



Evidence Based STI Approaches to Achieve Sustainable Development Goals

Meeting of the Senior Policy Makers from the Asia-Pacific Region

26 November 2014

MILODA, Ministry of Finance and Planning

Colombo, Sri Lanka

Evidence Based STI Approaches for Sustainable Development

Issues, Challenges and Opportunities

26 November 2014
Colombo, Sri Lanka

N. Srinivasan
Coordinator, STI
Asian and Pacific Centre for Transfer of Technology (APCTT)
of the United Nations ESCAP

Plan of Presentation

- 1. Background and Rationale**
- 2. Current STI Scenario**
- 3. STI Evidence : Current Methods & Tools**
- 4. Challenges and Opportunities**
- 5. New and Emerging Approaches**

1. Background and Rationale

- Eradicating poverty and pursuing sustainable development remain a formidable challenge.
- **STI and culture** hold huge potential as **tools and enablers** to realize countries' goals.
 - Significantly impact each of the three pillars of sustainable development – economic, social and environmental.
 - Affects economic growth through the knowledge spill-overs it generates between countries, firms, and industries.
 - Provides opportunities to “leapfrog” intermediate development stages

(Ref. Report of the SG to ECOSOC Annual Ministerial Review Meeting, Geneva, July 2013)

1. Background and rationale

- Income produced by **cultural industries** globally in 2007 was estimated at US\$1.6 trillion.
- **Cultural diversity and creativity, combined with scientific knowledge** can bolster nationally and internationally agreed development goals.
- Creative and cultural sectors are **characterized by self employed artisans and small businesses, including women and other disadvantaged people** who tend to remain in the informal economy.
- They **fosters human creativity and context-based development approaches** that can deliver benefits well beyond the economic dimension.

(Ref. Report of the SG to ECOSOC Annual Ministerial Review Meeting, Geneva, July 2013)

1. Background and Rationale

- Gaps in **technological advances** can further widen **developmental divides** as rapid technological transformations drive the historic shift from the industrial to the network age. (M. Desai, et. al., 2002)
- STI is also a **central element** for increasing energy efficiency, reducing waste, mitigating climate change and embarking on **sustainable development pathways**. (Ref. Report of the SG to ECOSOC Annual Ministerial Review Meeting, Geneva, July 2013)

- **2.7% of GDP is devoted to R&D activities in North America, while only 0.4% is devoted to it in Africa. (a)**
- **Of the world's researchers, only 27% are women. (b)**
- **Only 0.5% of the world's researchers live in LDCs (European Union: 20.1%, North America: 21.9%). (c)**
- **An estimated 2.5 million engineers and technicians will be needed in sub-Saharan Africa alone to achieve improved access to clean water and sanitation. (d)**
- **74% of inhabitants of developed countries are Internet users, compared with only 26% in developing countries. (e)**

(a) Global Investment in R&D, UNESCO Institute for Statistics (UIS), 2012; (b) UIS, 2012; (c) UNESCO Science Report, 2010; (d) Engineering: Issues, Challenges and Opportunities for Development, UNESCO, 2010; (e) <http://www.un.org/millenniumgoals/global.shtml>.

2. Current STI Scenario

- **Persistent technological and innovation divides** between countries and regions continue.
- Most important **innovation gaps** are between countries at different stages of development.
- **High-income** countries outpace countries with lower per capita income by a wide margin **in all innovation performance metrics**.
- Around **70 per cent of R&D** spending worldwide still takes place in **high-income countries**.
- Middle- and low-income **developing economies have increased their share of global R&D expenditure** and patent applications, most of this increase is accounted for by **East Asia**. Provides opportunities to “leapfrog” intermediate development stages

(Ref. Report of the SG to ECOSOC Annual Ministerial Review Meeting, Geneva, July 2013)

2. Current STI Scenario

- **Insufficient government commitment and resource base for STI**, including financing, technology and capacity, poorly designed national STI policies and lack of organizational capacities to implement the policies.
- **Lack of good quality national data and mechanisms** to ensure access to and use by decision makers.
- **Weak linkages between public R&D and national economic development.**
- **Lack of absorptive capacity in firms and their focus on imitative innovation and acquisition of foreign technology.**

(Technical Support Team Issues Brief: Science, Technology and Innovation, Knowledge-sharing and Capacity-building, 2013)

2. Current STI Scenario

- **Disconnect** between policy-makers, technical experts (scientists, engineers, etc.) and users/citizens.
- Lack of consistent life cycle thinking and **long-term perspective in the STI frameworks and policies** of countries.
- **Unequal access** to STI and knowledge as well as to their benefits remains persistent within and among countries.
- **Equitable (disabled, rural and remote people) access** to adequate infrastructure, including ICTs, is lacking

(Technical Support Team Issues Brief: Science, Technology and Innovation, Knowledge-sharing and Capacity-building, 2013)

3. STI Evidence : Current Methods and Tools

- **OECD** key products in measuring and analyzing STI & related policies
 - **Science, Technology and Industry Outlook**
(Key trends in STI, Main trends in national STI, Individual profiles of the science and innovation performance OECD; Major emerging countries (Brazil, Russia, India, Indonesia, China and South Africa), and other outputs.
 - **Science, Technology and Industry Scoreboard**
(Internationally comparable indicators, statistical information necessary to guide policy makers)
 - **OECD Country (Regional) Review of Innovation Policy**
(Comprehensive analyses of the national innovation and science systems; Key issues (Innovation and economic performance International benchmarking of performance Human resources in science and technology; Industry-science linkages Internationalization of R&D; **Regional Review SE Asia**)

3. STI Evidence : Current Methods and Tools

- **OECD** key products in measuring and analyzing STI & related policies
 - **Main Science and Technology Indicators**
(Resources devoted to research and development, patent families, technology balance of payments and international trade in R&D-intensive industries)
 - **Innovation Policy Platform** (Web-based tool, enabling governments and policy makers to benchmark their situation, learn from successful strategies from other countries, and design their own policy mix)

(Yuko HARAYAMA, OECD, July

2011)

3. STI Evidence : Current Methods and Tools

- **UNESCO** Regional Office for Science in Latin America & Caribbean
 - **Information platform: SPIN**
 - Strategic information tool: NEXUS
 - Funding facility for intra-regional South-South R&D
 - Capacity building for R&D managers
 - Foresight and research on STI policies
- **Dutch** STI Indicators 2012
 - R&D funding, Human Capital, Collaboration, Output, Outcome
 - Internationalization and specialization (trends in internationalization, **science domain**, economics and **technology & innovation domains**, overall trends in internationalization)
 - **Specialization as an effect of globalization** (Specialization in science, industrial specialization, overall trends in specialization)
- **China and Republic of Korea**

4. Challenges and Opportunities

- **Political level** : Lack of understanding of importance of STI and its indicators, will and to take action
- **Institutional level** : Weak statistical system; lack of trained personnel; high staff turnover and lack of trust by respondents
- **Technical level** : Private R&D (less systematic, data maintenance and transparency), measuring R&D personnel and R&D expenditure (private university, budget data); R&D activity fields (traditional knowledge, reverse engineering, clinical trials)
- **Developing Metrics and robust baselines** to monitor and assess innovation and related policy performance in order to support the global debate, guide policies and highlight good practices.

Martin Schaaper, UNESCO Institute of Statistics (UIS)

4. Challenges and Opportunities

- **Monitoring the risks and challenges** pertaining to STI policies and strategies.
- **Global access to knowledge** as new source of private and public innovation.

(Ref. Report of the SG to ECOSOC Annual Ministerial Review Meeting, Geneva, July 2013)

- STI efforts should be more effectively targeted to address environmental, economic and social challenges and to provide sustainable and effective tools for **strengthening sectors with the greatest poverty-reduction potential and/or involvement of people living in poverty.**
- **Strategic investments** need to be made in education, capacity development in STI and engineering, and innovation ecosystems.

4. Challenges and Opportunities

- Multidisciplinary and integrated as well as culture-sensitive approaches, **bringing together natural and social and human sciences as well as local and indigenous knowledge**, are key to build the necessary knowledge for sustainable development at all levels.
- **Unintended consequences of STI** need to be addressed and the precautionary principle applied.
- Need to **prioritize national capacity-building for innovation** focusing on the establishment of a conducive policy framework for innovation.
- **A data revolution for sustainable development is necessary, and a Global Partnership on Development Data should be established.**

(Technical Support Team Issues Brief: Science, Technology and Innovation, Knowledge-sharing and Capacity-building, 2013)

4. Challenges and Opportunities

- **Technology, information networks and people-led innovation** as critical resources for achieving sustainable development will help ensure progress on a range of 21st century development challenges such as food and nutrition insecurity, environmental degradation and climate change.
- **National STI policies** and systems will need to be designed within the **context of national action plans for sustainable development**.
- Governments should **develop national infrastructure, governing structures and legal frameworks** to harness the important potential of **ICTs for sustainable development**

(Ref. Report of the SG to ECOSOC Annual Ministerial Review Meeting, Geneva, July 2013)

4. New and Emerging Approaches

Major Geopolitical Transformations:

Population growth in 2025 up to 8 billion worldwide:
61% of world population in Asia, EU-27: 6.5%
35% of the European population will be more than 60

Geopolitical economic power:

30% of GDP produced by Asia, EU: 20%
Asia will be the first world exporter: 35%, EU: 32%
Asia on par with US & Europe in the field of R&D

Luc Soete, UNU Merit, July 2011

4. New and Emerging Approaches

Largest countries by 2025 (>100 million)

China (1453)

India (1431)

EU-27 (517)

USA (358)

Indonesia (263)

Pakistan (246)

Brazil (214)

Nigeria (210)

Bangladesh (195)

Russia (132)

Mexico (123)

Japan (120)

Ethiopia (119)

Philippines (117)

Egypt (105)

Turkey (100)

(Note: Not a single EU country, the EU as a union of small states)

Luc Soete, UNU Merit, July 2011

4. New and Emerging Approaches

- **Development of new indicators**
 - Resource allocation to **alternative directions of research and innovation** in specific fields (*eg: low carbon energy; sustainable agriculture; public health*)
 - Depth and scope of **oversight of stakeholders in research and innovation strategies**
 - Diversity in **stakeholder engagement in research and innovation governance**
 - **Key poverty alleviation and sustainability goals** for research and innovation
 - Resource allocation – direct as well as indirect – to **explicit, audited poverty alleviation and sustainability goals**
 - Engagements in **capacity building by excluded groups** (*eg: local entrepreneurs, communities citizens groups*)
 - **User-driven and user-engaged research** (*eg: provision for extension activities in higher and tertiary education*)
 - Increasing **support (in relation to basic science)** for engineering, design, services, and social entrepreneurship
 - Uptake in **benchmark criteria for poverty alleviation and environmental protection in research and innovation**

(Andy Stirling, STEPS Centre, SPRU – science and technology policy research, July 2011)

4. New and Emerging Approaches

- **Specific goals, targets and indicators** could be developed around the following priority areas:
 - **Investment in science, technology and innovation**, including investment in R&D, as a percentage of GDP and as a percentage of Official Development Assistance;
 - **STI policies as holistic frameworks** and integral part of national sustainable development policies addressing inter alia the following:
 - (a) **Increased multi-stakeholder collaboration** across the policy-science-industry-society spectrum;
 - (b) **Human, institutional and societal STI capacity-building**, with a strong focus on training and science education at all levels;
 - (c) **Measurement of innovation capacity** across a range of metrics which combine to create national innovation eco-systems;
 - (d) **Achieving gender parity in STI systems**;
 - **Level of openness achieved** in accessing, sharing, processing and using scientific research and knowledge;

4. New and Emerging Approaches

- **Inclusive Internet connectivity and use**; scaling up of ICTs to spur local innovation;
- **Data revolution** including solid STI statistics and indicators systems, and adequate capacities for data collection and analysis;
- **Regional and international STI cooperation** and multi-stakeholder partnerships, in particular South-South and North-South-South;
- **New and stronger financing mechanisms** at all levels for STI, knowledge and data-sharing, capacity development and green technology transfer;
- Achieving specific resource efficiency/decoupling factors via STI.

(Technical Support Team Issues Brief: Science, Technology and Innovation, Knowledge-sharing and Capacity-building, 2013)

4. New and Emerging Approaches

- **3 C Model from STEPI, Korea**

- **Componentization** - Identification of major components of system weakness and bottlenecks from a holistic viewpoint with statistically described and overviewed symptoms of system

- **Contextualization** : Structurised and heuristic understanding of identified components in the context of system dynamics with several rounds of deepening diagnosis

- **Conceptualization** : Synthesized diagnosis that provides a plausible explanation of the structural problems of the system and leads to consensus among stakeholders through common understanding of system weaknesses and bottlenecks

(Dr. J. H. Lee, STEPI, Republic of Korea)

4. New and Emerging Approaches

- **4 C Model** based on sustainability assessment framework *(Ekins and Medhurst (2003, 2006))*

Manufactured Capital

Manufactured (or human-made) capital is what is traditionally considered as capital: produced **assets that are used to produce other goods and services**. Some examples are machines, tools, buildings, and infrastructure.

Natural Capital

In addition to traditional natural resources, such as **timber, water, and energy and mineral reserves**, natural capital includes **broader natural assets, such as biodiversity, endangered species, and the ecosystems which perform ecological services (e.g. air and water filtration)** that absorb and neutralize human wastes. Natural capital can be considered as the components of nature that can be linked directly or indirectly with human welfare.

Human Capital

Human capital generally refers to the health, well-being, and productive potential of individual people. Types of human **capital include mental and physical health, education, motivation and work skills**. These elements not only **contribute to a**

4. New and Emerging Approaches

happy, healthy society, but also improve the opportunities for economic development through a productive workforce.

Social Capital

Social capital, like human capital, is related to human well-being, but on a societal rather than individual level. It consists of the social networks that support an efficient, cohesive society, and facilitate social and intellectual interactions among its members. Social capital **refers to those stocks of social trust, norms and networks that people can draw upon to solve common problems and create social cohesion**. Examples of social capital include **neighbourhood associations, civic organizations, and co-operatives**. The political and legal structures that promote political stability, democracy, government efficiency, and social justice (all of which are good for productivity as well as being desirable in themselves) are also part of social capital.

Further Reading : The Four Capital Model, Matrix and Accounts by Bojan Radej, OCCASIONAL PAPER No. 7, 2007

4. New and Emerging Approaches

- In the 4 Cs Model the concept of capital is extended in a number of directions, to **take into account the quality** (as opposed to the quantity):
 - Of labour (**human capital**);
 - Of the networks through which labour and society are more generally organized; which create the social context for economic activity (**social/organizational capital**); and
 - Of the natural resources and environment which both provide inputs into the economic process and maintain the existence of life on earth (**natural capital**).
- The 4 Cs Model goes further than the three dimensions of sustainable development in describing **the linkages between the different interests**, and offers a potentially more powerful appreciation of what the 'integration' of disparate policy interest in support of sustainable development might mean in practice.

4. New and Emerging Approaches

- The application of the 4Cs model thus **allows decision makers to apply a crucial test: when is development not sustainable?**
- At any given time **stocks of particular types of capital are in decline at the same time as other stocks are increasing.**
- The substitution of one form of capital for another (where feasible) has the potential to lead to an overall decline in total capital, and hence unsustainable development.
- The **substitution between capitals, or tradeoffs, is a key component of the Model.**
- It raises the question of whether substitution is allowed between the various forms (weak sustainability) or, whether below certain stock levels (critical thresholds), particular components of capital are non-substitutable, i.e. they are complementary and contribute to welfare in a unique way that cannot be replicated by another form of capital, thus preventing unlimited substitution (strong sustainability).

(ESCAP, 2014)

4. New and Emerging Approaches

Substitution of Capitals or Trade Offs

- When **one of the forms of Capital among the 4 Cs increases** and that increase is associated with the **decline of another capital** then sustainable development theories refer to this as the creation of a tradeoff by the development intervention.

The challenge:

- To **establish the existence and nature of tradeoffs** (and the extent to which these can be reduced or offset)
- To **engage in an explicit determination** of whether declines in particular forms of capital are unsustainable by reference to the **possible existence of critical thresholds** and the acceptability of compensation implicit in the tradeoff.

(ESCAP, 2014)

Thank you

E-mail : srinivasann@un.org
www.apctt.org <http://nis.apctt.org> www.techmonitor.net