ECOSOC Development Cooperation Forum

Strengthening technology facilitation and capacity building in a post-2015 setting: Understanding the issues

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Technology and innovation key means of implementation

Technology and innovation are seen as a key means of implementation, given the important role they have played historically in underpinning economic and social development and helping to manage the environmental impacts of human activities. They are recognized for their central role in meeting development objectives and putting us on "the road to dignity by 2030." The report of the Open Working Group, the Secretary-General's synthesis report on the post-2015 development agenda, and the summary of the high-level thematic debate on MOI organized by the President of the UN General Assembly all highlight the critical role of technology in meeting global development objectives. The Financing for Development (FfD) process has also recognized the interlinkages between financing and technology development and transfer, especially through the provision of appropriate and innovative means of financing.

The scale and nature of global challenges– and the timeframe in which we would like to address them – will require new and additional efforts in advancing science, technology, and innovation for a sustainable future.

This Policy Brief provides a brief overview of the role of technology facilitation and capacity building to support implementation of the post-2015 development agenda and the role international development cooperation can play in this regard.

Development cooperation and technology[0]

Development cooperation in the technology domain, it has a rich and long history, with the Consultative Group on International Agriculture, perhaps, being the most prominent example, because of the major role it has played in transforming agriculture in developing countries since the 1960s. More recently, the health arena stands out for the enormous efforts and investments in making available vaccines and other health technologies for developing countries through the establishment of partnerships to develop and make accessible new products and local production capacity. Information and communication technologies for development (referred to as ICT4D) have also become a vital tool for development cooperation.

Interspersed with these and other major initiatives are a large number of partnerships both within and beyond the UN that facilitate and support the harnessing of technology for a variety of developmental and environmental objectives. This includes, for example, the demonstration of new and improved technologies, provision of finance and technical support to adapt and deploy such technologies, and advice to shape policies to enable related local activities (see Appendix 1 for an illustrative compilation of actors and initiatives).

[0]Such development cooperation has both supported and complemented domestic efforts in many developing countries to utilize S&T to advance their developmental agenda.

Preparing for development cooperation in a post-2015 era and 2016 DCF

The post-2015 development agenda builds on the successes of the past two decades and strives for "sustainable development and… ensuring the promotion of an economically, socially and environmentally sustainable future for our planet and for present and future generations." Major challenges remain in achieving this vision. Action will be needed on a wide range of areas including poverty eradication, inequality, economic growth, industrialization, employment, food security and nutrition and sustainable agriculture, water and sanitation, health and population, energy, and climate change.

Accordingly, the Sustainable Development Goals proposed by the Open Working Group are sweeping and ambitious in scope. Understandably so, financing and other means of implementation (MOI) for the post-2015 development agenda and SDGs have received great attention. The proposed SDGs, in fact, contain a goal explicitly focused on financing and other MOI, at the same time, these MOI underlie the other substantive goals.

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The views presented do not necessarily represent those of the United Nations or the Republic of Korea. The study aims to generate ideas for the post-2015 discussions in advance of the Third International Conference on Financing for Development in Addis Ababa in July 2015 and the High-level Meeting of the Development Cooperation Forum in New York in July 2016.

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Some of these activities are sectoral, for example, focusing on areas such as agriculture, energy, and climate change and some are more cross-cutting in nature, focusing, for example, on intellectual property, capacity building, and more recently the creation of a global technology bank for LDCs.[1] A wide range of actors – intergovernmental, governmental, and non-governmental (such as firms, philanthropic organizations, non-profit organizations, universities, public research institutions, etc.) –are engaged in advancing and leveraging technology to address various global challenges through different modalities of development co-operation, both financial and technical.

New and innovative forms of support are being used to make available technologies to meet developmental challenges. At the same time, new technologies can also raise various concerns, for example, relating to impacts on employment, economic equality, environment, and health.[2]

Much more that can be done to enhance the availability of, and access to, much-needed technologies; ensure that the needs and context of users, especially women and other often marginalized groups, are taken into account; and to be responsive to consequences of technological change in local communities. The development of capacity in developing countries will be key to engage meaningfully in such responsive technology facilitation to support implementation of a post-2015 development agenda.

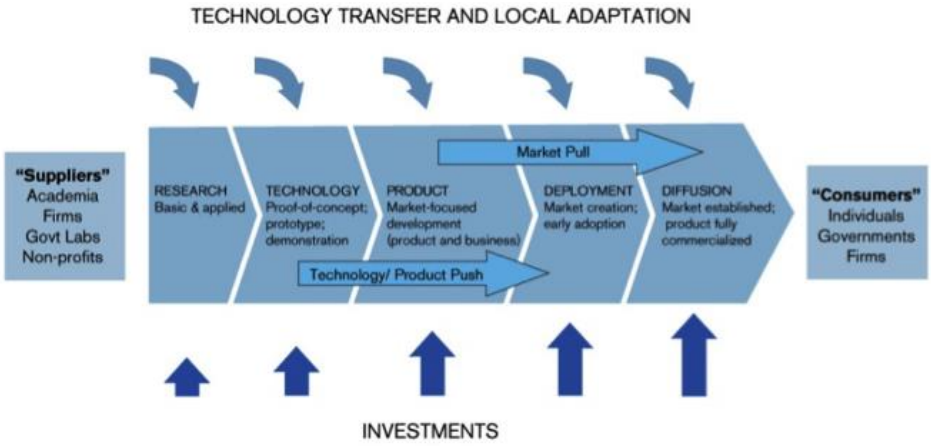
The technology cycle: a brief overview

In order to explore how to better support the development and deployment of technologies that can help meet the post-2015 development agenda, it is helpful to understand the typical technology cycle, i.e., the various steps through which technology is developed and deployed (also termed as the "technology innovation process") and in particular the practices to ensure resources and capabilities to develop and deploy technologies are available.[3]

The technology cycle can be depicted as shown in Figure 1 below. The earliest stages generally require basic and applied research to develop a new technology. Once a technology seems to show some potential, and based on an understanding of consumer needs and market conditions, the next step then is to develop a commercializable product (where firms play a central role), or – importantly in the case of developing countries – to adapt an existing product to local requirements. Such a product may be tested among potential consumers or in real-world conditions. If all goes well, manufacturing may commence.

The success of a product may require the development of a new market by creating demand among potential early adopters that are willing to try the technology and then, over time, market conditions become more favourable for larger-scale deployment.

Figure 1. A stylized depiction of the stages of technology innovation



[1] See http://unohrlls.org/technologybank/

[2] For example, the rise of the information economy, while being beneficial for many, has also raised concerns regarding those who do not have access to resources and skills to participate in this economy; more recently, a range of issues surrounding privacy of personal data has also received much attention.

[3] Innovation does not only refer to the development of products that are new to the world, but also new to a specific market. Thus the adaptation of an air-conditioner to conditions in a tropical area should be treated as an innovation.

We highlight below some key characteristics regarding the innovation process:

1. The nature of activities, along with the required financial and other resources, and the key actors, change as a product goes through the stages of the technology cycle. At the early stages, scientific and technical talent plays a key role. The outcomes at these stages are more uncertain (research by definition is exploratory) so there is a higher risk for investors. Therefore, in many cases, public sources dominate the funding of basic research (while universities and other research institutions are key performers), although private players also invest in, and perform, such research. At the later stages, market acumen plays an important role and private actors and investments dominate since the risk is lower and the potential of appropriable returns higher, although public funds (and civil society, etc.) may still be useful in filling particular gaps.

2. Innovation can happen in many ways: the development of new technologies, product, process and business model innovations, and adaptation of existing tools and technologies to local contexts, and the deployment of these technologies. Some of these innovations may be radical, but most often they are incremental. But many incremental changes cumulatively can lead to major changes, thus contributing to transformation.

3. Innovation can be stimulated by increased inputs (often termed as "technology push") or by increased demand for its products (termed as "market pull"). This has implications for the design of any program intended to stimulate innovation in a particular application area. Investments in innovation, where research and development (R&D) serve as one common proxy, are a major indicator of the level of innovation activities.

4. The skills and capabilities required for "new to the world" innovations are greater than for "new to the market" innovations and therefore different countries are able to engage differently in innovation processes, depending on the level of their technological (and associated) capabilities. Conversely, this also means that all countries should, in principle, have some scope to engage in innovation in some way (for example, by enhancing their capabilities over time, by "learning by doing", or other strategies, such as strengthening tertiary education).

5. The needs for any given technology may be very different at different stages of the technology cycle. Also, the needs for different technologies may be different at the same stage.[4] And, lastly, these needs also may depend on specific country contexts (depending, for example, on external factors such as stability and security, the domestic policy landscape and the nature of the local innovation ecosystem). The successful introduction of a product into real-world use involves meeting the combination of these needs (or the "innovation gaps," so to speak) at every stage. Thus **successful innovation, in some sense, is the result of a delicate interplay between technology and market development, facilitated by policy and appropriate business models, and involving a range of actors**.[5] This suggests that efforts to promote the development and deployment of technologies need to be tailored to address the gaps that relate to particular technologies in a particular national context. International development cooperation can play a key role in identifying and addressing these gaps through targeted support, for example, through technology transfer and adaptation, development and use of appropriate business-models and policies, and the provision of suitable finance. It also plays a key role in promoting the enabling environment for all relevant actors to work together towards effective technology innovation and diffusion.

6. Policies to support innovation play a role across the cycle. Different policies may be needed to promote research, develop markets for new technologies, and facilitate diffusion.[6]

7. In the case of technologies and products that have public benefits, such as environmental technologies, large-scale deployment of resources, and close collaboration between national governments

[4] For example, solar PV technologies require much greater investments in basic research than wind power and market introduction of a vaccine, requiring clinical trials, may be far more expensive than introduction of a new health diagnostic tool.

[5] Analysts of innovation processes refer to "innovation systems' as underpinning innovation, where an innovation system comprises of interacting actors (involved in the complex set of activities surrounding the development of technologies and bringing them to market) and institutions ("rules of the game" such as culture and policies that characterize the environment in which these activities are undertaken).

[6] For example, facilitating the introduction of an energy-efficient refrigerator in the developing country might require R&D funds and technical skills to adapt the compressor for local weather conditions. It might require assisting a local manufacturer to set up a production line and working with a government agency to put in place a policy that promotes the uptake of these refrigerators among the public through provision of information or reduced taxes.

and their external partners, is necessary for achieving the desired outcome and results.

In the case of technologies and products that have a clear market demand and users have the ability to pay, there generally is an incentive for the relevant actors (whether technology firms, financial players or service providers, for example) to invest resources, coordinate with each other, and even influence the policy and regulatory landscape. But in the case of others, for example environmentally sustainable and clean technologies or other technologies that have a 'public goods' nature, there may not be a market signal to promote the assembling of resources and capabilities to develop/adapt and deploy such technologies and users may not have adequate purchasing power. Therefore **advancing technologies that are relevant to sustainable development generally requires active intervention**[7] – and often even a strategic perspective (see, for example, Kemp, Schot, and Hoogma, 1998) – to overcome these 'market failures.'

Therefore, an increase in innovation inputs and the creation of market demand could be seen, in a first-order approximation, as enhancing the scale of the innovation process. But the effectiveness and speed of the process by which sustainable development technologies are developed (or adapted) and diffused to the relevant user group, are dependent on the availability of support of different kinds to make sure that any "innovation gaps" (which depends on the specifics of the technology and the market and policy context) are filled, that there is coordination of actors and activities across the technology cycle and the relevant domains – technology, firm-level planning, finance, and policy – and that the product is made available to the ultimate users.

Given the complexity of these tasks – and their relationship to the local context – the development of local capacity to shepherd and manage such processes is key to long-term effectiveness and success. Development cooperation could play an important role in helping build local capacity to advance and manage technological change. At the same time, it also could help through strategic interventions to help develop and deploy technologies to address specific urgent sustainable development challenges.

Issues relating to technology facilitation for the post-2015 setting

The assessment of the state of innovation needed to meet sustainable development challenges – and how development cooperation can support it – may be best carried out by looking at four dimensions of the innovation process:

1. *The nature and scale of innovation (i.e., Is the scale of innovation activities, and the resources being invested, appropriate in relation to global development goals?)*: There is some concern about various aspects of the level of investments in R&D in key sectors, such as agriculture, health, and energy, motivated by a perceived mismatch between the scale and the urgency of the challenges in these sectors.[8] At the same time, efforts have been made to explore the greater stimulation of innovation through the creation of market pull through advanced market commitments (as in the case of pneumococcal vaccine) or through incentive prizes.

The graphic in Appendix I indicates that much of the international effort in technology facilitation is focused on the downstream parts of the technology cycle and there is relatively-less focus on technology development and adaptation. The balance in attention, resources, and capabilities across various stages of the technology cycle is therefore central to its full success.

A vast disparity between investments in innovation (using R&D investment/capita or R&D investments/GDP as a proxy) exists across countries,

[7] These can range from development of technologies related to drugs and vaccines for neglected diseases, or the development of markets for these technologies, to deployment of technologies for renewable energy through feed-in tariffs, to give a few examples.

[8] For example, a recent report by the International Food Policy Research Institute (Beintema et al., 2012) indicates that while agricultural R&D expenditures have risen worldwide, investments in smaller and poorer countries have often fallen and are also more volatile. Furthermore, despite a rise in the CGIAR's expenditures, its share in global agriculture R&D has dropped. The IEA's Energy Technology Perspectives (2014) states that "although absolute spending on energy related RD&D has increased, the share of energy RD&D is not keeping pace with the level of ambition needed to meet long term economic, security and climate goals," a sentiment shared by the American Energy Innovation Council's recent report (AEIC 2015). And a recent WHO report notes that "current incentive systems fail to generate enough research and development, in either the private or public sectors, to address the health-care needs of developing countries" (WHO 2014); the Lancet Commission on Investing in Health, in fact, calls for a doubling of health R&D.

with many developing countries investing far less than industrialized countries. This has implications for the technological capabilities in these countries, which are essential to meeting most of the SDGs. This suggests that **different, tailored national and development cooperation policies and strategies may be required to support different countries in the development and use of technologies needed to meet the objectives of a post-2015 development agenda**. This includes efforts to strengthen their capabilities to engage in such innovation.

2. *The organization of innovation (i.e., Is innovation organized in a way that it yields expected results efficiently and speedily?)*: The ways in which actors, resources, and capabilities are marshaled greatly determine innovation outcomes. The traditional roles of various development cooperation actors that are involved in innovation – governments, academic/research labs, firms, etc. – have evolved and sometimes even been upended. Thus:

    - Academic researchers are more and more directly involved in bringing their technologies to market;[9]
    - Firms and other organizations are sourcing innovations from outside their own boundaries;[10]
    - Internationalization of R&D[11] and production is increasing; and
    - Large private firms are increasingly involved in activities aimed at helping the poor.[12]

    There also have been efforts targeted specifically at creating new organizational forms that aim to facilitate innovation either in specific stages of the technology cycle, or across the cycle.[13] Some governments have even created agencies at the national level to promote innovation.[14]

3. *Achieving desirable developmental outcomes (i.e., Are innovation outputs, such as new technologies, being used to achieving real-world impact?)*: The existence of a promising technology or even its commercial introduction does not guarantee large-scale uptake. There are many examples of technologies that did not manage to live up to their transformative potential because of the difficulty in scaling up their diffusion. This can be due to challenges with the management and sustainability of these technologies, limited acceptability, and the complexities of large-scale diffusion.[15] Thus their impact remained limited. In other cases, technologies that seem to result in desirable outcomes under laboratory or controlled conditions may sometimes yield only limited benefits for sustainable development.[16] Thus the ultimate focus of efforts has to be on ensuring real-world impact, rather than on making new technologies available. Issues such as affordability and large-scale diffusion approaches become key.

4. *Capacity development (i.e., Are we building the innovation capacity in developing countries to help meet global development goals?)*: Development of capabilities to support and manage technological change is difficult under the best of conditions, which is why there are only few examples of successful technology-led economic "catching-up" (the East Asian tigers being striking counter-examples). In the case of sustainable development technologies, the lack of markets adds another layer of complexity to the innovation process and hence to the development of capabilities to support this process. In addition to technical, financial, and policy capabilities, the capacities to develop priorities among choices to meet development imperatives, strategically guide the process of technological change and the addressing gaps in the technology cycle, and coordinate the overall process of technology development/adaption and deployment also take on great salience.[17] In the past, efforts to build such capacity have had limited success for a variety of reasons, not the least of which is the difficulty in building such capacity. But the lack of major programmatic efforts to do so has not helped either.

[9] An interesting example is the Embrace infant warmer that was designed by a group of students in a Design for Extreme affordability course at Stanford and then brought to market through a social enterprise established by them.

[10] See Chesbrough (2003).

[11] See OECD (2008).

[12] Vodafone is a major partner, for example, in m-pesa, a mobile-phone based money transfer service.

[13] Examples include product development partnerships in the health arena (Moran et al. (2010)), the Advanced Research Projects Agency-Energy (ARPA-E) (http://arpa-e.energy.gov/), Climate Innovation Centers (Sagar, Bremner, and Grubb (2009); http://www.infodev.org/climate), and the Climate Technology Center and Network under the UNFCCC (http://www.unep.org/climatechange/ctcn/).

[14] See, for example, http://www.vinnova.se/.

[15] Domestic biogas plants, for example, were seen as a way to help address the rural energy challenge in developing countries. Yet, in many countries, this technology has not diffused or stayed in use (Bond and Templeton 2011).

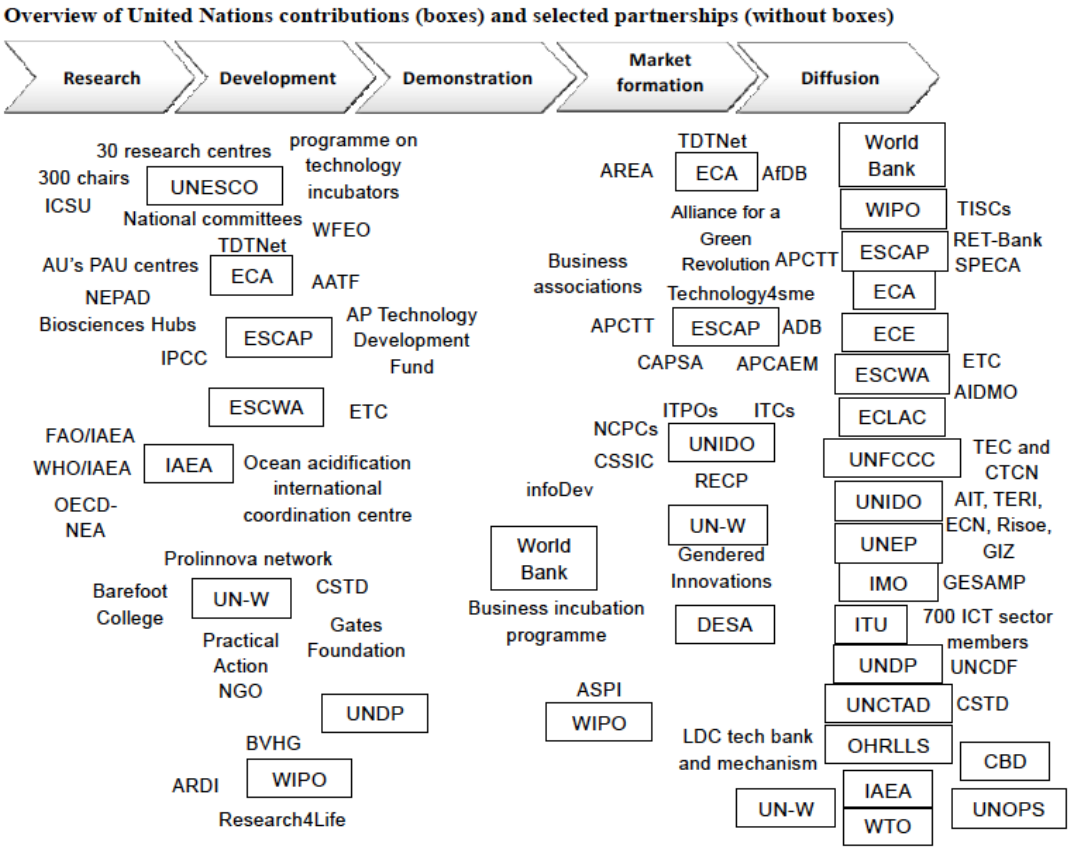
[16] For example, while improved biomass cookstoves do reduce indoor air pollution, the concentrations remain well above WHO indoor air quality guidelines (Rehfuess, et al., 2014).

[17] See, for example, Chaudhary et al. (2012).

The development of the capacities that underpin technological innovation is perhaps the most critical, but also the most difficult issue: technological innovation can underpin progress on all SDGs, but only if national systems of innovation are in place with strong actors (universities, firms, finance providers, government agencies, etc.), institutions (policies, regulations, etc.) and virtuous interactions between them.

Efforts to strengthen technology facilitation and capacity building in the post-2015 setting through development cooperation, then, might be driven by reflections related to these four dimensions. It would be essential to examine how development cooperation can address each of these areas with the tools at its disposal, namely financial and technical support, capacity building, and policy change support (Alonso and Glennie 2015).

Figure 2. An illustrative overview of relevant actors and initiatives (Source: United Nations Resolution A/67/348)



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