable development strategies" (para 119). In the 2017 STI Forum, participants highlighted that the STI roadmaps and action plans are needed at the subnational, national and global levels, and should include measures for tracking progress. These roadmaps incorporate processes that require feedback loops, evaluate what is working and not working, and produce continual revisions that create a real learning environment.

With a view to translate these objectives into concrete outcomes, the IATT[1] established a sub-working group for taking forward the discussions and initiatives on STI Roadmaps. The objective of the sub-working group on STI for SDGs Roadmaps is to devise and implement, with the help of IATT partners and other stakeholders, an inter-sessional work program that will enrich STI Forum discussions on STI Roadmaps, through delivering tangible impact to be achieved over 2018-2019.

Consequently, the IATT sub-working group together with 10-Member Group[2] has launched the Guidebook for the preparation of STI for SDGs Roadmaps. As a mean to engage countries in piloting the approach and methodology elaborated in the Guidebook, the IATT sub-working group has launched a Global Pilot Programme on STI for SDGs roadmaps, and since the last in July 2019, five pilot countries, Ethiopia, Ghana, India, Kenya and Serbia, together with two international partners, Japan and the European Commission's Joint Research Centre, have been participating in the first phase of the Programme.

As more countries are interested in joining the Pilot Programme[3], new efforts are also underway to initiate a support mechanism for the second wave of countries to join the Pilot Programme through a new joint initiative called "Partnership in Action," concept in which is described in a draft outreach note.

At the same time, IATT has developed two background papers, one on international STI collaboration and investment for the SDGs and another providing an overview of methodologies for STI for SDG roadmapping, which, together with the Guidebook, inform IATT's continuous dialogues with national authorities leading roadmap pilots, and prepared grounds for solidifying respective pilot design as well as peer learning.

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[1] IATT is coordinated by DESA and UNCTAD, and the co-leads for its sub working group on STI for SDGs Roadmaps, which also include the World Bank and UNESCO; Outside of the UN, EU-JRC and OECD actively participate and contribute to the activities.

[2] 10 Member Group is a group of 10 high-level representatives from civil society, the private sector and the scientific community.

[3] In total (including the countries in the first phase of the pilot programme), more than 20 countries, including a number of Asian and African countries, including Cambodia, China, Indonesia (Oman and Republic of Korea), Botswana, Chad, Rwanda, South Africa, and Tunisia, have expressed interest in joining the programme to implement the roadmaps along the guidelines of the Guidebook.

Objectives

This objective of this progress report of the Global Pilot Programme is to:

- Summarize the current state of the programme in the five pilot countries through country write-ups prepared by the IATT focal points working on each country in coordination with the country teams developing the roadmaps (Chapter 3)
- Summarize the lessons and implications from the current implementation experience in the five countries as well as from the three country case studies of successful national examples submitted as of May 2020 and implications for international STI collaboration (Chapter 4)
- Draw out some of the implications of these lessons (Chapter 4) for
  - Future revisions and sharpening of the Guidebook
  - Further work in the pilot countries
  - For countries that may join the pilot programme in the future and
  - For moving forward

To put what in context what is being done in each pilot country, chapter 2 provides a broad snapshot of the STI gaps in the five countries, as well as their relative positions on the SDG gap index and their innovation capability.

The three country case studies that have been received as of May 2020 are in the Annex.

Chapter 2. Current State of Countries and of Country Pilots
Contextualization of where countries are with respect to STI for SDGs

While each country has to do a detailed assessment of its SDG gaps and it goals depending on its situation and ambition, it is useful to look at broad set of indicators of where countries stand in order to provide some context for understanding their STI for SDG roadmaps. This is done in this section by using two indicators that are available for most countries in the world. In addition, Appendix Table A.1 presents some basic data on the five countries on relative size, economic structure, social and environmental indicators or the five pilot countries to provide some more context for the country STI for SDG roadmaps each is preparing.

The SDG Index

Although full and robust indicator of SDG gaps are not available at a global level[4], a rough idea of country's position can be obtained from the SDG Index produced by Bertelsmann and Sustainable Development Solutions Network every year. It is not an official monitoring report but put together by using publicly available data published by official data providers (World Bank, WHO, ILO, others) and other organizations including research centers and non-governmental organizations. The SDG Index scores countries on the 17 SDG goals. The score indicates a country's position between the worst (0) and the best or target (100) outcomes on each of the 17 SDG goals.[5] Although there is some variation, in general, there is a positive relationship between a country's overall SDG Index and its per capita GDP (Appendix Figure A.1)

The position of each of the five pilot countries with respect to the 17 SDGs is presented in Figure 2.1 where the outer part of the circle represents being on target.

The Global Innovation Index (GII)

This index is published every year by Cornell, INSEAD and WIPO, again based on publicly available data. It consists of 80 indicators grouped into seven pillars (institutions, human capital and research, ICTs, market sophistication, business sophistication, knowledge and technology outputs, and creative outputs) and covers 127 countries.[6]

Figure 2.2 maps out country's position on overall SDG index relative to its global innovation index. Within that scatter plot for the whole world, the five pilot countries can be identified as well as some outliers to serve as reference points.

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[4] There is ongoing work to improve SDG indicators. The UNESCO Statistical Institute, in particular, is working on a broader and more detailed set of STI and SDG indicators. There are also various methodologies for STI roadmapping. The IATT Background paper on Overview of the existing STI for SDGs roadmapping methodologies (2020) provides a summary of various such methodologies.

[5] While data for indicators is missing in many countries, and there are lack of indicators for some dimensions of important components of SDG goals, particularly for developing countries, the SDG index does provide some useful information that can be compared at the global level.

[6] It is possible to look at countries' positions on any of the 80 indicators or the aggregation by different categories or subcategories. But for the broad positioning of the five pilot countries only the aggregate innovation index was used.

Figure 2.1 Position of the Five Pilot Countries on the SDG Index Score.

Pilot Countries SDG Index Scores
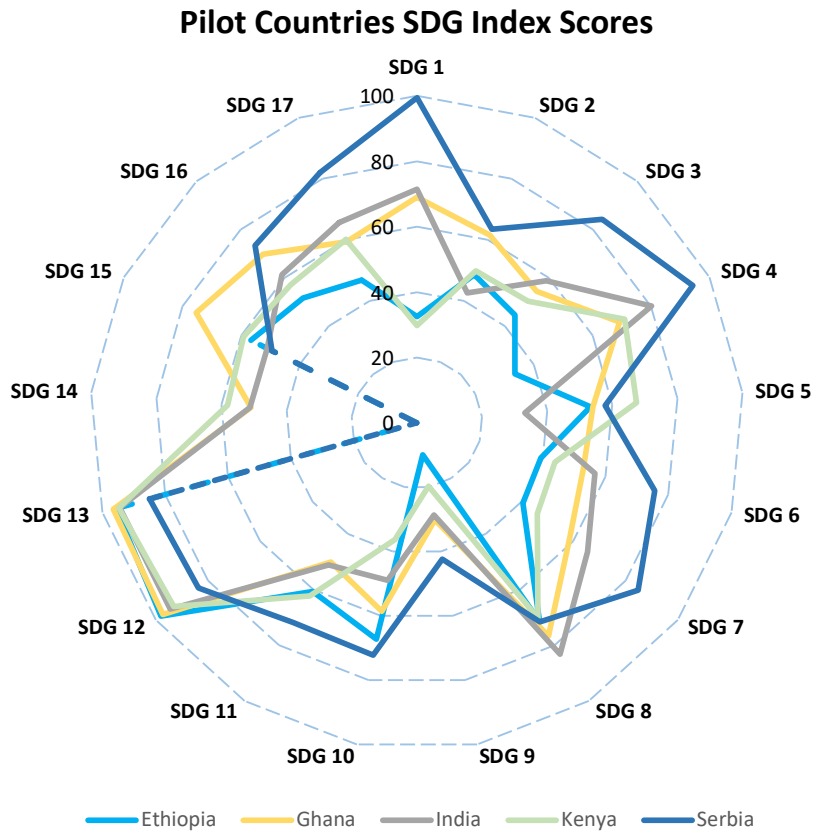
Source: Bertelsmann and Sustainable Development Solutions Network (2018). *SDG Index*

Figure 2.2: Relative Position of Five Pilot Countries on SDG Index vs the Global innovation Index.
(Pilot countries in blue, some outlier comparator countries in red)
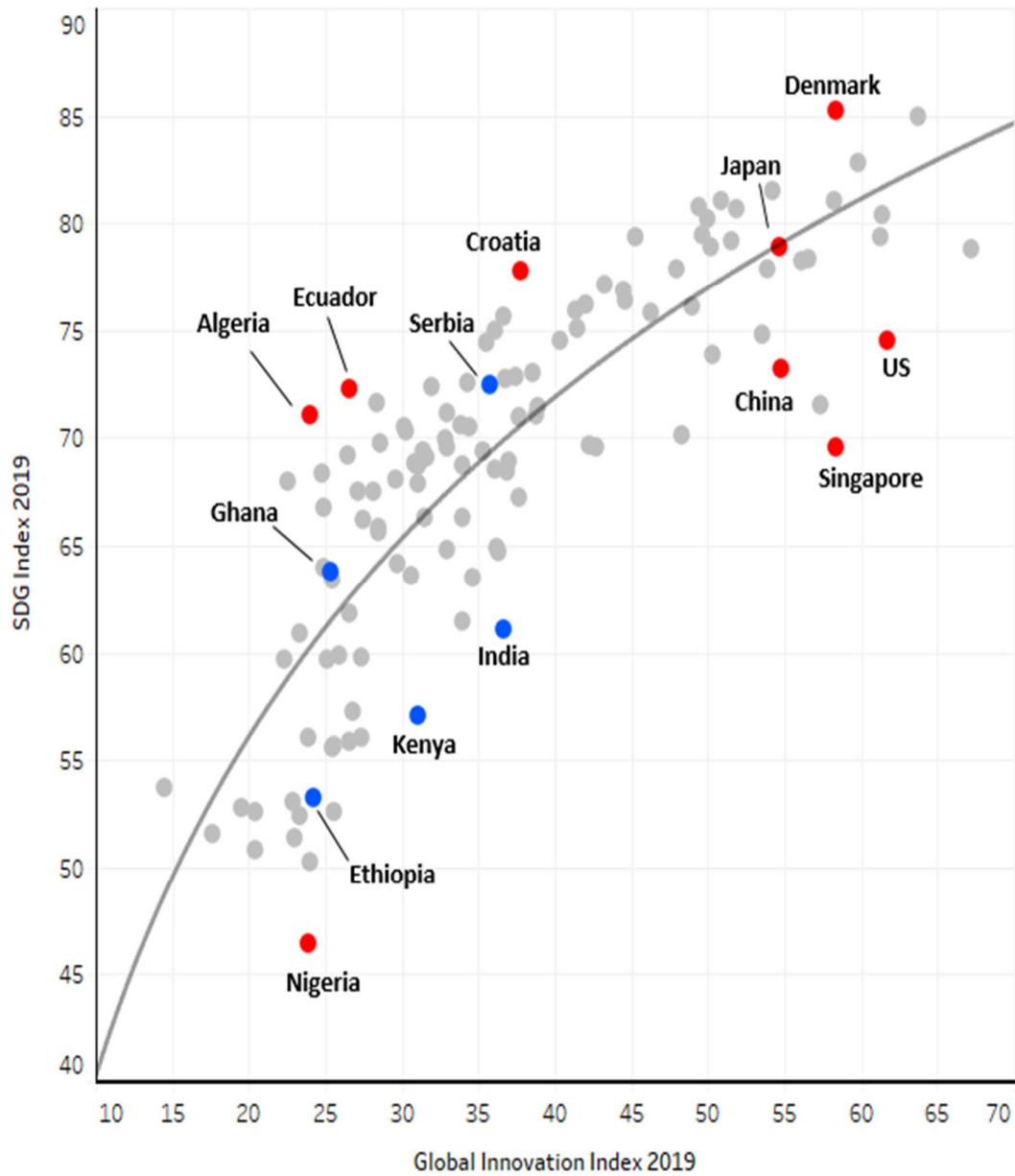
Note: Red dots are the pilot countries, blue dots are some outliers as reference points.

Source: Bertelsmann and Sustainable Development Solutions Network 2018. *SDG Index*
 Cornell University, INSEAD, and WIPO (2018). *World Innovation Index 2018*

Observations

SDG gaps

One of weakest areas is the SDG 9 index which although the goal is supposed to cover industry, infrastructure and innovation, the actual indicators used in the index are structured primarily around STI capability. This is the SDG on which all the pilot countries score the lowest. It is also generally the case where almost all developing countries score the lowest across all SDG goals. This implies that much more effort needs to be dedicated to improving STI capability in the pilot countries as well as among developing countries more generally.

One of best performing SDGs for developing countries is environmental. However, good ranking for developing countries is because of their low level of development. But it should be noted that developing countries do poorly on natural resource depletion as indicated in comparative ESE basic indicators.

Innovation gaps

Developing countries generally do poorly on innovation index because it is biased towards indicators that are more relevant for developed countries.

The Global innovation Index does not measure extent to which STI is being deployed, so this progress report attempts to infer that from three case studies in Annex. There should be more emphasis on measuring to what extent country makes effective use of knowledge that already exists.

SDG Gaps vs Innovation Index in general and for the five pilot countries

In comparing the two gap analyses together, it should be noted that while there is a positive relationship, there is large variance. Some of the pilot countries do worse on SDG index than on Innovation Index, especially India. This suggests that STI capability per se is not a guarantee that there is good performance on the SDGs. Therefore, there is a large room for improvement in harnessing STI for SDGs; STI capability has to be oriented to help achieve the attainment of SDG goals.

In addition, more than just STI capability is needed. The additional elements are things such as political will, planning, resources, institutions, infrastructure, skills and dynamic government, private and social actors, as is clearly illustrated in the three country case studies that are presented in the Annex. This is also why the development of STI for SDG roadmaps with clear objectives, broad stakeholder consultation and engagement, and clear implementation plans with assignments of responsibilities and strong monitoring and evaluation are so important, and this point has been emphasized in the Guidebook.

The assessment of current state of STI for SDG roadmaps

The assessment of current state of STI for SDG roadmaps is based on the achievements to date reported by the IATT focal point on the six steps outlined in the Guidebook, plus their use of data, expertise and stakeholder consultations, as well as self-reporting challenges/problems/lessons learned.

Table 2.1. presents a review of progress on the development of the STI for SDG roadmaps by each of the pilot countries, including the key agencies leading the process, expected other stakeholders and timeline, and challenges and lessons learned, as reported by the IATT focal points for each country.

Chapter 3 summarizes what has achieved to date in developing the STI for SDG roadmaps in the pilot countries.

Chapter 4 draws the lessons and implications from their experience to date, as well as from the case studies (Annex) of the effective use of STI to accelerate development goals in three pilot countries.

Table 2.1: Summary of Pilot Countries Approach and Progress in Developing Their STI for SDG Roadmaps (based on reports from Chapter 3)

	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.
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
Vision, Goals and Targets	In process, part of drafting a New National STI Policy; Roadmap is to follow preparation of the new STI policy; Linked to strong employment focus in National Development Plans; Focus on job creation, SDG 8 (decent work and economic growth) which feeds indirectly into improving other SDGs such as 1, 2, 3 and 10.	Build strong STI capacity to support social and economic development for sustainable development.	Overall framework in Strategy for a new India@75; Vision, goals, and targets still under preparation while some of main initiatives revolve around use of digital technologies to facilitate coordination and implementation of plan; Currently in process of evolving a new STI Policy 2020; Introduced significant amendment in the CSR Roles by MCA, allowing CSR fund to promote R&D that enables SDGs.	Guided by Vision 2030 which aims to transform Kenya into a newly industrialized middle- income country with high quality of life in a clean and secure environment by 2030, and President's Big Four Agenda (agriculture, manufacturing, health, and housing); Within Big Four Agenda it is focusing on SDG 2 (end hunger) and those closely related to it such as SDGs 1, 8, and 9.	Vision is "Serbia Creates Innovation"; Goals include 5 objectives: 1) R&D focused on 4S priorities, 2) economic growth supported through R&D, 3) education focused on innovation and entrepreneurship, 4) improved business environment through digitalization in 4S areas, and 5) internationalization through regional and global value chains in 4S areas
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.
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.
Timeframe and Key Milestones	COVID-19 delayed process of preparation.	Assessment of strategies by July 2020; Detailed 10-year STI for SDG roadmap planned for December 2020.	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.

	Ethiopia	Ghana	India	Kenya	Serbia
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.
Inputs/ Data/ Consultation	STIP Review involved stakeholders in the national innovation system, including government, academia, research centers, private sector, and civil society; Potential new stakeholders include the Development Planning Commission and possibly the line ministries.	Multiple consultations, including on-line consultations and survey with broad range of S&T stakeholders and quantitative data collection; Partnership with academia (UCL) for research assistance; Technical Task Team established to oversee and advice.	Extensive domestic data inputs and consultations with multiple stakeholders at central government, state and local levels, including with private sector and civil society.	Extensive use of data and expertise from national and international sources, including India and Japan; ACTS working with counterparts in Ethiopia, Mauritius, Rwanda, Tanzania, Uganda for developing STI for SDGs roadmaps	Extensive use of national and international data including creation of own Analytical Team; EU-JRC financed study by Fraunhofer Institute; Extensive consultations across government, private sector, academics, and broader society. Creation of working groups for each priority.
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.

Chapter 3: Review of Progress [Inputs from Focal Points of Each Pilot Country

Ethiopia – inputs from UNCTAD

1. Leading Agencies and National Counterparts

Ethiopia's roadmap is being coordinated by the national counterpart, the Ministry of Innovation and Technology (MINT). The Ministry of Science and Higher Education (MOSHE) has participated in several recent IATT events and is interested to participate in the preparation of the roadmap. MINT and MOSHE are the prime institutions responsible for planning related specifically to innovation and technology, and to science, respectively. MINT and MOSHE are discussing bilaterally their modalities for collaboration.

2. Achievements so far, Expected Outcome and Key Activities

The process for the development of STI for SDGs roadmap is on-going with out of the six steps completed as part of the preparation of the STIP Review of Ethiopia concluded in 2019. The two steps are the definition of objectives and assessment of the current situation. The STIP Review process included the mobilization of the three core inputs for the STI for SDGs roadmap process. First, it mobilized stakeholder's engagement among the main actors of the national innovation system, including government, private sector (sector leaders and business associations), academia and research centers, and civil society, through interviews, workshops and capacity building activities. Second, it engaged the expertise and experience of senior policymakers in Ethiopia as well as of international and national consultants to identify challenges and opportunities for using STI for development in Ethiopia. Third, the STIP Review process included the collection of data and knowledge on the development situation in the country, the status of the national innovation system, as well as the critical issues on promoting STI for job creation and inclusive and sustainable development. The STIP Review of Ethiopia presents the findings and recommendations to strengthen the national system of innovation of the country. It also serves as the report of the two initial steps of the STI for SDGs roadmap in Ethiopia.

The development of the roadmap is now at step three (develop vision, goals and targets), which corresponds to work on drafting a new national STI policy. The key activity so far is the discussion of the objectives and scope of the roadmap, and modalities for collaboration across MINT and MOSHE as the most relevant STI-related ministries in Ethiopia. Discussions so far have centered on preparing an implementation plan covering several of the 22 sectoral technology roadmaps that have to date been prepared in Ethiopia. To date, Implementation Protocols (or plans) have only been prepared for three of these technology roadmaps.

The expected outcome is an STI roadmap that covers important aspects of the current high priority areas of Ethiopia's evolving development plans and the SDGs. This might focus on job creation (most closely aligned with SDG 8 (decent work and economic growth), but which feeds indirectly into improving several other SDGs such as 1 (no poverty), 2 (zero hunger), 3 (good health and well-being) and 10 (reduced inequalities)) as a unifying theme. National development plans and priorities have been evolving rapidly in the country in recent months. The employment focus recognizes the serious challenges created by high unemployment in the country and the high priority placed on creating jobs as part of the recent National Job Creation Agenda in Ethiopia.

3. Expected Other Stakeholders, Milestones and Timeline

Other relevant stakeholders include the Development Planning Commission and possibly key line ministries. Representatives of the private sector and academia should also play a role in the steps involved in preparing the roadmap.

UNCTAD has provided support to date as part of its project on implementing a STI policy review for Ethiopia. The roadmap is to be sequenced as a follow-up to the preparation of the STIP review (which has now been completed) and the drafting of a new national STI policy. Ethiopia is currently engaged in the process of drafting a new national STI policy, with UNCTAD supporting this process. The roadmap preparation should follow directly the preparation of the new STI policy. Currently, the timeline is being revised due to delays emanating from the outbreak and rapid evolution of the COVID-19 crisis in Ethiopia and other countries around the world. The original timeline was for activities related to drafting a new national STI policy to start in late April, but a new timeline has to be agreed that corresponds to what is possible given the restrictions on travel to and from Ethiopia and other countries as part of emergency measures to address COVID-19. This likewise implies a delay in starting the roadmap.

4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

A key challenge encountered is the lack of a specific budget for the implementation of the roadmap. This has slowed the process of planning activities due to the need to provide financing to support planned activities. UNCTAD was able to mobilize some limited resources as part of the follow up to the development of the STIP Review of Ethiopia.

An additional challenge is establishing a smooth mechanism for generating collaboration across stakeholders that would ideally be involved in preparation of the roadmap. The lack of regular meetings by the National STI Council means that getting approval from this cross-governmental body on coordination is not easy to achieve.

Ghana – inputs from UNESCO

1. Leading Agencies and National Counterparts

The process for development of STI for SDGs Roadmap in Ghana is part of Ghana's current effort to align the national STI priorities and the National STI policy (2017) towards achieving the SDGs.

Launched in late 2019, the pilot exercise in Ghana is coordinated by the Ministry of Environment, Science, Technology and Innovation (MESTI) and the Science and Technology Policy Research Institute (CSIR-STEPRI), and involves also other ministries such as the Ministry of Finance, and Ministry of Planning, Ministry of Trade and Industry, Ministry of Health etc. The Technical Task Team with oversight responsibility over the process of developing the STI for SDGs roadmap is co-chaired by the representative from the Office of the President SDGs Advisory Unit and the National Development Planning Commission (NDPC) in Ghana. UNESCO is the IATT focal point agency for the implementation of the pilot road-mapping exercise.

2. Achievements so far, Expected Outcome and Key Activities

Activity: Define objectives and scope

The country has the current national development plan frameworks "**Agenda for Job-Creating Prosperity and Equal Opportunity for All** (2017-2021) and the **Coordinated Program for Economic and Social Development Policies** (2017-2024) which set out the **national priorities** in all sectors of the economy. The objective of the development of the STI for SDGs roadmap is to align and implement STI priorities towards contributing to the achievement of the SDGs. Developing an action oriented STI for SDGs roadmap is expected also to accelerate developing new or adapting existing solutions to meet the SDGs target by 2030, whiles ensuring sustainability.

Activity: Assess current situation

Ghana has started organizing the conduct of assessment studies of the policies, strategies, implementation plans of priority sectors in relation to STI and the National Development Plan. The assessment studies will reinforce the STI diagnostics, notably of the STI policy; The 2010 policy has a 5-year STI implementation plan which had 17 programs and 84 projects outlined for implementation, but no monitoring and evaluation system in order to track progress of implementation of policies and programs. Further situational analysis regarding the targeted SDGs and outlining SDG needs for reaching these goals is being conducted, including assessment of available resources within Ghana.

Other advancements include: i) the adoption of Ghana's Science Agenda for Agriculture in Africa (S3A) promoted by the Forum for Agricultural Research in Africa (FARA), ii) the establishment of the Presidential Advisory Commission on STI and a Research Fund for scientists and researchers, and iii) the inter-institutional framework for working towards the achievement of the SDGs through the development plans of Ministries, Departments and Agencies (MDAs), and Metropolitan, Municipal and District Assemblies (MMDAs). Ghana has processed a STI ecosystem survey and an R & D survey which results, and data provide key baseline indicators for STI and for the STI-SDGs roadmap exercise. In addition, the National SDG baseline Report of 2018 serves as well as a baseline for the work.

Activity: Develop vision, goals, and targets

The vision of Ghana is to build a strong STI capacity to support the social and economic development for the sustainable transformation of the economy.

The vision, goals and targets of the STI for SDGs roadmap are still being discussed, however, the 1st national consultation on the process held in Accra in December 2019, identified some of the SDGs

(**SDG: 1, 2, 4, 6, 7, 8, 9, 10 & 13**) that Ghana could prioritize in the development of the roadmap. SDG 3 and 5 will also be considered.

Activity: Assess alternative targets

The current STI development trends in the country show that technology incubation hubs are making a great impact that contributes significantly to socio-economic development of Ghana, complementing to the efforts by actors in the formal R & D system. These hubs are centered on students and young graduate in tertiary institutions. The STI roadmap in Ghana should place emphasis in promoting these systems. While the formal institutions continue to work on existing and emerging technologies some of these incubation hubs focus their energies mainly on emerging technologies such as Artificial Intelligence and Robotics. The roadmap will also pay special focus to STI in the informal sector, with particular attention to the role of women.

Activity: Develop detailed STI for SDG roadmap

A **work plan and tentative timelines** for the roadmap development has been elaborated during national consultation in December 2019. The detailed STI roadmap for the SDGs is expected by December 2020.

Activity: Execute, monitor and evaluate, and update plan

Ghana's plan is to implement from 2021-2030 up to 50 programs, projects and activities by **mobilizing resources** through GoG budgetary supports/donors with the help of the Ministry of Finance, President of Ghana. In parallel to constitute an Apex level **Inter-Ministerial Implementation Team** to oversee the implementation of the STI for SDG Roadmap. Also, the Ministry of Monitoring and Evaluation with support from the UN will request regular reports for each program/project/activity. These monitoring methods will allow to review and evaluate the STIs Roadmap for the SDGs by 2030.

Inputs: Data, stakeholder consultations and expertise

The 1st national consultation was held in Accra, in December 2019, including key national partners and UNESCO, who reflected on the process and way forward. **A Technical Task Team** for developing the STI Roadmap for the SDGs is being established, to advise on: i) practical information of the UN Guidebook on STI roadmaps for SDGs as basis for adapting to specific conditions and capacities in Ghana, ii) inputs from **on-line consultation** meetings with multi-stakeholders and iii) qualitative and quantitative data collected through an **online survey** and interviews targeting policy makers, research & academia, private sector and civil society representatives. Also, the technical task team will work on potential key STI policy instruments.

Meanwhile, UNESCO as the IATT focal point for the Ghana Pilot has been developing a partnership with academics. A team of students at the University College of London (UCL) - Department of Science, Technology, Engineering and Public Policy (STEaPP), who is contributing to the pilot roadmap project in Ghana under Dr. Jean-Christophe Mauduit as a mentor. The UCL team is mainly contributing with desktop research and analysis on STI for SDGs in key priority sectors in Ghana, also working with UNESCO on the on-line survey that will gather information and contributions for the roadmap design from various STI stakeholder institutions, including youth and women organizations in STI

3. Expected Other Stakeholders, Milestones and Timeline

The current **work plan** for the development of Ghana's STI Roadmap for the SDGs involves:

1. Assessment studies of the current situation of the policies, strategies, implementation plans; March- August 2020
2. Sensitization of key stakeholders; Jan- Dec 2020

3. 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
4. Mobilization of Resources, Implementation of programs/projects/activities, Monitoring and Evaluation; Jan 2020- Dec 2030

4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

The main challenge is to involve a broad range of STI stakeholders for the definition of priorities of STI policies and strategies. Dissemination of information and consultations are key aspect of the process. Inter-ministerial coordination and cooperation, including with STI agencies in the country, is key in order to avoid duplication of programs and activities. Better alignment of the STI policies to the sectoral policies is essential, as well as capacity building in STI policy. Involvement of UN country team and representatives of agencies needs to be strengthened to ensure sustainability and successful implementation of the future STI roadmap.

India – inputs and updates by WB

1. Leading Agencies and National Counterparts

The Government of India remains fully committed to leveraging and promoting STI to achieve SDG goals and has entrusted the task at the highest levels of the government to facilitate coordination across key departments including the federal and sub-national level, and other partners including the private sector. The Indian STI for SDGs roadmap is being developed and spearheaded by the Office of the Principal Scientific Advisor (PSA) through the Prime Minister's Science, Technology, and Innovation Council; in coordination with NITI Aayog (a policy think tank of Indian Government chaired by the Prime Minister). India is still at an early stage in developing a detailed STI for SDGs roadmap and for the STI for SDGs roadmap pilot it is focusing on SDGs 2, 3, 6, 7, and 17. Because of its strong STI capability India is also in position to partner with other developing countries through capacity building, technology transfer, and development cooperation to address sustainable development.

2. Achievements so far, Expected Outcome and Key Activities

Activity: Define objectives and scope

The Indian STI for SDGs roadmap is being led by the Office of the Principal Scientific Advisor (PSA) through the Prime Minister's Science, Technology, and Innovation Council; in coordination with NITI Aayog. The latter is a policy think tank of Indian Government chaired by the Prime Minister which replaced the Planning Commission in 2014. It is in charge of policy planning, including coordination among line ministries and as interface between the central government and the states. Among other tasks, it is entrusted with the coordination of the SDGs.

While all SDGs are taken into account, the pilot mapping is restricted to SDG2 (End hunger,), SDG 3 (Good Health and Well-being), SDG6 (Clean Water and Sanitation), and SDG7 (Affordable and Clean Energy). These four goals have been selected as they robustly capture the interconnectedness of the SDGs in India as well as the significant progress that India has made in these sectors. India has also taken a lead in SDG17 (International Partnerships for the Goals) through its role in pushing for the creation of the UN Technology Facilitation Mechanism, and through collaboration programs to share its technical expertise and eliciting and diffusing meaningful lessons with other developing countries in Asia and Africa, as well as STI partnerships with developed countries. India is also a host country to several regional and international STI institutions including the Asian and Pacific Center for the Transfer of Technology (APCTT), the International Center for Genetic Engineering and Biotechnology (ICGEB), the International Solar Alliance (ISA), the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); and is party to various international conventions, treaties and protocols including the Global Environment Facility (GEF), and various institutions in nuclear and space technologies.

Activity: Assess current situation

India is currently mapping ongoing STI interventions in relation to the selected SDGs at the subnational, national, and international levels. Besides this ongoing process, and referring only to the STI dimension, in July 2019 the Economic Advisory Council of the Prime Minister of India (EACPM) published R&D Expenditure Ecosystem: Current Status and Way Forward which assesses India's R&D effort at the national and subnational level. The report proposed that by 2022 R&D expenditures share of GDP should double to 2% of GDP, exports of R&D should also double to US $6 billion, FDI inflows more than double to US $300 billion, the ratio of private to public R&D should be inverted from the current 40/60 to 60/40, and that the office of the Principal Scientific Advisor be the Apex body for preparing and implementing the National R&D Agenda and Action Plan.[7] As per

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[7] EACPM, 2019, p. 17.

its Voluntary National Report (VNR) on the Implementation of the Sustainable Development Goals[8], India is emerging as a major research and development hub in Information Technology and electronics. It also makes reference to the Atal Innovation Mission which aim to transform the innovation and entrepreneurship landscape in the country.

The NITI Aayog has constructed an SDG India Index spanning 13 of the 17 SDGs to track the progress of all the States and Union Territories on a set of 62 Priority Indicators, measuring their progress on the outcomes of the interventions and schemes of the Government of India. In 2019, NITI Aayog brought out, 'SDG INDIA - INDEX & DASHBOARD 2019-20' along with the UN. It is constructed using 100 indicators covering 54 targets across 16 Goals, except SDG 17.[9]

The STI for SDGs mapping activity for the selected sectors through publicly available data is ongoing. Mapping for the agriculture sector is completed, and energy, water and health sectors is underway. A deep dive into selected programs is planned as the next step. That apart, a Monitoring and Evaluation (M&E) platform is planned to be developed for tracking the STI for SDGs portfolio at the Office of the Principal Scientific Advisor. The nature and design of this platform is currently being worked out.

The workshop on Developing STI Partnerships for Sustainable Development, co-hosted with Japan and IATT was recently held on June 23 and 29 in a virtual format. The main theme of the 2nd day of the workshop was *Accelerating International Cooperation Through the Global Pilot Programme on STI for SDGs Roadmap*. This IATT event has provided substantive inputs for the High-Level Political Forum as well as the TFM.

Activity: Develop vision, goals, and targets

At the broader level the most recent vision and strategy document is "Strategy for a New India@75, put out by NITI Aayog in November 2018. It aims at fast growth with social and political inclusion by 2022, 75 years after India's independence.[10] For the STI for SDGs roadmap, vision, goals, and targets are still being developed. Some of the main initiatives revolve around the use of digital technologies to facilitate coordination and implementation of plans. Some specific examples of what India has already done leveraging digital technologies are the JAM trinity (linking affordable access to financial services, mobile phones, and the Aadhar unique ID system to implement, among other things, large scale direct benefit transfers to the poor), as well as the ongoing Ayushman Bharat universal health insurance project, all of which are based on extensive digital platforms. Potentially some of these could be replicated in other countries (see Indian case studies in Annex).

India is currently in the process of evolving a new Science, Technology and Innovation Policy 2020 through extensive consultations with all stakeholders including citizens. India has also introduced significant amendment in the Corporate Social Responsibility (CSR) Rules by the Ministry of Corporate Affairs (MCA) which allows for using CSR fund to promote R&D that enables SDGs.

Activity: Assess alternative technologies

Analysis of alternative technologies are being done as part of mapping out the role of STI for SDGs. Unlike most developing countries at its per capita income, India has strong technological capability in a broad range of areas ranging from agriculture to space and digital technologies.

Activity: Develop detailed STI for SDG roadmap

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[8] Voluntary National Review Report on The Implementation Of Sustainable Development Goals, India, 2017
[9] https://niti.gov.in/sites/default/files/2019-12/SDG-India-Index-2.0_27-Dec.pdf
[10] NITI Aayog, 2018.Tjis

The detailed STI for SDG roadmap is yet to be fully developed. However, some of the specific STI interventions for the effective outcome of various programs include the following[11]:

- Soil health cards to farmers, electronic marketing support, digital lockers, neem coated urea, and household rural electrification for poor farmers
- Health & wellbeing Initiatives, including immunization drives, construction of two-pit toilets/septic tanks, and a proposed National Rural Telemedicine Network
- Clean & affordable energy for poor families through LPG connections for poor women as well as a Biogas Development Program
- Atal Tinkering Labs in schools to support scientific innovation
- Optical Fiber Connectivity to 119,000 rural local self-governing bodies
- e-Governance initiatives including the Digital India initiative
- Digital technology enabled initiatives focused on inclusive development, such as the JAM trinity

In addition, the Prime Minister's Science and Technology Advisory Council has announce eight major missions: artificial intelligence, quantum frontier, natural language translation, deep ocean exploration, waste to wealth, national biodiversity, electric vehicles, bioscience for human health, and accelerating growth of new India's innovations.[12]

Activity: Execute, monitor and evaluate, and update plan

As the detailed plan is still to be developed, it is not yet being executed, monitored or evaluated. However, judging by the initiative to start with a strong focus on monitoring, evaluation and developing a strategic decision system for science and technology, it would appear that this focus may also be applied in the execution of the STI for SDGs roadmap.

Inputs: Data, stakeholder consultations and expertise

The Office of the PSA is undertaking a major effort to collect data and to hold extensive consultations and draw on a wide range of expertise in developing its STI for SDGs roadmaps. One of the main initiatives of the PSA is to develop a data driven, robust, and effective monitoring and evaluation system of science and technology that is to be used to provide strategic guidance to the implementation and adjustment of the plan.

3. Expected Other Stakeholders, Milestones and Timeline

Apart from the agencies and counterparts mentioned above, the STI for SDGs Roadmap exercise will involve a knowledge partnership with an autonomous policy research institute based in New Delhi.[13] As part of the mapping STI for SDG portfolio mapping, a deep dive functional effectiveness review would be planned into specific sectors and departments as a next step.

4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

The STI for SDG Roadmap activity in India has received great support from the office of the Principal Scientific Advisor. The key challenges so far have mainly pertained to obtaining data for creating the data infrastructure (availability of information on budget flows, outcome budgets, state-level data etc.) and coordination between various agencies. There has also been some slowdown of plans involving interactions with different stakeholders on account of the Covid-19 crisis.

Significant progress has been made on the STI for SDGs pilot activity in India. The STI for SDGs mapping activity for the selected sectors through publicly available data is ongoing, with a deep dive

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[11] Examples taken from "Leveraging STI For Promoting SDGS: an India Perspective" (2019) prepared by the PSA as an input to the Indian STI for SDGs pilot

[12] http://psa.gov.in/pmstiac-missions. Accessed 01/10/2020.

[13] Research and Information System for Developing Countries (RIS)

into selected programs being planned as the next step. To support the STI for SDGs portfolio, a Monitoring and Evaluation (M&E) platform or some kind of 'Design Support System' is also planned. Interactions with stakeholders including the recent workshop, co-hosted by India, Japan and IATT, are being adapted to a virtual format to the extent possible so as to ensure that meaningful inputs can still be provided within the changed environment.

Kenya – inputs and updates by WB[14]

1. Leading Agencies and National Counterparts

Kenya's STI for SDGs roadmap is being led by the State Department for Planning, SDP, (which hosts SDGs Secretariat) in the National Treasury and National Commission for Science, Technology and Innovation (NACOSTI) under Ministry of Education (MoE) in partnerships with line ministries for ICT, Foreign Affairs, Agriculture and Industry. The process is supported by the African Centre for Technology Studies, as a technical and knowledge carrier. A small technical team was established to spearhead the pilot project and prepare draft documents to be used for engagement with wider stakeholders.

2. Achievements so far, Expected Outcome and Key Activities

Activity: Define objectives and scope

Objectives: In formulating the objectives and the scope of the STI roadmap, the Kenyan Technical Team has been guided by several national and sectorial development policies and strategies. These includes the Vision 2030[15], the Third Medium Term Plan 2018-22 (MTP III)[16], as well as the President's Big Four Agenda, which covers Agriculture, Manufacturing, Health and Housing. In additional, the pilot project has also been guided by the draft STI policy and the recently launched National Research Priorities (2018-2020). The main objective of the Kenyan STI roadmap is to provide a medium term timebound and resourced plan for the implementation of the STI policy[17] and to support the delivery of the president's Big Four Agenda.

Focus: Accordingly, the STI for the SDGs roadmap focusses on SDG 2 (End Hunger) as well as those SDGs closely linked to it, such as SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth) and SDG 9 (Industry, Innovation, and Infrastructure).

Activity: Assess current situation

Analyzing the gaps and further prioritization of the SDGs: The roadmap technical team used indicators from the SDG Index, African SDG Dashboard 2019 report, the Kenya Department of Planning Status Report 2019, National Statistics, Food Insecurity Index as well as a Kenyan SDGs Policy Gaps Analysis (2018). The team so far undertook a detailed assessment of SDG 2, covering all the five sub-objectives (2.1, 2.2., 2.3, 2.1. and 2.5). Although, the analysis showed that Kenya was lagging behind in most of the SDG 2 targets[18], the team prioritized SDG 2.3 (increasing productivity and income of smallholder farmers) which, if addressed, would bring the highest impact to all the other sub-objectives of SDG2 and also contribute towards realization of SDG 1, SDG 8 and SDG 9. SDG 2.3 also synchronizes well with the aspiration of the Big Four Agenda for Agriculture and Food Security.

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[14] This summary is based on a progress report on the pilot program in Kenya (ACTS, 2019), supplemented by the Kenya focal points discussion with the Kenya team leader.

[15] *The Vision 2030* is the national long-term development strategy covering the period from 2008 to 2030 which aims to transform Kenya into a newly industrializing, middle-income country providing a high-quality life to all its citizens through three pillars: economic, social and political.

[16] *The Vision 2030* is implemented through tranches of five-year Medium-Term Plans.

[17] The National STI Policy was drafted by a multi-stakeholder committee consisting of NACOSTI, SDP, the MoE, and various research institutions and thinktanks, the private sectors as well as the development partners.

[18] Kenya's 2016 performance relative to 2014 had worsened on targets related to stunting, malnutrition, and obesity.

Identifying the STI needs and Gaps: The team identified the following six areas along agricultural value chains that require STI inputs: improved seed varieties; access to quality inputs; irrigation and mechanization; reducing postharvest losses; agro-processing; and marketing; with ICT as cutting across the value chain. The team has also identified the current gaps in the STI systems, which may hinder effective deployment of the required STI. In addition, supported by the World Bank, the team is analyzing, through STI Public Expenditure Review, existing and planned relevant programs/projects funded by the government and international partners, aiming to promote R&D and technology adoption and diffusion with increased efficiency and effectiveness.

Activity: Develop vision, goals, and targets

The broad vision of the STI for SDGs was framed within the aforementioned Vision 2030, which pays out the long-term priorities of transforming Kenya into a newly industrialized middle-income country with high quality of life in a clean and secure environment for all citizens by 2030. The STI for SDG pilot roadmap initially focusses on two of the President's Big Four agenda—manufacturing and agriculture--because of the strong interlinkages between them. Accordingly, it focusses on increasing agricultural productivity and increasing the incomes of small holder farmers because at the 2019 STI Forum, it was determined that such focus would have the greatest positive impact on livelihoods. The roadmap aims to mainstream the application of STI for the realization of SDGs in Kenya. The goal is set to "Realize 100% food and nutrition security by 2022 through the application of science, technology, and innovation in increasing agricultural productivity, increasing income of small holder farms, and reducing the cost of food."

Activity: Assess alternative technologies

With the prioritization on agriculture in SDG 2 the roadmap process has started by focusing on three crops: maize, rice and potatoes. To test the methodology the STI team is focusing on maize with the short-term goal of achieving self-sufficiency in maize by 2022. To achieve this, the team is identifying technologies in new plant varieties; production and blending of fertilizer; control of pests, disease and week, mechanization; reduction of postharvest losses, processing technologies, and STI for enhanced market access. Improved seed varieties were prioritized, and various conventional as well as alternative existing technologies were assessed. It was decided to go ahead and develop a roadmap using an existing conventional variety available domestically.

Activity: Develop detailed STI for SDG roadmap

To develop the detailed plan, the team will map and hold consultations with various stakeholders; identify programs through which the technologies can be delivered; agree on what need to be done by different stakeholders. This will include different government agencies, the private sector, and the small holding farmers. The team will also document how to mobilize the resources required for the deployment of the technologies to scale, and to incentivize the private sector's participation in technology uptake and deployment. The next steps will be to expand the scope of the STI for SDGs roadmap to the other priority interventions identified, to do further consultations with relevant stake holders and to scale up and harmonize the roadmap, and to plan a communication strategy for the government to announce the roadmap.

Activity: Execute, monitor and evaluate, and update plan

As the plan is still under preparation, and no explicit mechanisms for monitoring, evaluating, and updating the full roadmap seem to have been put in place yet. However, the pilot exercise focused on improved maize varieties has helped to identify the importance of the technical committees giving broad guidance and the need for increased stakeholder consultation.

Inputs: Data, stakeholder consultations and expertise

The STI for SDG team has made extensive use of existing national and international data. It has also held some consultations with stakeholders, including various parts of government, the private sector, civil society and farmers. Technical input has involved domestic and some foreign experts and

international institutions. However, from the conclusions of the pilot test, an important lesson is the need for a more proactive stakeholder engagement strategy.

The team has made significant progress in terms of forging international stakeholder involvement. The NACOSTI as the lead agency and Toyota Tsusho Corporation forged an agreement, which was announced during TICAD7 in July 2019, that the Japanese firm would support Kenya's roadmaps e.g. in skills development for the Big Four agenda, initially in agro-processing and value addition as well as improving SMEs' managerial and technology adoption capabilities through the corporation's educational/vocational training platform (Toyota Kenya Academy). The Kenyan team has been active in bilateral/trilateral cooperation with Japan and India to tap into their expertise. The three countries have been discussing concrete ways to forging coordination/cooperation, i.e. through think tank network among ACTS, Research and Information System for Developing Countries (RIS) (India) and National Graduate Institute for Policy Studies (GRIPS) (Japan) and to share good practices and lessens-learned in supporting national roadmaps related activities at recent events, including India-Japan 2-day Workshop on STI for SDGs Roadmaps, co-hosted by IATT. The governments of Kenya and Japan have been encouraging research partnerships among their research institutions, i.e. combating parasitic plant (Striga) affecting maize production. Additionally, ACTS has been working with Japan International Corporation Agency by identifying and coordinating at least 16 ongoing/pipeline projects with high relevance to Kenyan Pilot project. Furthermore, ACTS has reached out its counterparts in Tanzania, Rwanda, Uganda, Ethiopia and Mauritius to formulate a regional partnership in developing and implementing STI for SDGs Roadmaps in these East African countries by applying for EU African, Caribbean and Pacific (ACP) Innovation Fund (currently under selection process).

3. Expected Other Stakeholders, Milestones and Timeline

The original plan was that the process would be rolled out as follows as from effective from January 2020.

a. Generation of a work plan for the whole process
b. Mapping of the actors and stakeholders who are relevant to the various focus areas.
c. Validate the SDG gaps (SDG focal points)
d. Define and prioritize in collaboration with (relevant) stakeholders' entry points of STI for SDGs roadmap. Prioritization be done at this stage
e. Area-specific technical team to develop the STI for SDGs roadmap for their area.
f. Review and harmonize the drafts generated by the area specific technical committees by the core technical team.
g. Validation by the relevant stakeholders.
h. Consolidation (involves harmonization) of the various drafts.
i. Strategic communication to relevant authorities (Cabinet Secretaries and Principal Secretaries).

Currently the timelines are being revised due to delays emanating from covid-19 and changes in personnel both at the department of planning and NACOSTI. The main contact person at Planning has retired whereas there is a new Director General at NACOSTI.

4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

a. The process of developing an STI roadmap for the SDGs is a unique opportunity that has brought together government agency responsible for SDGs (Department of Planning) to work closely with the NACOSTI, the Agency responsible for STI. In the past such coordinated efforts between the two had never taken place. Such situation of limited coordination between SDGs and STI may also be found in other pilot countries.
b. The process of developing the STI roadmap is complex, requires expertise and various stakeholders.
c. The presence of clear government prioritized sectors (like the big four agenda) may make the processing of defining the scope easier.

d. Data is a challenge. There is inadequate data to provide the baseline for all the targets. There are no direct SDGs targets. They can only be inferred from sectoral plans and strategies. Therefore, the gaps were determined using SDG Index and Dashboard

e. Most of government departments are implementing programs and projects that contributes to SDGs but have not linked their targets to SDG objectives. As relevant documents of government funded STI programs/projects rarely mention which SDGs are relevant, it has been difficult for the team to track down and list up existing work.

f. Developing of the STI roadmap for the SDGs is new and requires skills and capabilities to make use of country diagnostic methodologies and tools for gaps and needs assessment. Such skills and capabilities may not be readily available in government, the private sector and the NGO. When Kenya initiated its analytical work with the WB, the Kenyan technical team members needed a hands-on support and guidance from the Bank in collecting domestic data to be collated in a table, for example. Capacity building is required, and attentive technical support of relevant international partner agencies is essential.

g. Assess Alternative Pathways is perhaps the most complex and expensive step in this process. It requires active participation of carefully selected stakeholders, not only from the government and research institutions but also from the private sector and civil societies, for each of the identified areas of interventions. As mentioned in 2.3, the team has assessed various technologies for achieve self-efficiency in maize by 2022. In doing so, nearly a dozen of workshops have been held to cover a wide range of sub-topics, e.g. new plant varieties and production/blending of fertilizer. Knowledge and networks of Agricultural experts in the team were crucial in mapping out issues and stakeholders, put together a series of workshops and come up with priorities.

Serbia – inputs and updates by EC/JRC with UNIDO[19]

1. Leading Agencies and National Counterparts

Serbia decided to use the ongoing Smart Specialisation Strategy development process to elaborate the STI for SDGs Roadmap. Smart Specialisation Strategies are Research and Innovation Strategies that aim to prioritize the limited number of STI priorities with highest potential impact on socio-economic development. These priorities are then used to target public and private investment. The Prime Minister Cabinet leads the Inter-ministerial Working Group on Smart Specialization and Industrial Policy in Serbia (Decision of the Government of the Republic of Serbia, OGRS 33 and 34/2019). The operational leadership for the Smart Specialization stays with the Ministry of Education, Science and Technological Development (MESTD) and the Public Policy Secretariat with active engagement of other ministries and stakeholders. In 2017 – 2019, when the first Inter-ministerial Working Group (Decision of the Government of the Republic of Serbia, OGRS 95/2016) was active, the following stakeholders were involved: Ministry of Economy, Ministry of Finance, Ministry of Labor, Employment, Veteran and Social Policy, Ministry of Trade, Tourism and Telecommunications, Ministry of Agriculture, Forestry and Water Management and Environmental Protection, Ministry of Culture and Information, Provincial Secretariat for Economy and Tourism of AP Vojvodina, Serbian Chamber of Commerce and Industry and Serbian Academy of Sciences and Arts - SASA). At that time the Inter-ministerial working group formed sub-units, the Operational and Analytical Team. The latter was tasked with the mapping of economic, innovative and scientific potential of the Republic of Serbia in cooperation with relevant institutions in the country. It worked with the National Statistical Office, Intellectual Property Office, Public Policy Secretariat, Ministry of Education, Science and Technological Development, Ministry of Economy, Serbian Chamber of Commerce and Industry, University of Belgrade. EC JRC provided support financing Fraunhofer Institute expertise. Recently, the national Inter-ministerial Group for Agenda 2030 (26 Ministries) under the lead of the Minister for SDGs decided to hold joint meetings for the development of the STI for SDGs Roadmap, where a dedicated STI for SDGs subcommittee is being created.

2. Achievements so far, Expected Outcome and Key Activities

The Serbian government adopted the Smart Specialization Strategy Serbia (4S) on 27 February 2020. The government's intention is to leverage from the experience and established processes underpinning the 4S to produce an STI for SDGs Roadmap, which will become the detailed Action Plan of the 4S. In line with the methodology elaborated in the STI for SDGs Roadmaps Guidebook, the 4S includes:

- Wide policy framework and synergies,
- Analysis of economic, innovative and scientific potential,
- Selection of policy priorities and targets,
- Vision for the future,
- Policy measures,
- Monitoring and financial framework,
- Operational framework for implementation

Activities: Define objectives and scope

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[19] This case builds, among other sources, on the Serbian presentation at Session 10 of the UN-China Ministry of Science and Technology Joint Capacity Building Workshop in Guilin, China, December 9-17, see Knezevic and Nedovic, 2019, the following presentation in Vienna (February 2020) and the official Smart Specialisation Strategy text. The text was prepared by Monika Matusiak (EC JRC) and reviewed by Viktor Nedovic and Tijana Knezevic (MEDST) and Fernando Santiago Rodriguez (UNIDO).

The 4S is an interdisciplinary research and innovation agenda to foster the socio-economic development and transformation based on knowledge-intensive activities. It focuses on the following priorities:

- Food for future (including High-tech Agriculture, Value added Food Products and Sustainable Food Production chain)
- Creative Industries (including Creative audio-visual production, Video Games and Interactive media and Smart Packaging)
- Future Machines and Manufacturing Systems (including General and special-purpose Machines, Information for Smart Management: Industry 4.0 and Smart Components and Tools)
- Information and Communication Technologies (including Custom Software Development and Own Product Development)
- Key Enabling Technologies (horizontal priority supporting the vertical ones)
- Energy Efficiency and Environmental Protection (horizontal priority supporting the vertical ones)

The targeted SDGs include SDG 2, 7, 8 and 9.

Assess current situation

Serbia tasked her Analytical Team tasked with the mapping of economic, innovation and research potential of the Republic of Serbia in cooperation with relevant institutions as described in section Leading Agencies and National counterparts. The work was completed in 2019. Additionally, EC JRC has financed an additional study on mapping of SDGs, including the identification of SDGs prioritized in the national strategic framework, the statistical baseline analysis and the identification of the STI inputs focused on specific SDGs (finished in May 2020). This analysis has identified the importance of additional SDGs: 3, 4 and 12, which will be taken into account in the STI for SDGs Roadmap development.

Develop vision, goals, and targets

The vision for the future has been developed in a wide participatory process as described in the section Stakeholder consultations. Over half of the participants represented private sector. The accepted vision is:

Serbia Creates Innovations - Serbia country of smart and creative people, highly competitive in the World, recognized by its knowledge-based innovations, partnerships of the domestic ecosystem and creativity of individuals in areas of:

- *sustainable high-tech production of high value-added food for the future.*
- *sophisticated software solutions for the global market.*
- *inter-sectoral-based industrial innovations.*

with a high degree of inter-sectoral integrated industrial and business solutions and innovations.

Overall goal aims to achieve the vision "Serbia Creates Innovation": Development of the Republic of Serbia towards a highly competitive economy through research, development, innovations, and entrepreneurial initiatives in the 4S areas. The goal includes 5 objectives:

1. *Research and development focused on 4S priorities.*
2. *Economic growth supported through R&D and collaboration among the quadruple helix participants.*
3. *Education focused on innovations and entrepreneurship.*
4. *Improved business environment through optimization and digitalization of procedures in 4S areas.*

5. *Internationalization of the economy through involvement in regional and global value chains in the 4S areas*

and a set of priority-specific targets to be achieved by 2027.

Activity: Assess alternative targets

The entrepreneurial discovery process framed the discussion of alternative targets and solutions. This is documented in separate workshop reports.

Activity: Develop detailed STI for SDG roadmap

The detailed roadmap will become the Action Plan for S4, as indicated in the government-approved 4S Strategy. It will focus on specific actions to achieve the prioritized SDGs, with detailed indicators and timeframes for the achievement of the targets.

Activity: Execute, monitor and evaluate, and update plan

Smart Specialization Strategy includes monitoring and evaluation system, based on the input, output and outcome indicators. It will be further developed in the Roadmap document for specific actions.

Inputs: Data, stakeholder consultations and expertise

Data and expertise: The Serbian approach is fully evidence informed. It includes a mix of quantitative and qualitative indicators disaggregated for specific purpose of the analysis, sourced from the National Statistical Office, Intellectual Property Office, Public Policy Secretariat, Ministry of Education, Science and Technological Development, Ministry of Economy, Serbian Chamber of Commerce and Industry and the University of Belgrade. The country has mobilized its own Analytical Team (described above) and used external expertise of JRC and Fraunhofer Institute (financed by JRC). Additional support of JRC covers study on mapping of SDGs, including the identification of SDGs prioritized in the national strategic framework, the statistical baseline analysis and the identification of the STI inputs focused on specific SDGs.

Stakeholder consultations: Serbia has run a wide participatory process (entrepreneurial discovery), with over 700 stakeholders, 178 interviews, 17 workshops and 2 conferences were organized to develop the consensus on the joint vision and priorities. Over half of the participants represented private sector. The entrepreneurial discovery working groups for each priority have been formalized and will be actively involved in the implementation and monitoring process. Each working group is run by the representatives of business and academia, with the government providing a platform for discussions and joint work.

3. Expected Other Stakeholders, Milestones and Timeline

The Inter-ministerial Working Group for Agenda 2030 has just joined the work on STI for SDGs Roadmap, expected to be adopted by the end of 2020. The Group proposed to create a subcommittee on STI for SDGs. An area of interest is localization of SDGs. UNIDO joined the Roadmapping work in partnership with JRC and will be instrumental in the development of the detailed roadmap, contributing particularly to industrial development aspects.

4. Lessons Learned, Challenges/Problems Encountered So Far (if applicable)

The development of an interdisciplinary, multi-ministerial document in a transparent and participative way brings several challenges. They include:

- Dependence on external financing at the beginning of the process,
- Lack of sufficiently disaggregated data for the analysis of the current state,
- Building trust of stakeholders and convincing them to participate in the government-led dialogue,
- Overcoming the governmental silos, and launching a real inter-ministerial cooperation,

- Insufficient familiarity with SDGs and the overall 2030 Development Agenda, which may seem overwhelming for both policy makers and individual practitioners,
- Need to balance between time and effort invested in strategy setting and actual implementation to avoid stakeholder fatigue.

Due to these challenges the process encountered some delays, but the successes include: mobilization of Serbian own funding for the implementation of 4S, accompanied by additional EU-funding; developing a permanent cooperation with the Statistical office and IPR office that delivered necessary information; launching a permanent public-private dialogue platform with high involvement of stakeholders and winning the approval of the Prime Minister who took leadership of the Inter-ministerial Working Group. These achievements show increased institutional capacity that bears well for the later implementation.

Chapter 4: Lessons and Implications from Experience to Date

This chapter draws lessons and implication from the five country pilots undertaken to date. The first section summarizes the progress on the six steps of the roadmap as well as what they report as challenges and lessons learned. The second section reports on the lessons learned from three country case studies from India, Kenya and Serbia. The third section draws some of the preliminary lessons and implications for moving forward from progress to date. This chapter also highlights key messages that emerged out of two recent IATT events: an expert group meeting co-hosted by EU JRC (Box 4.1) and a workshop co-organized with India and Japan (Box 4.2). The former primarily focused on country-pilots' methodologies and the latter focused on international partnerships.

From Country Pilots

Following is the summary of progress of the country pilots on the six steps of the roadmap as well as what they report as challenges and lessons learned.

1. Objectives and scope

The objectives have been framed within the context of the country's national development plan and their economic and social conditions. All countries have chosen a narrow set of SDGs (from three to seven) because of the difficulty of tackling all the SDGs simultaneously.

The most common SDG, chosen by five countries each, has been SDG 2 (Zero Hunger). The second most common, chosen by four countries each, have been SDG 8 (Decent Work and Economic Growth) with a strong focus on jobs. The third most common, chosen by three countries each, have been SDG 1 (No Poverty), SDG 3 (Good Health and Wellbeing), SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Infrastructure and Innovation). The next most common, chosen by two countries each, has been SDG 6 (Clean Water and Sanitation) and SDG 10 (Reduced Inequality). Another four have been chosen by one country each. They are SDG 4 (Quality Education), SDG 5 (Gender Equality), SDG 13 (Climate Action) and SDG 17 (International Partnerships).

As all but Serbia are low income or lower middle-income countries with high poverty rates and the largest share or employment in agriculture (see Appendix Table A.1), it is not surprising that SDGs 2 and 8 are the most commonly chosen. Serbia, the highest per capita income country, has focused most on using STI to increase its growth and competitiveness.

India stands out in having included SDG 17 on international partnerships for the goals even though it is a lower middle-income country. That, in part, is because of its strong technological capability and its commitment to the TFM to help other developing countries use STI to accelerate their development.

2. Assessment of current situation

The assessment of the current situation of both SDG gaps and STI supply/capability requires as lot of data and expertise. The depth of the assessment has varied across the pilot countries. In Ghana, India, Kenya and Serbia, they have been done based on assessments of both STI capabilities and SDG gaps, although the data available in each country has varied. In India a detailed analysis of the technological STI system disaggregated to the state level has been done. In Serbia, the target-level statistical analysis has been prepared showing the distance from the best performers in the European Union (see Appendix Figure A.2 for the aggregated results of the analysis and Appendix Figure A.3, for a detailed example for one of the SDGs). In Ghana the assessment has focused mostly on a Science Technology and Innovation Policy Review and detailed technology roadmaps for 22 sectors, but not yet on SDG gaps and goals.

3. Vision

Developing a vision, goals and targets has varied widely across the pilot countries because of the different institutional set-ups through which they have engaged in the pilot exercise. The most

developed visions have been done in Serbia, India and Kenya where there has been more involvement of the highest level of government in the process. In Ghana, the vision is still being developed and is mostly driven by the Ministry of Environment Science and Technology. In Ethiopia, a clear vision for STI for SDG roadmaps is still in the process of development because the work so far has been undertaken only by the Ministry of Innovation and Technology and will be articulated after drafting a New National STI Policy.

4. Assessment of alternative technological pathways

Assessing alternative pathways is perhaps the most complex and expensive step, requiring the engagement of representatives from different parts in the innovation chain, including not just the technology, but the agents involved in the value chain to diffusion and use as well as the provision of complementary inputs, including finance and infrastructure. This has not been very fully developed in most of the pilot countries except perhaps for Kenya where the methodology for considering alternative technologies was tested for the case of maize.

5. Development of detailed STI for SDGs roadmaps,

None of the pilot countries have yet fully developed detailed roadmaps. They are at different stages of developing the roadmaps. In some cases, such as Serbia and India, they are more comprehensive and involve the actions of many stakeholders. In others, so far, they are more narrowly focused (technology roadmaps in various sectors in Ethiopia, technology incubators in Ghana, the agricultural value chain for three crops in Kenya) and are still in the process of expanding the coverage and developing the details of the policies and implementation actions.

6. Execution, Implementation, monitoring and evaluation

As the detailed STI for SDGs roadmaps have not yet been finalized in any of the pilot countries, none have reached the execution or implementation phase. However, some implementation actions have already started in India. In addition, India is putting a strong emphasis on monitoring and evaluation for strategic decision making for the execution and adjustment of the plan. Serbia has also prepared for the implementation with dedicated actions planned, among others, with the Science and Innovation Funds. As noted in the Guidebook, monitoring and evaluation is a critical element because the implementation of the roadmap is essentially a learning exercise. It will be important of learn from the implementation experience and to make adjustments as well as to take into account the impact of changes in the context, such as the current COVID-19 crisis.

7. Data, expertise and stakeholder consultation

The use of data and expertise has varied widely across countries, depending in large part on what information is readily available as well as how much effort they have put into developing and collecting relevant data. There has also been a lot of variation in the extent to which domestic and international expertise has been tapped to help develop the roadmap, as well as the nature and depth of stakeholder consultations. The most extensive appear to have been in India, Serbia, and Kenya which are developing broader and more detailed roadmaps. In Ethiopia and Ghana, the consultations have been more limited to stakeholders in the national innovation system. Ghana project has initiated a new partnership with academic institution for data collection and analysis.

8. Challenges, Problems and Lessons

The most common challenge, mentioned by all the five countries, has been getting stakeholder involvement and active participation. In countries involving several ministries and agencies, this has included getting effective coordination. In the case of Serbia, the development of the roadmap has allowed a great mobilization of not only public but also private stakeholders and civic society. In addition, though not always explicitly mentioned in the country write-ups, except in the Serbia progress report, a related challenge has been to encourage different parts of government that are involved in STI or general development planning to focus on SDGs. In many cases the plans are still

just STI roadmaps, or parts of national development plans, not necessarily STI for SDGs roadmap. The second major challenge has been the availability of updated data to do the assessment to develop priorities.

Another major challenge which has slowed the preparation of the roadmaps has been the COVID – 19 crisis which has diverted the attention of government officials to the addressing of the crisis. In addition, another critical challenge has been the lack of specific budget to develop and more importantly to implement the STI for SDG roadmap.

Some of the key lessons are the importance of creating platforms for coordination and collaboration among government and between government and other stakeholders. Other major lessons are the importance of getting relevant expertise and securing funding.

Box 4.1: Key messages from the *Expert Group Meeting on STI Roadmaps for SDGs – paving the pathways for sustainable recovery and future resilience*, **co-organized with EU JRC (June 22 and 30)**

The first day (June 22) focused on the lessons learnt from the Global Pilot Programme for STI for SDGs from the perspective of the pilot countries: Ethiopia, Ghana, Kenya, India and Serbia and the UN and partners focal points: UNIDO, UNESCO, UNCTAD, the WB and EC – JRC. It was open to the interested observers and the candidates to the Global Pilot Programme. Key messages are the following:

- All five countries participating in the UN-IATT Global Pilot Programme have made a significant progress in terms of STI roadmaps for SDGs.
- Despite the differences in the terms of progress due to the individual approaches and challenges, some common elements emerged in the discussion.
- All countries agreed on the importance of mobilising STI for SDGs, especially in the post COVID-19 era and in the "Decade of Action", taking into consideration different approaches and tools.
- India, Serbia and Ethiopia mobilised STI for COVID response, an inspiring example on how the STI can be used to answer economic, social and environmental challenges.
- All Pilot countries agreed and highlighted the importance of linkages between SDGs but also between STI policies, SDGs and National Development Plans.
- All countries also agreed that STI innovation policy can be used to accelerate achievement of SDGs.

The second day (June 30) focused on the implementation of the STI for SDGs roadmaps in the context of their contribution to sustainable recovery and future resilience. Countries, regions, cities and international partnerships presented and discussed the roadmap implementation experience based on the challenges and achievements in implementing Smart Specialisation as localised roadmaps for transformation and for the achievement of the SDGs. These presentations were the basis to elaborate suggestions on how to better use STI to deliver post- crisis recovery and strengthen resilience. The potential application of the STI for SDGs roadmaps and smart specialisation to support the economic and social recovery and greener development models were discussed. Key messages are the following:

- European Commission-JRC continues to be committed to supporting UN Inter-agency Task Team on Science, Technology and Innovation for the SDGs, (IATT) as well as EU and non-EU countries at national sub-national levels in their effort to achieve SDGs by the development and implementation of STI for SDGs Roadmaps.
- Adopting integrated approach that takes into consideration complex systems and interdependencies is key to achieve the 2030 Agenda in a synergistic way, avoiding unnecessary tradeoffs.
- Innovation policy needs to embrace directionality, ambition and resilience to respond to societal and sustainability needs. Therefore, policy makers need to revisit strategic goals.
- Although SDGs are not mandatory in Smart Specialisation strategies, a number of countries, sub-national entities and international partnerships have decided to address them.
- International interregional Partnerships for Smart Specialisation connect Quadruple Helix actors (governments, knowledge institutions, private sector and civil society), develop shared vision and shared goals that place people and the planet at the centre, work across the territories and leverage private investment.
- STI roadmaps are well suited to implement structural changes and they can be used for the achievement of the SDGs.
- The SDGs proved to be a common vocabulary to communicate with stakeholders at different levels (local, regional, national).

Lessons from pilot country case studies

This section draws the lessons from three Pilot country case studies: M-PESA from Kenya; The Ayushman Bharat PM-JAY Health Insurance System from India; and the Innovation Fund from Serbia.

Key elements of success

1. Strong collaboration among multiple stakeholders with effective coordination

Multi-stakeholder engagement with effective coordination is seen in all the case studies. The three cases also demonstrate the importance of involving relevant stakeholders from different parts of government, the private sectors, technical experts, and civil society. Although the process of involving stakeholders may be lengthy and complex, it is critical for the successful development and implementation of the project.

2. Importance of developing a good deployment system

All three cases had an emphasis on the development of deployment system.

In India, for both health systems and Aadhaar (the unique ID system), the key requirement were considerable buy-in from state government, plus multiple providers of IT and of health providers, in case of health system.

In Kenya for M-Pesa, it was critical to have participation of vendor networks.

In Serbia a lot of effort was put into developing the capacity of the staff in charge of the innovation fund, including foreign study trips, hands on training and advise from renowned foreign experts. The case study also shows that often it is necessary to enact new laws and create specialized institutions in order to be able to operationalize the plan.

3. Importance of the ability to adjust to changes

There are at least two functions to monitoring and evaluation. One is accountability, the other is learning. Effective M&E systems help in building legitimacy and consensus on chosen paths, while helping to increase transparency. Learning from implementation is also critical. All three cases had to adjust as they were being implemented to take into account unexpected changes as well as to incorporate lessons from what was working and what was not.

4. Sustained engagement

All three cases show that the process of developing and implementing takes time because it requires experimenting and learning from the experience. In the case of M-Pesa, it took lots of experimentation and adjustment as different uses for the service were discovered and there were needs to add different functionality to the system and to broaden its deployment system. In the cases of the Serbia fund and the Indian universal health system, there was also a need for sustained engagement and several rounds of work to develop and scale up the programs.

5. Involvement and partnership with private sector

Private sector can play a very important role. This point was seen clearest in Kenya M-Pesa case studies where main driver was Vodaphone/Safaricom (International and domestic private sector). This was also the case in India, as the health insurance system required the participation of the private sector to develop the digital platforms to integrate the system. The India system also needed the active participation of private doctors, health care facilities, and hospitals part of the system. In Serbia, the point of establishing the Innovation Fund was to reorient public research towards the needs of the private sector in order to increase Serbia's industrial competitiveness, and the private sector was the co-investor, together with the public sector.

6. Adequate financing

Securing adequate financing was also critical, particularly for social programs provided by the government such as in India. But it is important to note that public (DFID) financing was instrumental even in case of Vodafone (a large multinational) in the initial development stage. Also, important to know that M-Pesa seems to have been privately financed once its viability was demonstrated. Also focus changed and it seems to be privately financed by users who find value in this application. In Serbia, the Innovation Fund required international funding from the EU (EUR 15.8 million) and the WB as well as from the Serbian government, and co-funding from the private sector for approved projects (695 such projects financed so far).

Role of assessment of alternative pathways

Little assessment of alternative pathways was evident in the three case studies, although there appears to have been some in the India case. Also, there was a significant effort to learn from best practices from other countries in setting up the Serbia Innovation Fund.

It should be noted that assessing alternative pathways is generally difficult for any countries to do as there is not easily and readily available system of technological alternative information.

Replicability

Replicability varies, depending on many contextual factors including capacity of local agents.

M-Pesa has had some limited replicability. The case study highlighted the importance of the regulatory regime as well as the deployment system. But it should be noted that M-Pesa was not so replicable in India because of the regulatory system of the banking sector.

Aadhaar-potentially has a large replicability although there are issues of technical capacity in other countries, as well as important issues of trust, privacy and security.

India Universal Health is in fact still being expanded in India. Potentially, it has replicability to other developing countries. But some preconditions need to be met, such as vertical and horizontal coordination, multiple healthcare providers and finance.

Serbia's Innovation Fund has some elements of replicability. However, the case study clearly shows how a program has to be adapted to the specifics of the country. It also requires strong support from the highest level, the creation of a strong independent institutions, strong, extensive stakeholder consultation, changing or passing new legislation, and lots of external technical and financial support and involvement from the private sector.

Lessons related to International Partnerships on STI for SDGs Roadmaps

The progress reports from the five pilot countries as well as the country case studies have the following lessons for international partnerships, which resonate with the recommendations of the IATT Background Paper on international STI collaboration and investment for the SDGs. The overall lesson is that greater technical and financial assistance from international partnerships for SDG Roadmaps will be very helpful to help countries develop effective STI for SDG roadmaps. More specifically this includes:

- Building the national STI capabilities of developing countries, to address challenges underpinning the SDGs; and helping to connect national innovation systems in developing countries internationally
- Undertaking concerted analytical efforts to improve methodologies for assessing synergies and trade-offs among the SDG goals in the challenging context of developing countries, and providing technical expertise and finance to help them design and implement their plans
- Boosting international flows of relevant knowledge and technology across countries and on supporting cross-country STI collaborations, addressing the SDGs.
- Brokering international collective STI actions with an ambition to tackle global challenges, notably the Global Public Goods as technological advances can help developing countries more effectively tackle their SDG challenge.

- Revisit methodologies to accommodate partnerships between international organizations that so far have their own established mandates and partnerships without mechanisms or explicit funding for working together.

Box 4.2: Key messages from *the Workshop on Developing STI Partnerships for Sustainable Development*, co-organized with India and Japan (June 29)

Office of the Principal Scientific Advisor to the Government of India (PSA), Research and Information System for Developing Countries (RIS), Cabinet Office of the Government of Japan (CAO) and the United Nations Interagency Task Team on Science, Technology and Innovation (STI) for the Sustainable Development Goals (UN-IATT) co-organized the Workshop on Developing STI Partnerships for Sustainable Development on June 29, 2020. The main theme of the workshop was Accelerating International Cooperation and Actions Through the Global Pilot Programme on STI for SDGs Roadmaps. The workshop built on the preparatory dialogues between India and Japan and invited pilot countries and IATT partner agencies participating in the Global Pilot Program, and other interested stakeholders. The workshop saw participation by senior policy makers and experts from the pilot countries including India, and Japan and other partner agencies.

The key messages and conclusions of the workshop are the following.

1) In order to operationalise the Technology Facilitation Mechanism (TFM) adopted as part of the Agenda 2030/ SDGs, the Global Pilot Programme on STI for SDGs Roadmaps initiated in 2019 is considered the most important vehicle, backed by evidence based and robust conceptual framework and is expected to evolve into a very useful tool to strengthen national efforts on STI for SDGs mapping and international cooperation on knowledge, technology transfer, governance, capacity-building, networks and finance for countries to better address global challenges including COVID-19 pandemics, by ensuring access, equity and inclusion leading to sustainability and wellness.

2) Based on the existing close partnership in science and technology between India and Japan, the both sides have expressed strong interest in extending their collaboration in STI for SDGs, particularly in cooperating in formulating STI for SDGs Roadmaps on 4 specific goals (SDG 2, 3, 6 and 7) through the Global Pilot Programme. The two countries are willing to deepen their collaboration in applying frontier technologies in the above mentioned areas and in collaborating with the UN-IATT in supporting pilot countries from Africa in particular, and African and other LDCs in formulating and implementing their STI for SDGs Roadmaps by sharing of experience, knowledge and capacities with them, in the spirit of South-South and Triangular Cooperation as mandated under the TFM.

3) It was suggested that UN-IATT accelerate the Global Pilot Programme by launching "Partnership in Action" and by leveraging more dedicated resources through emerging partnerships among research organizations and leading think tanks based in Japan, India and select African countries, as reflected in the collective expression of interest among those participating in the workshop.

4) The participants acknowledged the importance of multi-stakeholder engagement that includes academia, think tanks and private sector in formulating and implementing STI for SDGs roadmaps.

Implications and recommendations for moving forward

The following is a list of lessons learned from current state of pilots as well as from country case studies, for further strengthening the Guidebook and the Pilot countries as well as for expanding the pilot activities to other countries.

1. For the Guidebook

- Countries can't tackle, and should not be asked to tackle, all the goals and follow all the steps at once. The Guidebook should be more explicit that should start where there is enough political support and capability and then expand as experience is acquired.

- Beyond what is the country progress reports, it should be noted that in no country, except Serbia does it appear that an explicit effort was made to assess trade-offs and synergies between or among different SDGs in the particular country context. In Serbia, the synergies between different priority domains and related SDGs have been discussed during the entrepreneurial discovery process and included in the Smart Specialization Strategy. Methodologies for helping countries assess such trade-offs and synergies could help countries decide which are the key SDGs they may find it most effective to pursue, and to organize their objectives and scope accordingly.

- The case studies do not strictly follow the six steps. They developed more organically by trial and error rather than as part of a planned project and before the ideas of STI for SDG roadmaps were adopted. However, following the steps can help to systematize the process.

- It is important to take stock of the strategic framework, existing policies, and established approaches to policy making at the national level in order to avoid duplications of policy processes and fill the gaps. This has been done in most pilot countries. The six steps can then serve to understand what has been sufficiently developed and where there are areas for improvement.

- More guidance would be useful on how to get more international assistance on:
  a. Existing technology and innovation that can be harnessed
  b. Expert advice and technical assistance on how more effective use of technology and innovation can help to accelerate the goals
  c. Where to find finance for the development of the roadmaps, but more importantly for the implementation of the roadmap
  d. International efforts to build, boost and broker STI collaboration for the SDGs

- Provide more guidance on how to set up the roadmap as a learning experience to be adjusted and updated as experience is gained
- Provide more on concrete examples on how more effective use of technology and innovation can help achieve the goals in order to stimulate excitement and commitment to developing STI for SDG roadmaps as well as to illustrate what is required. The illustrative case studies from India, Kenya, and Serbia included in this progress report which provide concrete examples of how STI can contribute to achieving SDG goals and what is required in terms of getting stakeholder involvement, expertise, planning, implementation, monitoring and evaluation and adjustment as experience is acquired Such concrete successful experiences should be reflected in a future version of the Guidebook.
- Provide more guidance on how to create high level interest, buy-in, and commitment to implementation and improvement
- Set up a community of practice of countries developing and implementing roadmaps
- Update the Guidebook as more experience is accumulated

2. For current pilot countries

This is not directed at any specific country but is mean rather as general suggestions that countries may wish to consider as they move forward with fleshing out their STI for SDG roadmaps and begin to implement them.

- Draw more on existing national and international information, technical and financial resources

- Generate greater stakeholder participation and national ownership

- Improve coordination across relevant ministries/government agencies and other stakeholders in the private sector and civil society, possibly making use of existing inter-ministerial institutional platforms where available (for example, national STI or policy councils).

- Improve STI governance capacities at different levels, involve universities and academia for research support in the process

- Consider potential synergies and complementarities as well as trade-offs among the SDGs targeted in the STI for SDG roadmaps, in order to make the most effective use of limited financial and human resources.

- Take advantage of the many opportunities offered by new digital technologies and the convergence between digital, physical and biological technologies, but also address the potential negative effects of these disruptive technologies such as tendency for increasing inequality, risk that as more personal data becomes digitized there are serious issues of privacy, security, and autonomy that need to be addressed.

- Move to developing strong implementation plans with clear assignment of responsibilities for the different agents and stakeholders.

- Build monitoring and evaluation systems into the roadmaps, as it is certain that there will need to be adaptations and change in the implementation of the roadmaps in light of the implementation experience as well as major changes in the global and local context (think for example of the disruption caused by the COVID-19 pandemic, and other expected climate related stocks such as extreme weather, flooding, droughts; as well as unknown and unexpected shocks

- Partner with academia for adding academic robustness on the STI metrics and enhancing M&E in general.

- Partner with UN sister agencies, regional and international development partners present in the country for the implementation of the STI for SDG roadmaps.

- Participate in community of practice among countries that are developing STI for SDG roadmaps which is likely to be set up to share experiences.

- Do more to take advantage of positive synergies across SDGs and targets

- Country specific observations implementation:

  a. Ethiopia: A big challenge is expanding scope beyond STI to STI for SDGs. This requires more active involvement of ministries beyond MINT and MOSHE and ideally should include the Development Planning Commission (responsible for coordination on SDG plans), Ministries of Finance, Agriculture, Industry and possibly other sectorial ministries, as well as involvement from the President's or Prime Minister's Office.

  b. Ghana: A big challenge is to expand objectives and scope beyond STI to develop more comprehensive STI for SDG roadmaps for the SDGs chosen.

  c. India: There is great potential to use its considerable digital skills to improve the coordination, monitoring and evaluation of STI and STI for SDGs. India also has many

compelling examples of using STI to accelerate the achievement of many SDG goals which
have potential applications in other developing countries.

    d. Kenya: Kenya has taken a deep dive into developing a plan for improving maize technology
to increase the income of poor farmers. Now that it has acquired some experience with
assessing alternative technologies it needs to broaden its scope and for that it will need to
mobilize more stakeholders and expertise and to make concrete implementation plans.

    e. Serbia: Serbia first developed an ambitious 4S strategy with initial focus on priority SDGs
and is now moving to incorporate SDG goals into its implementation plan. Based on the
additional SDG mapping, other important SDG goals will be discussed and addressed within
the STI for SDGs roadmap.

3. For expanding to other countries

- Disseminate compelling examples of how effective use of STI can speed the achievement of
SDGs. This should include examples such as those from the country case studies in the Annex,
which although they were not developed explicitly as STI for SDG roadmaps, are good examples
of what can be accomplished by focusing STI on attaining SDG development goals.

- Organize another call for pilots

  · Ask for high level commitment

  · Require a strong high-level coordinating body

- Build a community of practice to share experiences in developing STI for SDG roadmaps and
invite potential member countries to join

- Boost more active involvement of UN IATT, other international and national agencies and
private sector to help developing countries develop their STI for SDGs roadmaps

- Broker more technical and financial support from the international system

- Conduct capacity building activities for countries engaging in the process (e.g. short training
courses for national working teams; training materials based on the guidebook); possible
cooperation with the UN-IATT workstream on Capacity Building in STI for SDGs

4. For the international community,
in light of relative slow progress to date

- Raise alarm that goals are not going to be met and that we are entering critical tippling points.

- Undertake greater advocacy of the benefits of STI for SDGs roadmaps

- Provide more concrete compelling examples

- Create and participate in the upcoming community of practice

- Strengthen the STI online platform of available technologies

- Create platform of technical and financial assistance

- Build more STI for SDG roadmaps in developing countries, but be careful not to just support STI
for its own sake, but to contribute to the SDGs

- Mobilise advanced countries to develop STI for SDGs Roadmaps and share their experience and
support

- Involve the private sector more. Refer to case studies such as M-Pesa and other examples and
build on efforts such as the WEFs "Frontier 2030—a New Fourth Industrial Revolution Platform
for Global Goals Platform (see WEF 2020)

- Broker more international coalitions to create Technology and Innovation relevant for the goals (see the IATT background paper on International STI Collaboration and Investment for Sustainable Development Goals)

- Above includes the need to manage the downsides of technology (see GSDR 2019 and TWI2050, 2018 and 2019).

Appendix Table A.1: Basic Indicators of Pilot Countries

In 2018 unless otherwise indicated

	Ethiopia	Ghana	India	Kenya	Serbia
GNI/Capita	790	2,130	2,020	1,620	6,390
GNI (billions)	86.7	63.4	2,733.5	83.1	44.6
GDP growth 2000-2018	9.9	6.6	6.8	5.0	3.2
Population (millions)	109.2	29.8	1,352.6	51.4	7.0
Fertility rate, births/woman 2017	4.4	3.9	2.2	3.6	1.5
Agriculture as percent of GDP	31	20	14	34	6
Percentage employment in agriculture male//female	72.0//59.5	40.7//26.4	40.2//57.1	51.4//69.3	18.9//14.7
Agricultural value added/worker in 2010$, 2016	547.3	2,711.5	1,589.1	1,258.3	6,254.1
Access to electricity 2017	44.3	79.0	92.6	63.8	100.0
Access to internet 2017	18.6	39.0	34.5	17.6	70.3
Expenditures on R&D/GDP	0.6	..	0.6	..	0.9
Life expectancy at birth, 2017	66	63	69	66	76
Population below $1.25//$3.20, 2011-2016	30.8//68.9	13.3//30.5	21.2//60.4	36.8//66.2	5.5//11.0
Gini coefficient, 2011-2016	35.0	43.5	35.7	40.8	39.6
Child malnutrition percent of children under 5, 2010-2016	38.3	18.8	38.4	26.0	6.0
Maternal mortality rate/100,000 births, 2017	401	308	145	342	12
Under-five mortality rate/ 1,000 live births	55	48	37	41	6
HIV/1000 un-infected population ages 15-49	0.40	1.10	..	1.62	0.04
Adult literacy rate male//female 2000-2019	59//44	84//74	82//66	*85//78*	99//98
Primary completion rate male//female	55//53	93//95	93//96	*99//100*	99/99
Secondary completion rate male//female	30//29	79//77	82//88	*79//79*	98//98
Percent of population using safe drinking water 2017	11.4	36.4	..	..	74.7
Percent of population using safe sanitation services 2017	..	..	..	84/74	24.7
Natural resource depletion as percentage of GNI, 2017	9.4	11.4	1.0	2.5	0.4
Renewable energy consumption as percentage of total 2015	92.2	41.4	36.0	72.7	21.2
Ambient air pollution--micrograms per cubic m 2016	39.2	36.3	89.7	28.6	24.8
Carbon dioxide emissions per capita, metric tons, 2014	0.1	0.5	1.7	0.3	5.3
CO2Kgs/2011 PPP$ GDP 2014	0.1	0.1	0.3	0.1	0.4

Source: World Development Indicators 2019

Appendix Figure A.1: Relative Position of Pilot Countries
on the SDG Index vs GDP per Capital

(Pilot countries in blue, some outlier comparator countries in red)
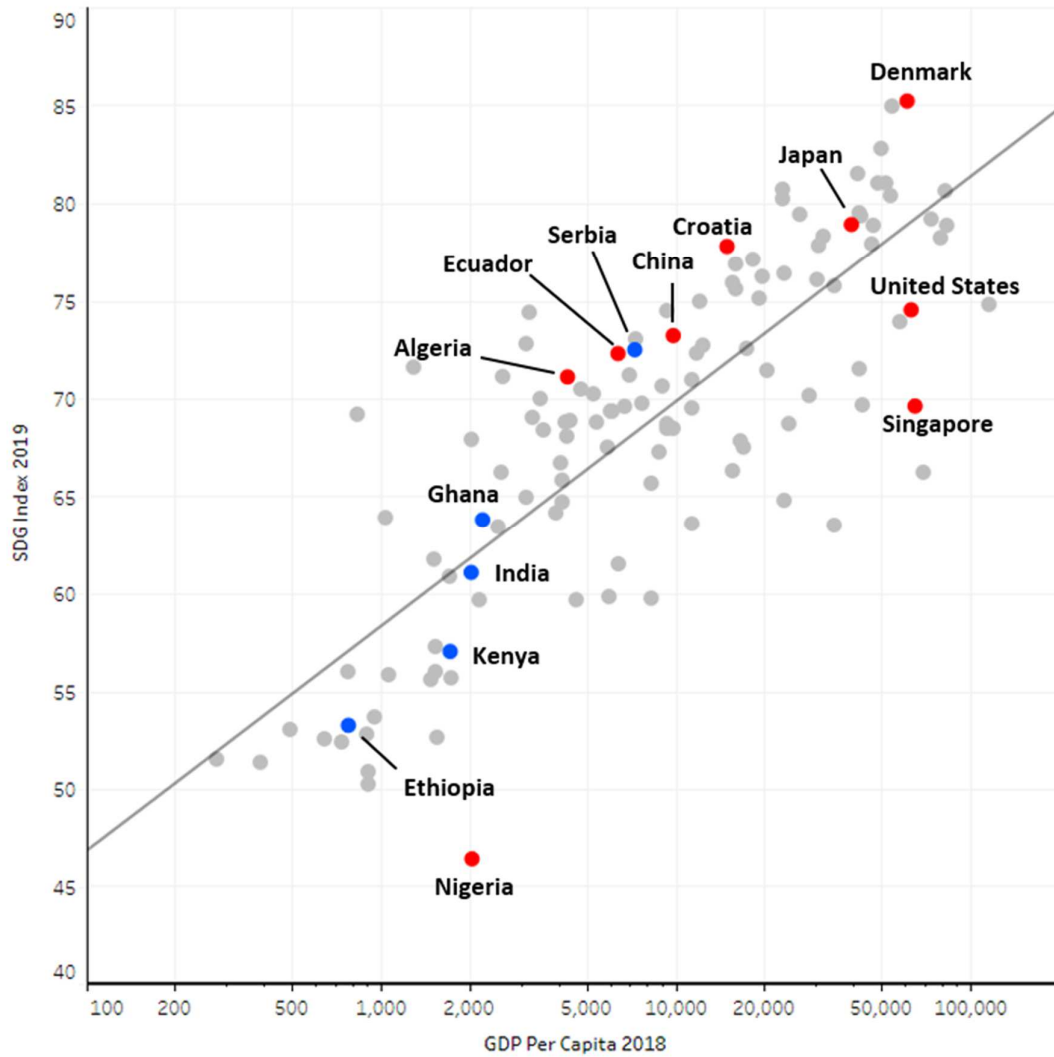
Note: Red dots are the pilot countries, blue dots are some outliers as reference points.

Source: Bertelsmann and Sustainable Development Solutions Network 2018. *SDG Index*
World Bank World Development Indicators for GDP per capita

Appendix Figure A.2. Serbia indicators

The median distance in the statistical indicators of each SDG goal with respect to the EU-27 frontier (top 10% countries).

10. Reduced Inequalities	100
6. Clean Water and Sanitation	98
3. Good Health and Well-being	97
8. Decent Work and Economic Growth	95
9. Industry, Innovation and Infrastructure	88
17. Partnerships for the Goals	82
4. Quality Education	82
7. Affordable and Clean Energy	79
1. No Poverty	77
11. Sustainable Cities and Communities	69
2. Zero Hunger	52
16. Peace, Justice and Strong Institutions	51
5. Gender Equality	39
15. Life on Land	32
13. Climate Action	26
12. Responsible Consumption and Production	21
14. Life Below Water	Not indicated

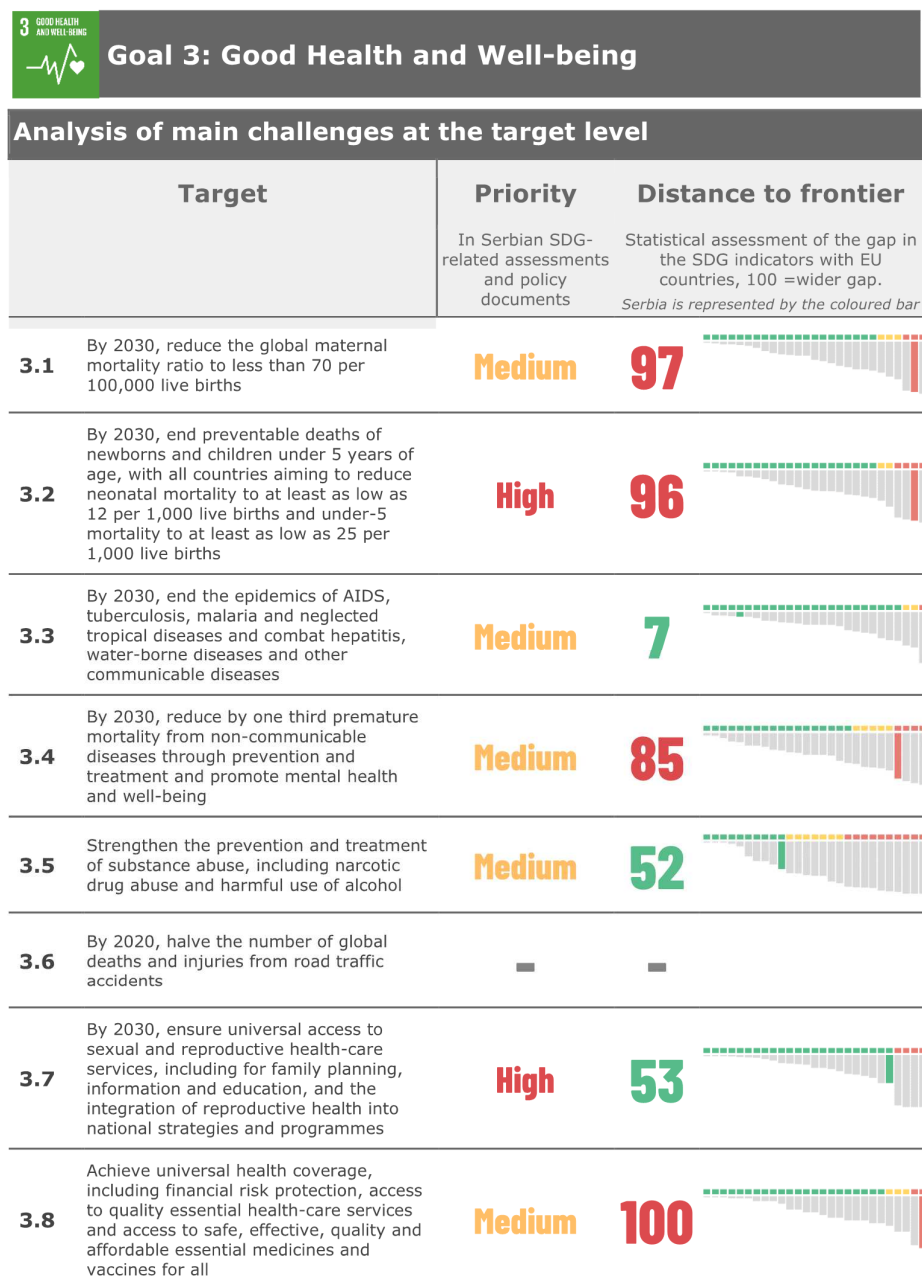⬆ **SDGs presenting a wider statistical gap between Serbia and leading EU countries**

Median distance to the EU-27 frontier (Top 10%) in the statistical indicators

Source: European Commission, Joint Research Centre

Appendix Figure A.3. Analysis of Serbia Pilot

Example of the target-level analysis for Serbia – SDG3.

3 GOOD HEALTH AND WELL-BEING	Goal 3: Good Health and Well-being		
Analysis of main challenges at the target level			
Target		**Priority**	**Distance to frontier**
		In Serbian SDG-related assessments and policy documents	Statistical assessment of the gap in the SDG indicators with EU countries, 100 =wider gap. *Serbia is represented by the coloured bar*
3.1	By 2030, reduce the global maternal mortality ratio to less than 70 per 100,000 live births	**Medium**	**97**
3.2	By 2030, end preventable deaths of newborns and children under 5 years of age, with all countries aiming to reduce neonatal mortality to at least as low as 12 per 1,000 live births and under-5 mortality to at least as low as 25 per 1,000 live births	**High**	**96**
3.3	By 2030, end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases	**Medium**	**7**
3.4	By 2030, reduce by one third premature mortality from non-communicable diseases through prevention and treatment and promote mental health and well-being	**Medium**	**85**
3.5	Strengthen the prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol	**Medium**	**52**
3.6	By 2020, halve the number of global deaths and injuries from road traffic accidents	**–**	**–**
3.7	By 2030, ensure universal access to sexual and reproductive health-care services, including for family planning, information and education, and the integration of reproductive health into national strategies and programmes	**High**	**53**
3.8	Achieve universal health coverage, including financial risk protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all	**Medium**	**100**

Source: European Commission, Joint Research Centre

References

African Center for Technology Studies, August 2019. *Kenya Pilot STI Roadmap For the SDGs: A pilot test of the guidelines.*66 pages.

Bertelsmann Stiftung and Sustainable Development Solutions Network (2018). *SDG Index and Dashboards Report 2018: Global Responsibilities-- Implementing the Goals.* Available at: http://www.sdgindex.org/. Accessed 11/04/2018.

Cornell University, INSEAD, and WIPO (2018): The Global Innovation Index 2018: Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva. Available at: https://www.globalinnovationindex.org/gii-2018-report. Accessed 11/05/2018.

European Union-- Joint Research Center (forthcoming 2020). Science Technology and Innovation Roadmaps for Sustainable Development Goals-- Background Paper: Overview of Existing STI Roadmapping Technologies.

Government of Kenya 2018. *Third Medium Term Plan 2018-2022-- Transforming Lives: Advancing Socioeconomic Development through the 'Big Four'. Available at:* https://planning.go.ke/wp-content/uploads/2018/12/THIRD-MEDIUM-TERM-PLAN-2018-2022.pdf *Accessed 01/11/2020.*

IATT. (2020). Guidebook for the Preparation of Science, Technology and Innovation (STI) for SDGs Roadmaps. Inter-Agency Task Team on Science, Technology and Innovation for the SDGs (IATT), Sub-Working Group on STI Roadmaps co-led by World Bank, DESA, UNCTAD and UNESCO. New York, NY: United Nations publication.

Independent Group of Scientists appointed by the Secretary General (2019). Global Sustainable Development Report: The Future is Now—Science for Achieving Sustainable Development. New York: UN. Available at: https://sustainabledevelopment.un.org/content/documents/24797GSDR_report_2019.pdf Accessed 09/2502019

Knesevic, Tijana; and Viktor Nedovic 2019. S3 Development Process as Improvement of STI Framework for SDGs, Presentation at UN-China Ministry of Science and Technology Joint Capacity Building Workshop on STI for the SDGs, Guilin, China, December 9 – 17. Available at:https://sustainabledevelopment.un.org/content/documents/29105Session_104_Tijana.pdf

Miedzinski, M., Kanehira, N., Cervantes, M., Mealy, S., Kotani, R., Bollati E. (2020). Science, Technology and Innovation (STI) for SDGs Roadmaps—Background Paper: International STI Collaboration and Investment for Sustainable Development Goals.

Matusiak, M., Stancova, K., Dosso, M., Daniels, Miedzenski, M. (2020). Science, Technology and Innovation (STI) for SDGs Roadmaps—Background Paper: Overview of the Existing STI for SDGs Roadmapping Methodologies.

Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G. (2019): Sustainable Development Report 2019. New York: Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN).

World Bank (2019) World Development Indicators for GDP per capita. Washington, D.C. Retrieved from https://data.worldbank.org/

World Economic Forum 2020. Unlocking Technology for the Global Goals. WEF: Geneva. Available at: http://www3.weforum.org/docs/Unlocking_Technology_for_the_Global_Goals.pdf

Annex: Case studies from Pilot Countries

India: Ayushman Bharat PM-JAY Health Insurance for the Poor

Kenya: M-PESA

Serbia: Innovation Fund

India: Ayushman Bharat PM-JAY Health Insurance for the Poor

Introduction

Ayushman Bharat is a federal government initiative in India that seeks to improve access to healthcare for the poorer and more vulnerable households in India. A major novel component of the program seeks to address the issue of catastrophically high out-of-pocket expenses for a largely uninsured population that is estimated to drag down 60 million people into poverty every year. The ambitious program targeting 500 million people (107 million household) was announced by Prime Minister Modi in February 2018 and officially launched in September of the same year, making it particularly notable for the speed of its rollout. The program is reported to have enrolled 680,000 patients in its first 100 days and over 2 million in the first 200 days.

The performance of India's health system has been a source of disappointment, especially in terms of rampant inequities (e.g. income, gender) in access to services. Emblematic of this problem is the country's 1/3rd share of global maternal deaths. Although there have been a few visible successes of various initiatives such as eradication of polio, overall, the situation has stubbornly not improved, and India remains a laggard as regards SDG3 and until recently the idea of Universal Health Care (UHC) was seen as a pipedream. It is beyond the scope of this brief note to provide an analysis of the historical experience with various National Health Missions or even a rudimentary diagnostic of the Indian health sector that has been extensively studied both within the country and internationally. Rather, our limited objective is to recount the dramatic impact of concerted deployment of technology and innovation to improve healthcare and avoid impoverishment of vulnerable sections of the population in India. Equally important STI has been a game-changer in a profound paradigm shift for government intervention and mobilizing political will for UHC.

Background & Context: Genesis, Actors, Objectives (political/institutional)

Healthcare in India is a state subject, but the dismal state of the sector led to federal programs being been launched over the past decade, such as the National Rural Health Mission (2005) and the National Urban Health Mission (2014). Both of these supply-side interventions sought to expand public health facilities. The Rashtriya Swasthya Bima Yojana (RSBY) was initiated in 2008 as a rare demand-side intervention to provide health insurance for the population below the poverty line. The track record of these has been uneven at best though the RSBY did catalyse similar public insurance schemes at the state level.

The consolidating consensus around healthcare as a development priority in India and its increasing political salience prompted the government to announce the Ayushman Bharat (AB) in the National Budget in February 2018 with the Prime Minister himself soon visibly becoming its champion. Indeed, the timing, a year before the next national elections, was a source of skepticism by some observers who considered it just another electoral gimmick. That was however soon belied by the attention given, speed of critical decisions, appointment of a dynamic CEO and resources provided.

AB actually has two pillars, one on the supply side is an investment program for the central Ministry to set up 150,000 Health & Wellness Centers. Our focus is on the second pillar PM-JAY, a demand-side intervention to provide insurance coverage up to Rs.500,000 ($7000 approx.) per year each to 107 million eligible households in the country.

The program is funded entirely from tax revenues that is justified partly by the government's commitment to substantially raise the low level of public spending on health in India (around 1% of GDP). Fiscal, economic and administrative considerations prevented universal coverage at this juncture and the benefit is targeted to 40% of the population that is most poor and vulnerable according to the last Socioeconomic and Caste Census conducted in 2011 that has the widest acceptance as a basis for determining key parameters for such assessments and benefit transfers.

While AB-PMJAY is a federal program and combines many of the federal programs before it, healthcare in India remains a state subject; implementation responsibility therefore lies with state governments, which were also free to supplement their existing schemes, if any, with it or fold them into PMJAY. Moreover, states can choose whether to implement the program through a public trust fund, private insurance companies or a mixed model. Financing was arranged to be a 60:40 split between central and state governments, except for the Himalayan and North Eastern states where the federal share is 90%.

A National Health Agency was established to manage the program and upgraded to a National Health Authority with an interministerial governing board chaired by the Union Health Minister. The Chief Executive Officer has the rank of Secretary to the Government of India and has full executive and spending authority required for execution of NHA's responsibilities that include policy decisions, clinical guidelines, benefit packages, operational norms and standards, managing the IT platform, hospital enrolment, and claim management.

Finally, the vast scale of the program and large share of private sector supply in the field of health care made it necessary to extensively consult with a variety of stakeholders, such as private insurances and hospitals, in order to assess the feasibility of the program and develop key parameters. Such consultations also functioned to promote the program among these stakeholders. Not surprisingly, price caps or reimbursable costs that would be accepted generated the most spirited debates, and the controversy lingers even as the program appears to have been largely accepted and a large number of private hospitals have been accredited.

STI as a Critical Enabler

As indicated earlier, it is beyond the scope of this note to provide a comprehensive analysis of the overall scheme or the key decisions alluded to above. We confine ourselves to discussing how the unique features that made the AB:PM-JAY program technically feasible, economically viable and operationally workable are critically dependent on effective deployment of Science, Technology & Innovation.

First, the system needed to be able to identify individuals and authenticate their eligibility. Second, the system needed to be able to be able to add and monitor service providers in a decentralized environment. Third, admission, treatment, claims, and financial settlements needed to be processed and tracked again in a vast geographically dispersed context. Fourth, the system needed a dashboard, indeed several at different levels, to pull together relevant information for tracking progress and making corrective actions as well as shared learning across states and stakeholders to maintain momentum. Fifth is the importance of eliminating fraud and abuse and relatedly also monitoring trends related to moral hazard and adverse selection that may need corrective actions.

A Beneficiary Identification System (BIS) developed by the National Informatics Centre, which had previous experience with the RSBY program addressed the first issue aided by the Aadhaar identification system, as well as inclusion of the SECC database.

In order to meet the second and third requirement, the existing systems of 5 states were evaluated for their possible use for AB-PMJAY through in-depth testing of the various systems for compatibility with the requirements of Ayushman Bharat; the Telangana state system was ultimately chosen as the most suitable to build upon further. It is the foundation for modules of the Hospital Empanelment System, which allows for healthcare providers to be added to the system and monitored for quality, and the Hospital Transaction Management System, which allows for the tracking of treatment, claims, and payment for each patient. Together, these sub-systems form the core of the AB-PMJAY system. An important feature is their inter-state nature that allows beneficiaries to use the system anywhere in the country (i.e. not just in their home provinces) yet ensuring that annual benefit limits are not exceeded. Such provision of service across state lines is

highly relevant for less affluent workers migrating across India, e.g. for construction jobs that have provided livelihood to the largest number of entrants to the labor force. The Hospital Empanelment System ensures consistency and transparency of process for the licensing of healthcare services across state lines and is likely to be a key element in maintaining quality of care.

A PM-JAY dashboard was created to address the fourth requirement and uses the existing Application Programming Interfaces (APIs) of the other systems to create a "big picture" view. Even though this module may not be strictly essential to run the insurance program, its ability to show demand for healthcare services, in particular across rural regions and for migrant workers, is a highly important component for the secondary prong of Ayushman Bharat, as the supply of new public and private healthcare centers will be strongly based on the information it aggregates and presents.

Finally, another 10 modules have been created or are in the process of being created in order to give wide ranging access to information to citizens (e.g. mobile app, citizen portal, call center), facilitate operations (e.g. AB-PMJAY portal, grievance management system) and avoid fraud (e.g. data privacy checkpoints, anti-fraud measures, social media monitoring). Some observers believe that PM-JAY can unleash a data revolution in the Indian heath sector and more generally promote evidence-based policy in the country. In addition to data analytics to minimize fraud and waste, the information collected can be useful to improve quality of care particularly my detecting inappropriate use as well as positively through identifying local anomalies or geographical specificities. Indeed, real-time monitoring would be invaluable for epidemiological purposes, especially in developing countries such as India.

Technological and Other Challenges Going Forward

While the above systems have served to run and scale the scheme for almost a year, the overall scheme has reached a certain level of acceptance, is leaving its proof of concept stage, and moving toward a future as a mainstay of the Indian health system. Consequently, the government is looking toward increasing robustness of the system, allowing for more scalability (potentially up to billions to cover the entire population), and the possibility of innovation with existing or emerging technologies, such as A.I.

At this stage, however, the rapid rollout of the system is starting to catch up with its ambitions. Since none of the current core systems were originally designed specifically for their use in AB-PMJA and are largely licensed from vendors hired by the state governments, improving on the current system could present a major challenge. In particular, the increasing need for interfacing of the various modules and design of overarching functionalities could compromise robustness and data protection, ultimately limiting innovation. Beyond that, the licensing agreements and ownership of intellectual property are limiting the long-term sustainability of the system.

In light of these issues, a full redesign and rebuild of the system from scratch will likely be considered. While this would present a major undertaking, it will indubitably benefit from the existing political momentum behind AB-PMJAY, while being able to benefit from the lessons of the first system on the technological level. The existing interfaces would continue working throughout such a change, making it possible to replace one module at a time with ones that would be both inter-operable with the old system, and designed to have greater functionality with the new one.

Even though a scheme of the size and ambition of AB-PMJAY is bound to run into many challenges, the initial design and the government's flexibility in adapting to the challenges so far has led the program to being more successful than widely expected by early observers, while still picking up momentum. The Indian parliament has already approved the required allocations for Ayushman Bharat in the latest budget (64 billion rupees (approx. 900 million USD) for 2019-2020), and the government has reiterated its goal of spending 2.5% of GDP on healthcare by 2025. The government has also proposed the National Digital Health Blueprint, a roadmap to create a digital ecosystem to support and extend quality healthcare to all Indians.

Conclusion

While health care and health insurance considerations, as well as programs to address them exist in most countries, the case of India is unique for its scale and ambition. Having started with very low government spending on healthcare of only 0.93% of GDP, vast out of pocket costs for its citizens, and a medium score on the healthcare related SDG 3 (of 58), the government's commitment to a fully tax-funded insurance scheme for 107 million families presented a dramatic ambition. Nonetheless, rapidly deployment of its resources combined with technological prowess and organizational effectiveness allowed the program to be rolled out speedily. While many challenges still remain, its use of technology and organizational innovation has been notable in overcoming many of the hurdles considered insurmountable earlier.

Kenya: M-Pesa

Introduction

M-PESA is a mobile money service that was officially launched in March 2007 by Safaricom, the leading mobile phone operator in Kenya and an affiliate of UK telecom giant, Vodafone. Customers do not need to have a bank account and can transact at any of nationwide agent outlets without fees.
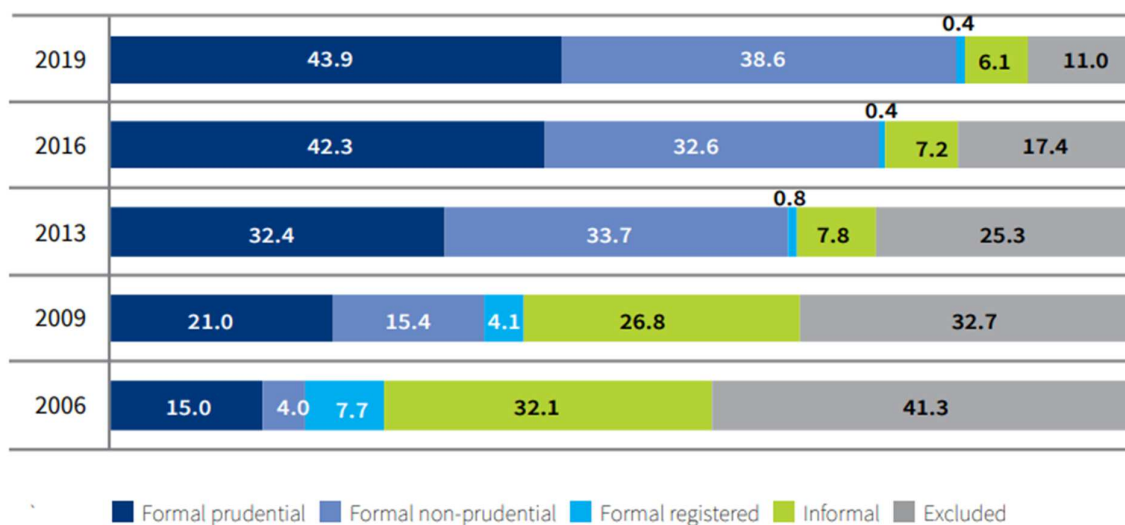
M-PESA was initially developed by Vodafone, and the six-month pilot phase of the project in 2005 was partly funded by the UK DFID with the aim of allowing customers of a micro-finance institution (Faulu) to repay small business loans using their smart phones, generally, by a few dollars a week. However, Safaricom representatives noted that the M-PESA was being put to other uses, including the payment for trading between businesses, purchasing airtime for relations in rural areas and depositing cash to be withdrawn at some other destination. After the pilot phase, Safaricom redesigned the M-PESA services, expanded the agent network and began a massive and culturally compelling "send money home" marketing campaign. Within one month of M-PESA official launch, over 20,000 customers registered the service. In July 2007, about 268,000 people subscribed to M-PESA. One year later, subscription increased by about 30 times to around 7,388,000.

The success of product was phenomenal—between 2016 July and 2017 July, the number of transactions processed over M-PESA was around 1.7 billion and 3.6 trillion Kenyan shillings processed over M-PESA. There are around 120,000 M-PESA agents across Kenya, where people can exchange cash for virtual currency and vice versa. Beyond its role as a money transfer tool, M-PESA now offers services to purchase airtime, withdraw cash from ATM, pay bills online, purchase at partnered outlets, transfer money internationally (through partners like Western Union) and make charity contributions or raise funds.

More recently, new products based on M-PESA like M-Shwari allow users to open interest earning bank deposit accounts and access microcredit loans electronically. Thus M-PESA functions not only as a steppingstone but also as a direct instrument to promote bank account adoption and increase credit access, which contributes significantly to the financial inclusion progress of Kenya. As a result, the overall access to formal financial services and products improved to 82.9% in 2019 from 26.7% in 2006 (see figure 1 below). According to Suri and Jack's (2010) analysis based on survey data, the implementation of this financial inclusion project is estimated to have lifted as many as 194,000 households – 2% of the Kenyan population – out of poverty (SDG 1), and has been effective in improving the economic lives of poor women and of members of female-headed households (SDG 5).

The impacts appear to be driven by changes in financial behavior—in particular, increased financial resilience and saving—and labor market outcomes, such as occupational choice, especially for women, who moved out of agriculture and into business. Mobile money has therefore increased the efficiency of the allocation of consumption over time while allowing a more efficient allocation of labor and higher-risk but higher return income-earning strategies, resulting in a meaningful reduction of poverty in Kenya. There is also growing evidence that the mobile money impacts the majority of SDGs as a critical enabler.

Figure 1. Access by Categories (%)

	Formal prudential	Formal non-prudential	Formal registered	Informal	Excluded
2019	43.9	38.6	0.4	6.1	11.0
2016	42.3	32.6	0.4	7.2	17.4
2013	32.4	33.7	0.8	7.8	25.3
2009	21.0	15.4	4.1	26.8	32.7
2006	15.0	4.0	7.7	32.1	41.3

Source: The 2019 FinAccess Household Survey

M-PESA has an iconic status in the international community which has actively promoted its virtues to countries around the world. More recently criticism has also emerged such as its role in driving the over-indebtedness of Kenya. Due to the simplicity of accessing funds via M-PESA and rapid development of microcredit and fin-tech institutions, there are more than 15 million M-Schwari accounts in a country of 50 million people. Very few checks and balances exist to restrain M-PESA clients who might wish to misuse funds received via M-PESA for purposes like gambling (Bateman,et al 2019). Many mobile lending companies are also accused of dodging the legal interest rate well below its annualized cost of round 100 percent since the services fell outside of the purview of state regulations

What is M-PESA
M-PESA is an electronic money transfer product Vodafone developed originally for Kenya that enables users to store value in the SIM card of their mobile-phone –a mobile account, in the form of electronic currency that can be used for multiple purposes including transfers to other users, payments for goods and services, and conversion to and from cash. The product menu is driven by SIM card toolkit that is standard software on all SIM cards. Consumer interface is very simple and can be used on basic mobile phones. Users use PIN-secured SMS (text messaging) to instruct M-PESA to send balance from their account on SIM cards to the receivers. Users are charged a small fee for sending and withdrawing money using the service. M-PESA is a branchless service so customers need to deposit or withdraw money from a network of Safaricom's airtime sellers or retail outlets acting as banking agent. All monies (e-float) are held at the M-PESA money transfer trust account at the Commercial Bank of Africa, a private bank. (Figure 2). Customers use their national ID or passport to verify their identity at the agent to send and receive money. In short, SIM card is the ATM card and the agents are the ATMs in the original M-PESA model.

Based on M-PESA's success, Safaricom partnered with Equity Bank and KCB Group, which are the biggest banks in Kenya by customer base and asset base, to launch M-KESHO and KCB M-PESA. Those products allow customers to deposit, withdraw or transfer money from their existing bank accounts. In partnership with Commercial Bank of Africa, Safaricom also launched M-Shwari which allows customers to save and borrow money through the mobile phone while at the same time earning interest on the money saved. M-PESA agent network has been open to other telecommunications companies and banks since 2014.

Figure 2. M-PESA service flow

Source: http://www.nixdell.com/classes/Tech-for-the-underserved/m-pesa.pdf
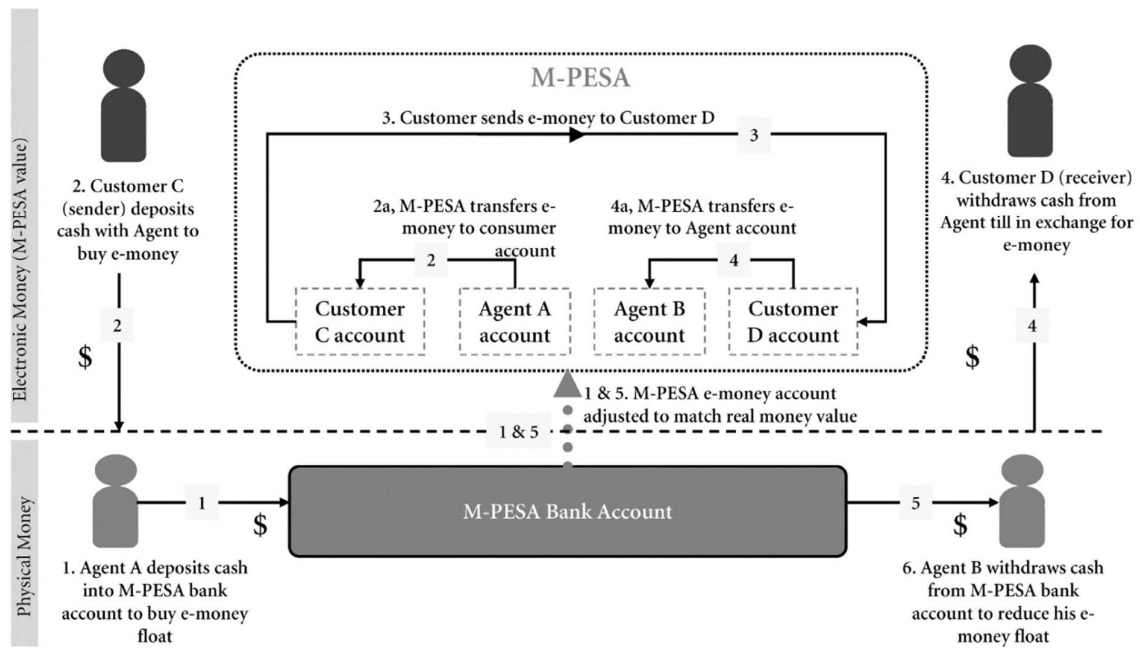
Who are the major stakeholders

Safaricom & Vodafone

Safaricom is the leading mobile communications provider in Kenya and it is a publicly traded company registered on the Nairobi Stock Exchange. 40% of company share is owned by Vodafone. The Government of Kenya owns 35% and the retail investors own the 25% (called free float) through Nairobi Stock Exchange. Safaricom is the operator of M-PESA Program. To use M-PESA service, all customers need to do is register at an authorized M-PESA agent by providing their Safaricom mobile number and their identification card.

Vodafone is a world leading telecommunication group based in UK. In 2003, one of its executives, Nick Huges agreed to use DFID grant to pilot a mobile fund transfer service. After the success story in Kenya, Vodafone has partnered with other operators across the world to expand M-PESA services.

Government of Kenya (The Central Bank of Kenya)

The Central Bank of Kenya (CBK), and in particular its Payments System group let a mobile operator take the lead in providing payment services to the bulk of the population. In 2006, the CBK had been made aware of the very low levels of bank penetration in the country by the first FinAccess survey, and they were determined to explore all reasonable options for correcting the access imbalance. The CBK worked in close partnership with Vodafone and Safaricom to assess the opportunities and risks involved prior to the launch and as the system developed. They were persuaded that premature regulation might stifle innovation, so they chose to monitor closely and learn, and formalize the regulations later.

UK Department for International Development (DFID)

In 2002, researchers at Gamos and the Commonwealth Telecommunications Organization, funded by UK DFID, documented that in Uganda, Botswana and Ghana, people were spontaneously using airtime as a proxy for money transfer. DFID introduced the researchers to Vodafone who had been discussing supporting microfinance and back office banking with mobile phones. Furthermore, DIFD funded the organizations that made the FinAccess Survey possible – the Financial Sector Depending Trust in Kenya. At that time, donor agencies like DFID were seeking innovative ways to delivery funds efficiently to those who need it most, so that the capital is productively deployed. DFID believed that if the amount of money necessary for a program's initial investment could be sufficiently reduced, poverty alleviation might become a profitable endeavor that would unleash the creative energies and logistical resources of some of the U.K.'s largest companies, such as Vodafone. Thus DFID granted Vodafone nearly £1m from its Financial Deepening Challenge Fund on a matched basis (50% of total costs) that helped Vodafone put together a pilot in partnership with the Commercial Bank of Africa (CBA) (providing local banking services and interface to the regulatory system) and the local micro-finance company, Faula Kenya (providing local expertise).

Key Lessons Learned from Policy Making and Implementation

According to literature, M-PESA's success was attributed to a number of characteristics of Kenya's population and culture that generated a unique demand for remittance services like great disparity but strong ties between rural and urban households, very limited local remittance services, young but highly literate population, and high mobile phone penetration rate. Traditionally in Kenya many people spend a significant amount of time working in the urban areas away from home and this rural to urban migration creates big demand for domestic remittance services. Prior to M-PESA launch, there were limited options including commercial banks, post offices, forex bureaus, bus companies, and friends and family. Almost all of those options entailed high security and reliability risks

In addition, almost 83 percent of the population who are fifteen years or older have access to a mobile phone in Kenya, which was a critical pre-condition to launch the mobile money program.

International partnership

International donor engagement played an active role in initiating the M-PESA program. The original research indicating the potential of mobile payment in African countries was funded by UK DfID. In 2003, it approached a Vodafone executive and proposed funding a small innovation project that was not typical of Vodafone's own R&D portfolio. In 2000, UK DFID had established the Financial Deepening Challenge Fund (FDCF) making available £15m for joint investments with the private sector on projects that help improve access to financial services, that was one of the MDGs.

Alternative pathways

Vodafone developed an innovative product using existing technology to tackle the financial inclusion challenge in a new market with big potential. Considering ease of usage and a wide coverage, Vodafone chose to build the consumer interface on basic model mobile phone and took SMS (text-messaging) as the main channel to send and receive money. The menu-driven access backed by SIM toolkit available on all mobile phones paved consumers and agents the easiest road to learn and use M-PESA. Internet and smartphone penetration were still low at that time.

Institutional arrangements

Kenya's regulators enabled the mobile money take-off through a cross-sector collaborative approach. Safaricom, as a telecommunication company, was an entity licensed by the Kenya telecommunication regulator, the Communications Commission of Kenya (CCK). Yet, according to the Central Bank of Kenya Act, the proposed M-PESA service by Safaricom is a kind of banking service that could only be provided by licensed bank, So the Central Bank of Kenya had the mandate to regulate Safaricom's payment system. This unusual situation required the CBK and the CCK to collaborate to ensure their respective roles and responsibilities were clearly defined when dealing with a mobile money provider, and to avoid unnecessary overlap or arbitrage.

The Central Bank of Kenya (CBK), in particular, played a very progressive role and allowed "regulation to follow innovation". In Feb 2007, incentivized by the low financial inclusion rate revealed by 2006 FinAccess survey, the CBK issued Safaricom a letter of no objection authorizing it to launch M-PESA under the oversight of the CBK pending a complete regulatory framework. The non-objection letter acted as a special license that provided a form of certification, legitimated M-PESA in the policy sphere. The CBK had to make sure that Safaricom would not be intermediating M-PESA customer funds. The letter requested all customer funds had to be deposited in a regulated financial institution with interest on deposits going to a not-for-profit trust and the e-float (e-money) could not be invested. As a result, the money in the trust fund was safe from claims by creditors in the event of solvency. Also, there were limits put on transaction size in order to deal with money-laundering concerns.

Government of Kenya continued to support M-PESA by validating existing business model through passage of new regulations. In Dec 2009, more stringent regulations were imposed with the passage of the Proceeds of Crime & Anti-Money Laundering Act (AML Act), which explicitly criminalized money laundering, provided enforcement measures to GOK and imposed serve penalties on money launderers. In 2011, in consultation with stakeholders including Safaricom, the CBK issued its Electronic Payment Guidelines of 2011 and Retail Electronic Transfer Guidelines of 2011. In Dec 2011, the National Payment System Act (NPSA) was enacted, which brings all payment services providers, including mobile payment providers like Safaricom into one regulatory framework. The NPSA provides CBK the right to directly oversee the providers to ensure their efficiency and safety.

In 2014, the Cabinet Secretary for the National Treasury issued a Legal Notice officially giving life to the National Payment System Regulations of 2014. The NPS Regulations permit both banks and non-banks, including mobile operators to provide mobile money services. The regulations also provide a stronger compliance and risk mitigation regime and help to drive competition and collaboration within Kenya's payment market, as well as address some "second generation" issues that have emerged as the mobile money has matured. For example, Anti-Money Laundering regulatory framework for mobile money services was finalized and enacted. A better consumer protection was detailed – service providers needed to have disclosure mechanisms, open channels for consumer redress, and clear terms and conditions for the service, and must maintain the privacy and confidentiality of customer data.

International replication experience of M-PESA

In order to replicate M-PESA's success in Kenya, many developing countries around the world partnered with development organizations and private companies to launch similar mobile money products. But the results varied: some countries' mobile money development flourished while in other countries mobile money failed to gain any traction for several year. For example, in India until a few years ago, mobile money transfer was stalled due to a rigid regulatory **environment** whereby only regulated banks can collect deposits and transfer money.

On the other side, despite a slow start between 2008 and 2012, mobile money has grown fast in Tanzania where conducive regulatory environment played the critical role in the greatest mobile money success story in recent years. Unlike Kenya, Tanzania has no dominant mobile network operator like Safaricom and within the competitive market, no company holds more than a 30 percent market share. Tanzania's financial system was far less developed than that of Kenya, with less than half as many bank branches per 1,000 citizens. Moreover, Tanzania is a large country with a dispersed population so quickly reaching dealers in rural areas was difficult. Even with fast growth rate of mobile phone penetration, the mobile phone subscribers' percentage was relatively low when mobile money launched (around 25%). Although these factors caused the slow initial uptake, the impetus for its turnaround can be traced to the policy changes beginning in 2011-12.

Following Kenya's example, the Government of Tanzania adopted a "Test and Learn" approach and let regulation follow innovation. Lacking of relevant regulations, Tanzania's central bank issued "letters of no objection" that permitted Vodacom and Zantel to offer mobile money (M-PESA and Z-PESA) without being subjected to the Know Your Consumers (KYC) and Anti-Money Laundering (AML) rules that made it impossible for them to reach poorer rural citizens, as well as requiring no official partnership with a bank. In 2011, laws on agent banking were also relaxed, greatly reducing the KYC-AML requirements and moving responsibility for ensuring agents were complying with existing laws from mobile networks to their sponsor banks. In addition, the Central Bank and Tanzania Communications Regulatory Authority have been cooperating on oversight of the mobile financial service (MFS) regulatory framework. Those resulted in an exponential increase of MFS access— from less than 1 percent of the adult population having access in 2008 to 90% having access by 2013

Another prominent success story in recent years is that Uganda, which also took a "light touch" on mobile money regulations and successfully achieved rapid growth. Between 2011 and 2013, the Bank of Uganda (BoU) and the Ugandan Communications Committee released a series of guidelines modelled after the enabling policies in Kenya and Tanzania. These guidelines allowed multiple e-money issuers to enter the market, offering basic payment and financial services, and allow banks to partner with Mobile Network Operators (MNO) under significantly simplified KYC-AML laws. The BoU has authorized mobile money services by issuing "no objection letters" to the commercial banks, who partner with the MNOs, and requires the bank to hold the balances recorded in the mobile wallet in an escrow account. Under the condition of the "light touch" regulation, the number of mobile money subscribers in Uganda rose from 2.9 million in 2011 to 22 million by 2018, compared to around 5 million registered accounts in traditional bank. The five largest MNOs in Uganda have partnered with commercial banks and now offer mobile banking accounts. These enabling policies to have resulted in an unprecedented rise in financial inclusion in Uganda.

REFERENCES

Mercy W. Buku and Michael W Meredith. (2013). "Safaricom and M-PESA In Kenya: Financial Inclusion and Financial Integrity". *Washington Journal of Law Technology & Arts*, Volume 8, Issue 3.

Elsie Onsongo. (2017). "Institutional Entrepreneurship and Social Innovation at the Base of the Pyramid: the Case of M-PESA in Kenya". *Industry and Innovation,* 26:4, P.369-390

Thomas McGath. (2018). M-PESA: how Kenya revolutionized mobile payments. https://mag.n26.com/m-pesa-how-kenya-revolutionized-mobile-payments-56786bc09ef

Financial Sector Deepening Kenya. (2019). The 2019 FinAccess household survey. https://fsdkenya.org/publication/finaccess2019/

Tavneet Suri & William Jack. (2016). "The long run poverty and gender impacts of mobile money", American Association for the Advancement of Science. Vol. 354, Issue 6317, pp. 1288-1292.

Milford Bateman, Maren Duvendack & Nicholas Loubere. (2019). "Is fin-tech the new panacea for poverty alleviation and local development? Contessting Suri and Jack's M-Pesa findings published in Science". *Review of African Political Economy,* https://doi.org/10.1080/03056244.2019.1614552

Nick Huges and Susie Lonie. (2007). "M-PESA: Mobile Money for the 'Unbanked'-Turning cellphones into 24 Hour Teller in Kenya". *Innovations: Technology, Governance, Globalization.* V 2. Issue 1-2. Winter/Spring 2007 http://www.nixdell.com/classes/Tech-for-the-underserved/m-pesa.pdf

Ignacio Mas & Dan Radcliffe. (2010). "Mobile Payments Go Viral"

Brian Muthiora. (2015). "Enabling Mobile Money Policies in Kenya – Fostering a Digital Financial Revolution", GSMA. https://www.itu.int/en/ITU-T/focusgroups/dfs/Documents/2015_MMU_Enabling-Mobile-Money-Policies-in-Kenya.pdf

William Jack & Tavneet Suri. (2011). "Mobile Money: The Economics of M-PESA 2". Nat'l Bureau of Econ. Research, Working Paper No. 16721

Paul Makin. (2010). Regulatory Issues Around Mobile Banking.
https://www.oecd.org/ict/4d/43631885.pdf

Scott Burns. (2018). "M-Pesa and the Market-Led Approach to Financial Inclusion". *Economic Affairs.* Vol 38. Issue 3. 2018
IFC. (2017). "M-money channel distribution case : Tanzania - Vodacom Tanzania M-PESA"

Simone D. Castri & Lara Gidvani. (2014). "Enabling Mobile Money Policies in Tanzania: A 'test and learn' approach to enabling market-led digital financial services". http://dx.doi.org/10.2139/ssrn.2425340

Rory Macmillan, Anthea Paelo & Tamara Paremoer (2016). The "Evolution" of Regulation in Uganda's Mobile Money Sector". *The African Journal of Information and Communication (AJIC),* 17, 89-110

GMSA. (2019). "Uganda: Driving inclusive socio-economic progress through mobile-enabled digital transformation".

Annex: Classification of the Access to Finance

Classification	Definition	Institution type	FinAccess survey cycles				
			2006	2009	2013	2016	2019
Formal (prudential)	Financial services and products used through prudentially regulated and supervised financial service providers by an independent statutory Government Agency including CBK, CMA, IRA, RBA and SASRA	Commercial banks including mobile phone bank products offered by banks in partnership with MNOs such as KCB M-PESA, MCo-op Cash, M-Shwari, Eazzy loan, Timiza and HF Whizz	✓	✓	✓	✓	✓
		Microfinance banks including mobile banking products offered by microfinance banks			✓	✓	✓
		Insurance service providers	✓	✓	✓	✓	✓
		Deposit Taking SACCOs			✓	✓	✓
		Capital markets intermediaries			✓	✓	✓
Formal (non-pru-dential)	Financial services and products offered through service providers that are subject to non-prudential regulation and supervision (oversight) by Government Ministries/ Departments with focused legislations	Mobile Money		✓	✓	✓	✓
		Postbank	✓	✓	✓	✓	✓
		NSSF	✓	✓	✓	✓	✓
		NHIF		✓	✓	✓	✓
Formal (registered)	Financial services and products offered through providers that are legally registered legal persons and/ or operate through direct Government interventions	Credit only microfinance institutions (MFIs)	✓	✓	✓	✓	✓
		Non-deposit taking SACCOs	✓	✓	✓	✓	✓
		Hire purchase companies	✓	✓	✓	✓	✓
		Development financial institutions (DFIs) e.g. AFC, HELB, ICDC & JLB	✓	✓	✓	✓	✓
		Mobile Money Apps/ Digital Apps				✓	✓
Informal	Financial services offered through different forms not subject to regulation, but have a relatively well–defined organizational structure	Groups e.g. ASCAs, *chamas* & ROSCAs	✓	✓	✓	✓	✓
		Shopkeepers/supply chain credit	✓	✓	✓	✓	✓
		Employers	✓	✓	✓	✓	✓
		Moneylenders/shylocks	✓	✓	✓	✓	✓
Excluded	Individuals who reported using financial services and products only through family, friends, neighbours or keep money in secret places or not using any form of financial service	Social networks and individual arrangements (e.g. secret hiding place)	✓	✓	✓	✓	✓

Serbia: Innovation Fund

Introduction: Critical issues to be addressed

About ten years ago, the industrial capacity of the Republic of Serbia had been severely weakened by the Yugoslav Wars throughout the 1990s and further diminished by the lingering effects of the financial crisis. Although Serbia's R&D spending was higher than other Balkan nation-states (but well below the European Union (EU) average) in 2012, it was dominated by basic research conducted by public institutions, which received funding without going through much of a competitive process.[20] Those publicly funded R&D activities by the research institutions were mostly delinked from industry needs, generating little to no economic value.[21] At the same time, the national innovation system and composition of R&D funding did not support enterprise innovation at any significant level, and the research sector modernization agenda was still in its infancy.[22]

To reorient public research towards the needs of the private sector in order to increase Serbia's industrial competitiveness, the Government of Serbia (GoS), supported by the EU and the World Bank (WB), has been working on renewing its policies and implementing relevant policy measures since 2011. The GoS's Ministry of Education, Science and Technological Development (MoESTD), with support from the two multilateral donors, has been undertaking structural reforms to improve the innovation ecosystem by 1) building up a key institution called the Serbia Innovation Fund (IF), which is an independent national agency under the MoESTD with the mandate to finance enterprise innovation, and 2) formulating new policies and regulations. Although much work remains, Serbia's efforts in pursuing primarily SDG 9: "Industry Innovation and infrastructure" (and simultaneously other goals that are especially relevant to environmental and social management issues[23]) illustrate a number of useful insights in terms of STI for SDG roadmap exercises.

Institutional setup of Serbia Innovation Fund

The establishment of the IF by strong political leadership

Serbia's journey to focus more on applied and industry-focused research was spearheaded by a Minister of Science and Technological Development, appointed in 2008.[24] He happened to also hold the position of Serbia's Deputy Prime Minister for EU integration. Unlike most of the previous Science Ministers, who were scientists themselves and therefore interested in promoting basic research,[25] this minister had a strong business and finance background and had served as Minister of

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[20] MoESTD conducted its last call for proposals in 2010. Although it was a competitive call with independent international evaluators, the success rate was nearly 90%, and the awarded researchers continued to receive yearly payments for these projects for nearly a decade, until a pilot call for grants opened in June 2019. See Mico Tatalovic, "Serbia passes controversial science reforms to modernise research," *Chemistry World*, 13 July 2019 <https://www.chemistryworld.com/news/serbia-passes-controversial-science-reforms-to-modernise-research-/3010733.article> and Nenad Jaric Dauenhauer & Mico Tatalovic, "Serbia is rethinking science — but the reforms could cost hundreds of jobs," *Nature online*, January 11, 2019. <https://www.nature.com/articles/d41586-018-07872-2>

[21] At the time, around 0.9% of GDP was invested in R&D, well below the EU average of 2.03%. R&D spending by the public sector was nearly double that of the business sector. Science infrastructure improvement had been the main focus up to that point, while stimulation of private-sector-led R&D and innovation had been negligible. R&D Institutes were the primary recipients of financing (80% of funds intended for science projects continue to be spent on researcher salaries), with private firms receiving funding only under the technological development component. Few mechanisms were implemented to incentivize private-sector R&D and innovation. Output from the R&D sector was not commensurate with the public resources being invested and did not support modernization of the Serbian economy.

[22] Bank financing was available for SMEs but not for startups with higher risks. No private seed financing or venture capital was available not only in Serbia but also in the Western Balkan region. MoESTD had a grant program with an annual budget of €1 million available to support individuals (not companies) in pursuing their scientific discoveries with disbursement of €1-2,000 per person, which was insufficient to effectively incubate startups. There was one incubator at Belgrade University with some companies, but no funding was available; other than that, there was a minor bilateral donor activity by the Swiss.

[23] The IF financial instruments have generally emphasized merit and commercialization potential and do not specify particular technologies or sectors/issues, but they have been effective in producing products and services that tackle a wide range of social, economic and environmental issues, such as renewable energy, education and waste management. In particular, the most recent EU fund (IPA 2014 Direct Award) to the GoS requires that all implemented projects will be environmentally and socially sound and sustainable. See: http://www.inovacionifond.rs/cms/files/medunarodni-projekti/20190315-IPA-2014-MiniMatching-ESMF-ENG-draft.pdf

[24] Minister Božidar Đelić grew up in France, graduated from Harvard Kennedy School and was a partner in McKinsey & Company before he became a politician. http://www.djelic.net/en/bio_long.html

[25] One exception was Prof. Dragan Domazet, who served as Minister of Science, Technology and Development in 2001–2004; he tried to change the system to be able to respond to the society's needs.

Finance and Economy a few years back, and he vigorously pursued making linkages between science & innovation and Serbia's social economic needs to make firms competitive. Luckily, there was no political opposition to this idea at the time; therefore, his ministry was able to develop and formulate a science strategy, which led to modification of two governing laws: the Law on Research Activity and the Law on Innovation Activity, which operationalized the IF.[26] Meanwhile, the minister secured investment loans for science from the European Investment Bank and the Council of Europe Development Bank, as well as a grant for the IF from the EU Instrument for Pre-Accession Assistance (IPA). This sequence of establishing a strategy, amending laws and securing funds for the activities was done quickly within the three years that the minister was in power.

Independent governmental agency under a ministry

The IF's success cannot be explained only by this strong leadership demonstrated by a politician, as his other ideas and initiatives did not survive through four successors and the advent of a new administration after he stepped down. Two key elements for the IF's institutional setup seemed to be crucial: 1) keeping a level of independence from its parent ministry and 2) securing strong support from international financial institutions.

Being an independent agency[27] under MoESTD means that the IF receives its operational cost[28] as well as strategic guidance from the ministry. The operational cost is approximately €500,000-700,000 annually to cover expenses like staff salaries, rent and electricity.[29] The ministry's strategic framework for R&D and innovation defines the IF's priorities and activities for a five-year period. Meanwhile, the IF's level of independence from MoESTD is ensured in its institutional setup. First of all, IF was deliberately mandated to co-finance innovation through cooperation with international financial institutions, organizations, donors and the private sector so that the agency would not entirely have to depend on the government and therefore would not be vulnerable to political/domestic turbulence and influence. The IF's Managing Board, which has the authority to approve or reject a list of projects to be funded, is represented by the GoS, but not necessarily MoESTD.

It is important to note that the Managing Board and its government representatives do not have the power to delete or add individual projects in the list, which is submitted as one package by an Independent Investment Committee. In addition to ensuring the independence of the Managing Board, the IF publicizes its financial decisions, monitoring and evaluation (M&E)[30] results and any other information and data needed by its clients and donors, in accordance with international standards. The transparency in those institutional decision-making processes has helped the IF build its reputation among the Serbian research and business communities and has led to the success of

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[26] The IF was established in 2005 by the Innovation Law (2005), but it was not operational until 2011 after the Law was amended to define form, governance and activities of it so that the organization could encourage entrepreneurship and manage financing for innovation. See for example: Page 2, Aleksandar Caslav Miletic, "Development of Innovations Infrastructure – Benchmarking the Leading Organizational Solutions with Serbia," April 2019.
https://www.researchgate.net/publication/332448072_DEVELOPMENT_OF_INNOVATIONS_INFRASTRUCTURE_-_BENCHMARKING_THE_LEADING_ORGANIZATIONAL_SOLUTIONS_WITH_SERBIA

[27] When the idea of IF first emerged, Serbia had no choice but to make it semi-public as there was no other real alternative. An ecosystem and market for innovative firms did not exist in the country, as there was no private seed fund that the government could invest public money in. Legally, the GoS was unable to set up an entirely private company with the public funding. Meanwhile, establishing a special window in a Serbian commercial bank was not a feasible option at the time as the banks had no experience and expertise in investing in startups or implementing/managing financial instruments for innovative firms and startups.

[28] A total of 3.86m was provided by the GoS for the period between 2011 and 2015. (P.24, Implementation Completion and Results Report for the Innovation Serbia Project, October 8, 2016.) http://documents.worldbank.org/curated/en/394131476361888907/Serbia-Innovation-Serbia-Project

[29] In 2014, the GoS failed to provide an operational budget in time, and as a result, the IF employees were without salary for three months. But in addition to the operational cost, MoESTD began to inject project budgets for grant funding, starting from 2017 with €3m, €5m and €6m. ICR for the Innovation Serbia Project. P.1 on Annex 8

[30] An internal M&E system was designed and built to constantly monitor and report about 50 indicators from all projects and programs (i.e. # of people hired in the beneficiary companies, revenues generated by the companies). Meanwhile, two series of independent evaluation of financial instruments were conducted for two financial instruments. The results are reflected in the IF programs and operations, i.e. resulting changes in the % of match (as other financial options emerged), % of grant required to be allocated to researchers in CGS projects.

launching and managing the financial instruments. Furthermore, the IF is designed to be able to receive input from other ministries besides MoESTD; specifically, the Ministry of Finance and Ministry of Construction, Transport and Infrastructure represent the government in the aforementioned Managing Board.[31] The Ministry of Finance and Ministry of Economy are involved in the strategic direction and management of the IF's financing instruments and projects as they are represented in the Supervisory Board and Steering Committee, respectively. Lastly, one of the biggest merits of being an independent agency is that the IF is able to set its wages at the level necessary to attract and secure highly eligible staff and experts. In fact, the IF staff generally gets paid approximately double the amount of Serbian public servants. In addition, with internationally competitive salaries, international talent has been recruited and hired as Investment Committee members as well as Strategic and Operational Advisors.

International partnerships and global expertise
As mentioned earlier, the GoS began its reform in the R&D sector through the establishment of the IF with the help of two international partners: the EU, which provided IPA funding, and the WB, which administered the fund; a Trust Fund Agreement was forged between them. This arrangement was the first of its kind, initiated by the aforementioned Minister, who served as chief negotiator for Serbia's accession to the EU and as chief governor of Serbia in relation to the WB Group at the time. He worked hard to set up this institutional arrangement as he was keen to draw on the WB's extensive networks and expertise in managing projects based on solid data, analysis and international good practices. It was a rather painful process in the beginning as the two international organizations were unfamiliar with the policies and procedures of their counterparts, resulting in some delays during project preparation. It took the highest political effort to resolve an administrative issue,[32] but once they became comfortable with each other as partners, implementation began to progress smoothly.[33]

Once on board, the WB brought global brains into the IF. Most importantly, the Bank was able to convince a prominent international figure in the innovation sphere to serve as IF's Strategic Advisor. He had vast experience and knowledge, including as Chief Scientist of Israel's Ministry of Industry and Trade in the 1990s managing over $1.5 billion in grant programs to promote R&D activities in the Israeli high-tech industry, which began to grow during his term in the office. The Strategic Advisor was deeply committed and devoted to his responsibilities; in fact, he was in the country for a week at least four times a year. He was in charge of designing and implementing grant instruments, and much of the IF's program design was modeled after Israeli programs and adapted to the needs of the Serbian market.

Another prominent international expert brought into the IF was an Operational Advisor, who dealt with issues related to human resources and operational infrastructure (including ICT and financial management). With rich international connections provided by the WB staff and the advisors, the IF built its system for staff training, including one or two weeks in the leading countries of innovation, such as Israel, Finland and the US, where they had hands-on training in managing funds. Through this training abroad, the IF staff could learn in detail how relevant documents and contracts are formulated and stored, how IT systems are set up to help manage calls for proposals, and how they conduct daily operations in running projects. Out of the nearly €1 million allocated for capacity building,[34] a high-spec IT system was built, including an online portal for applications to be accessible

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[31] IF Managing Board members are listed on the IF website.
http://www.inovacionifond.rs/fond/our-organization/managing-and-supervisory-board
[32] There was a heated argument over whose procurement procedure to use. In the end, it required the highest political efforts among the EU commissioner, Bank Vice President and Deputy Prime Minister in resolving this administrative issue, to use the Bank procedure.
[33] Since then, the WB and the European Commission have signed a Trust Fund and Co-financing framework agreement, dealing essentially with the operational aspects of the cooperation between both organizations. https://ec.europa.eu/europeaid/funding/procedures-beneficiary-countries-and-partners/fafa-world-bank_en
[34] See the figure of the Grant Financing for Component 1 (Capacity building) on the second table for Final Project Cost, p25 of the Implementation Completion and Result Report of Innovation Serbia Project. The figure for Government Financing is the IF operational

by reviewers, who can log in from anywhere in the world. The Independent Investment Committee, consisting of five international experts, including two Diaspora members, were selected through an international competitive open solicitation process, and the majority of them had finance/investment backgrounds. Additionally, with help from international experts, the IF built its internal M&E and training system for startups as well as the capacity to hold networking and educational events for enterprises and researchers to interact with each other. The IF capacity-building went well, as by the end of 2015, ten IF managers had gone through training and were applying the acquired skills, 51 startups had benefitted from monitoring, and 22 networking events had been held to promote public-private partnerships.

A series of financial instruments to support innovative firms

While institutional capacity was being built, the IF launched five programs[35] to support innovative firms under the guidance of the Strategic Advisor. The sequences of the following financial instruments were planned and executed with careful consideration: the first grant program (a Mini Grant) is designed to help innovators in the incubation stage to develop prototypes; the second grant program (a Matching Grant) supports enterprises in the next stage to manufacture and market products; then the IF established a special unit called Tech Transfer Facility (TTF) to stimulate and coordinate technology transfer from public R&D institutions to the private sector with small grant and advisory services; two newer grant programs (Collaborative Grant Scheme and Innovation Voucher) promote business-academia partnerships with different award levels. Having learned from international practice how to weed out "serial grant writers," these grant programs require entrepreneurs to provide a match in cash. The levels of IF co-financing in these programs were determined by the World Bank's analysis, drawing from lessons learned in other countries, e.g. in Israel. Generally, the matching contribution level of the beneficiary firms goes up as they get closer to the market. Meanwhile, as the Serbian innovation ecosystem have gradually developed with new investment options by private banks/funds becoming available, the matching levels required for IF-funded enterprises have become higher. Details and characteristics of those financial instruments are summarized below.

All financial instruments are designed to tackle different stages of technologies to be brought to the market.

Support for innovative enterprises

Mini Grants	
Issues to be solved	There was a lack of seed funding to support startups with ideas to develop a prototype
Objective and stage	Proof of concept, prototyping stage (except in high-tech areas like Nano-tech), IP protection, business plan preparation for mobilization of initial capital
Recipient	Incorporated entrepreneurs, innovative startups, spin-offs, micro and SMEs, existing for no longer than three years at the time of application
Grant size	Up to €80k for projects to be completed within 12 months
IF co-financing	Up to 85%
Calls for proposals	7 calls: 2012 (twice), 2013 (twice), 2017, 2018, and 2019 (twice)
# of projects supported	41 (out of 341 applications) in 2016 + 20 (out of 137) in 2017 + 13 (out of 143) in 2018

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cost. <http://documents.worldbank.org/curated/en/394131476361888907/pdf/P126229-Serbia-Innovation-Project-ICR-4-Portal-10-0-P126229-2016-10-08-11-25-10112016.pdf>

[35] Most recently, in September 2019, the IF launched its 6th program as a new service line of the Technology Transfer Facility: Proof of Concept. The program is designed for researchers who require support to prove that there is a new product, emerging from the research and for which there is a need in the market. It offers financial and mentoring support to existing research efforts to establish the proof of concept of an idea generated during the course of previous R&D efforts.

Matching Grants	
Issue to be solved	Support mechanisms did not exist for the next stage of startups, which already had prototypes but lacked money to manufacture or market products
Objective and stage	R&D (technology development) and commercialization projects for new or improved technologies, products and processes
Recipient	Incorporated entrepreneurs, innovative startups, spin-offs, micro and SMEs
Grant size	Up to €300k for projects to be completed within 24 months
IF co-financing	Up to 70% (company contribution is higher because prototype has been already tested and expectations are higher (the IF receives 20% of sales revenue within the 2 years)
Calls for proposals	6 calls: 2012, 2013 (twice), 2017, 2018, and 2019
# of projects supported	11 (out of 119 applications) in 2016 + 5 (out of 100) in 2017 + 9 (out of 75) in 2018

Support for public research organizations to commercialize their research

Tech Transfer Facility	
Issue to be solved	Serbian research institutions and faculties lacked technology transfer capacity; there was a need to centralize knowledge, expertise and resources in one place to be accessible for researchers who could benefit from receiving help in commercializing their research
Objective and stage	Eliciting invention disclosures from researchers, evaluations (of technologies, markets, teams), last-mile R&D grants (e.g. patent attorneys, prototyping, external expertise, testing), commercialization support, legal support and contract negotiations
Recipient	Public academic R&D organizations; other accredited R&D organizations, including private ones
Grant size	Up to €50k for projects to be completed within 6 months (if commercial partner co-finances, then within 12 months)
IF co-financing	Up to 100% (below €20K), or up to 70% in cases of commercial partnership (for above €20K)
Calls for proposals	Throughout the year
# of projects supported	19 (out of 28 applications)
Outcomes	3 tech transfer deals facilitated (and an additional 2 underway)

Support for public-private partnerships

Collaborative Grant Scheme (CGS)	
Issues to be solved	According to international experience, great innovations often come from research; but in Serbia, there was a big problem with connecting the research community and the private sector as existing ties were destroyed during the wars
Objective and stage	Joint R&D projects between academic R&D and SMEs aiming to create new products, services and technologies
Recipient	Consortium consisting of a lead private sector MSME (lead applicant) with at least one public scientific research organization (co-lead applicant)
Grant size	Up to $87.2k (€80k) for projects to be completed within 24 months
IF co-financing	Up to 70% for micro/small enterprise; up to 60% for medium-sized enterprise

Calls for proposals	3 calls: 2016, 2018 and 2019
# of projects supported	14 (out of 96 applications) in 2016 + 9 (out of 67 applications) in 2018
Outcomes (from the 1st cycle)	12 new products have been successfully created, 5 advanced prototypes have been developed, 3 new technologies and technological processes have been confirmed and given awards for the production of high-added-value products, while 5 projects have started achieving commercial results by selling their innovations[36]
Innovation Vouchers	
Issues to be solved	As the number of projects receiving CGS awards is limited, there is a demand for more opportunities to help the private sector and researchers to meet and get to know each other in order to generate new ideas for collaboration
Objective and stage	Industrial partners to make service contracts with public research organizations to improve products, processes, skills and services
Recipient	Private micro, small and medium enterprises
Grant size	Up to €6.5k for projects to be completed within 6 months
IF co-financing	Up to 80% (max of 2 vouchers allowed per MSME)
Calls for proposals	4 calls: 2017, 2018, 2019 (twice)
# of projects supported	325 (out of 411 applications)
Outcomes	Over 95% of the beneficiary enterprises indicated satisfaction

Source: author, based on WB and IF documents

Formulation of new research and innovation policies

Extensive and lengthy stakeholder involvement process led by the ministerial level

The reform of Serbia's R&D sector has been accelerated in recent years, especially in transitioning its research funding system to a mixture of highly competitive project-based funding and performance-based institutional funding. While the Prime Minister took on the reform as one of his priorities, the EU provided additional IPA money and the WB approved new loan projects. With the WB's technical assistance, the GoS has developed and delivered two sets of policy documents:

1) Research for Innovation (R&I) Strategy (2016-2020) (Mach 2016) with accompanying action plans (adopted in 2018), which led the GoS to pass two relevant laws.
2) Research Infrastructure Roadmap and corresponding action plans (adopted in December 2018).

The R&I Strategy (2016-2020) called for reform in the public R&D and innovation sector while reinforcing enterprise innovation as well as technology transfer for the economy, including the kinds of support provided by the IF. The government set up a committee to receive domestic experts' input for the R&I Strategy. At the same time, a series of events and roundtables with stakeholders were held to take stock and address the concerns of the research community. However, adoption of the strategy was delayed until March 2016. An accompanying action plan which spelled out the detailed program of reforms was even more controversial and time-consuming. The original plan was to adopt the accompanying plan within a few months after the adoption of the Strategy, and the World Bank experts helped the GoS finalize the draft based on consultations with stakeholders and the government. But for better or worse, the majority of the draft action plan ended up being altered by ministry staff before it was finally adopted two years later. It took that much time because the action plan included technical details of the reform, including detailed steps of how to introduce the new financial mechanism and what would be done during the transition period so that institutions/universities and their researchers would be properly paid with minimal disruption to their life and R&D. What happened was that, to enable full-scale stakeholder involvement, MoESTD top management, including the ministerial level, ended up meeting with all members of Academy of

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Science, faculty deans and directors of research institutes to receive their feedback and to address their concerns. The action plan was finally adopted after being updated to reflect much of the input from these one-on-one conversations with stakeholders.

Since then, two important steps were taken to further advance the reform. The first step in operationalizing the Strategy was the adoption of the Science Fund Law in December 2018. This law established a new independent funding agency (called the Science Fund) for research funding. This sister organization of the IF is crucial for Serbia to improve its research funding model to competitive and performance-based funding. Another law, called the Law on Science and Research, adopted in July 2019, established institutional funding for public R&D institutions while defining all the actors in the national research system so that their researchers would not have to depend, as before, on whether they worked on a project or not.[37] The law also recognized open science as a fundamental principle of science and research, mandating open science for all publicly funded research programs and projects with the intention of making public research output accessible to the private sector. This development made Serbia the first country in the Balkan region to recognize open science in a national law.[38]

Reliance on the expertise of international partners to collect data and analysis

While MoESTD and its minister spent much time and effort on adopting the R&I Strategy, the accompanying action plan and the two laws, Serbia relied on the expertise of the World Bank in formulating the Research Infrastructure Roadmap, including its action plans. Such a roadmap will be necessary in order for Serbian research communities to have access to EU Structural funds, if and when Serbia becomes an EU member. The original plan was to conduct an extensive bottom-up consultation involving the entire R&D community by launching a call of proposals. However, the formulation of this set of policy documents happened to coincide with the aforementioned highly sensitive time of systematic reforms in the research sector. MoESTD decided not to alert scientists with the call and chose a relatively low-key process to adopt the Roadmap. As a result, the GoS, with technical support from the WB, established a working group consisting of 15 committee members representing the research community with experience in either working on EU research infrastructure projects or managing large facilities in the country. The committee met several times, receiving two rounds of comments during the drafting period of 8 months to reflect these experts' input and data. Meanwhile, to be included in the Research Infrastructure Roadmap, the EU best practices were collected through a series of interviews with European practitioners. The interviews were conducted by the WB team, often accompanied by the ministry officials, who indicated their interest in getting involved in the process as much as possible. The draft text of the Roadmap was closely shared with the MoESTD as the WB team had weekly meetings with top management, often including the Ministerial level, to get comments and feedback. Serbia's Research Infrastructure Roadmap, which was necessary to improve the country's readiness in joining the EU, was adopted in December 2018.

These laws and policy documents have further encouraged Serbian public research institutes to shift to R&D based on excellence and relevance as well as innovation based on partnerships with the private sector.

Ongoing work

Continued STI reform and STI for SDG roadmap activities

MoESTD is currently working on operationalizing the aforementioned laws through bylaws, defining, for example, the details of institutional funding and the independent assessment of public R&D institutions. At the same time, with support from EC's Joint Research Centre, MoESTD has been leading the work on formulating Serbia's Research and Innovation Strategy for Specialization (RIS3), which aims to increase the competitiveness of the Serbian national/regional economy in order to

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[37] http://www.nip.rs/en/news/141-the-law-on-science-and-research-has-been-adopted

[38] https://www.sciencefordemocracy.org/open-science-included-in-new-serbian-law/

contribute to the economic growth and advancement of society by linking research and innovation forces and resources to a number of priority economic areas.[39] So far, Serbia has gone through an extensive bottom-up stakeholder consultation process (called EDP) by holding 17 workshops between March and May 2019, attended by approximately 900 participants and identifying four priority research areas.[40] Meanwhile, the GoS set up a governance structure involving:

- an inter-ministerial National Smart Specialization Team.
- a joint coordination group for smart specialization and industrial policy under the Prime Minister.
- a national analytics team gathering local experts for data analysis; and
- working groups of stakeholders (business, academia, local and national authorities and civic society) for each of the smart specialization priority domains.

These will be the foundation of Serbia's UN STI for SDGs Pilot Program.[41] In the coming months, the WB are planning to operationalize the sister organization of the IF called the Science Fund while supporting the new Fund's design and the implementation of programs/activities including competitive research grants with incentives to enhance Smart Specialization Strategy and infrastructure support for public research institutions. The support for the new Fund for research funding will be done in a similar manner as the support provided to the Serbia Innovation Fund described earlier. In other words, the new Science Fund will be one of the means to implement the RIS3 Strategy, as the new organization focuses on funding applied research on the four priority sectors already identified.

Conclusion

Over the years, a lot has been done in Serbia to formulate new laws, policy documents and programs to mobilize STI for achieving SDG 9 in industrial innovation and infrastructure as well as other SDGs related to social and environmental issues. It has taken time and much political leadership, government effort and extensive support from international partners in order to come this far. Serbia has yet to formally reflect the STI reform in formulating its SDGs policy, but so far, the country's experience seems to have generated at least two good practices and lessons learned. First, for a key institution such as the IF, a level of independence and the ability to work with international partners are crucial in building a foundation and core institutional capacity. Secondly, major reform takes years of extensive stakeholder involvement activities, led by a several political leaders. Looking at a decade of Serbia's work, it seems realistic and strategic for countries to start small by building the capacity of core institutions and financing pilot programs under one ministry, but eventually, policy environments need to be enhanced through relevant stakeholders while more government agencies need to be brought into the efforts in order to ensure sustainability and real impact.

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[39] See more details in Serbian RIS3 homepage: https://pametnaspecijalizacija.mpn.gov.rs/
[40] Identified research priorities are: 1. ICT (custom software development, software solutions development); 2. machines and production processes of the future (machines for specific purposes, information in smart management service - Industry 4.0, smart components and tools, combustion devices for eco-friendly and sustainable fuels); 3. food for the future (high-tech agriculture, value-added food products, sustainable food chain); 4. creative industries (creative audio-visual production, video games and interactive content, smart packaging).
[41] Serbia's pilot is to link its SDG process, STI policy reform and development of EU-supported Smart Specialization Strategy (RIS3), which is based on national or regional priorities that aim to build comparative strengths by linking research and innovation forces to the needs of the economy, as an EU candidate country. Serbia launched its preparation for RIS3 strategy in 2017. The process is led by the MoESTD and the Ministry of Economy, with the support of the Public Policy Secretariat and the technical assistance of EU JRC. The country is currently going through the Entrepreneurial Discovery Process (EDP), which is a bottom-up consultative process among academia, government, private sector and civil society in defining the priorities.