Introduction to Innovation Policy for Developing Countries

Module 05

Measuring Innovation: Indicators and Strategies

World Bank Institute

Presentation Script

Measuring Innovation: Indicators and Strategies

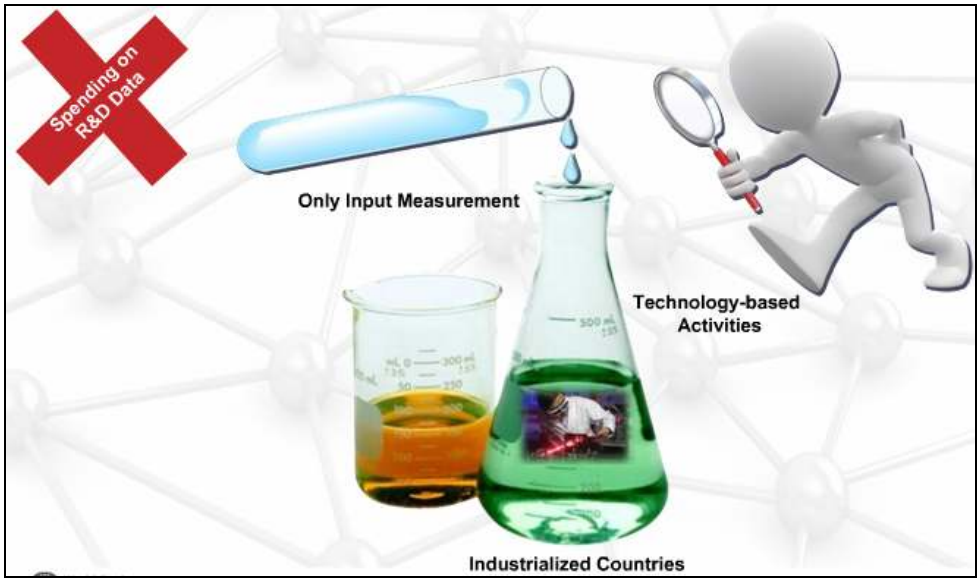
The module has looked at the M&E of projects, policies and programs. We finish our discussion by briefly reviewing some of the most commonly used measures of country and firm-level innovation and associated capabilities.

Measure of Innovation: R&D data

Spending on R&D is the longest-standing area of data collection and measurement in innovation. This is hardly surprising as R&D is a significant input into the innovation process and has enabled good harmonization across countries and detailed sub classifications; but the tendency to rely exclusively on it is open to criticism for a number of reasons.

First, R&D data is limited as an innovation indicator to the extent it measures an input only. As such, it says nothing about the success or outcomes associated with greater R&D intensity. Evidence suggests that money seldom buys results.

Another problem is that R&D is geared to measuring technology-based activities, which cover only a small part of broader innovative activity and applies more to manufacturing than services activity. In other words, R&D indicators are likely to be affected by the industrial mix of countries and less relevant to developing countries which often innovate in low-tech sectors.



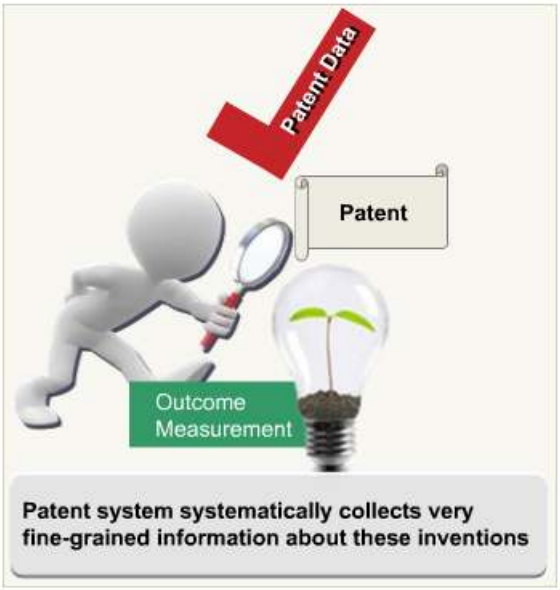
Beyond R&D indicators: Intangible Investments

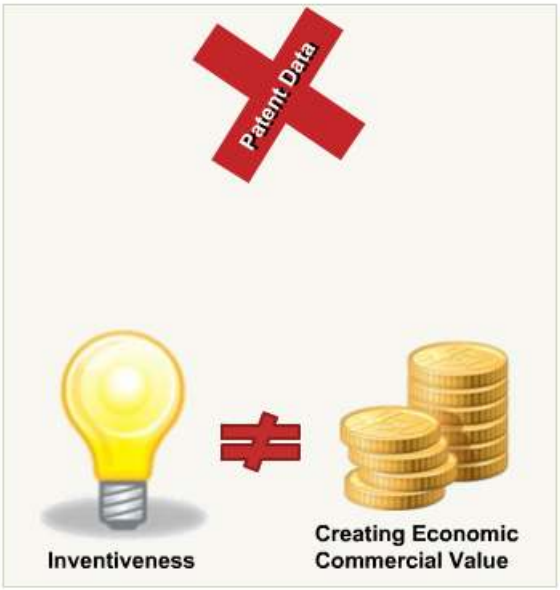
These considerations have led to a growing interest in other forms of innovation related investments, so called intangible investments– not only R&D but also design, organization improvement, training and skills development, software development, market research and advertising.

Measure of Innovation: Patents

Another widely used indicator is patent data. This has a number of distinctive advantages: first, it measures outcomes and patents are granted for inventive technologies with commercial potential. Second, the patent system systematically collects very fine-grained information about these inventions.

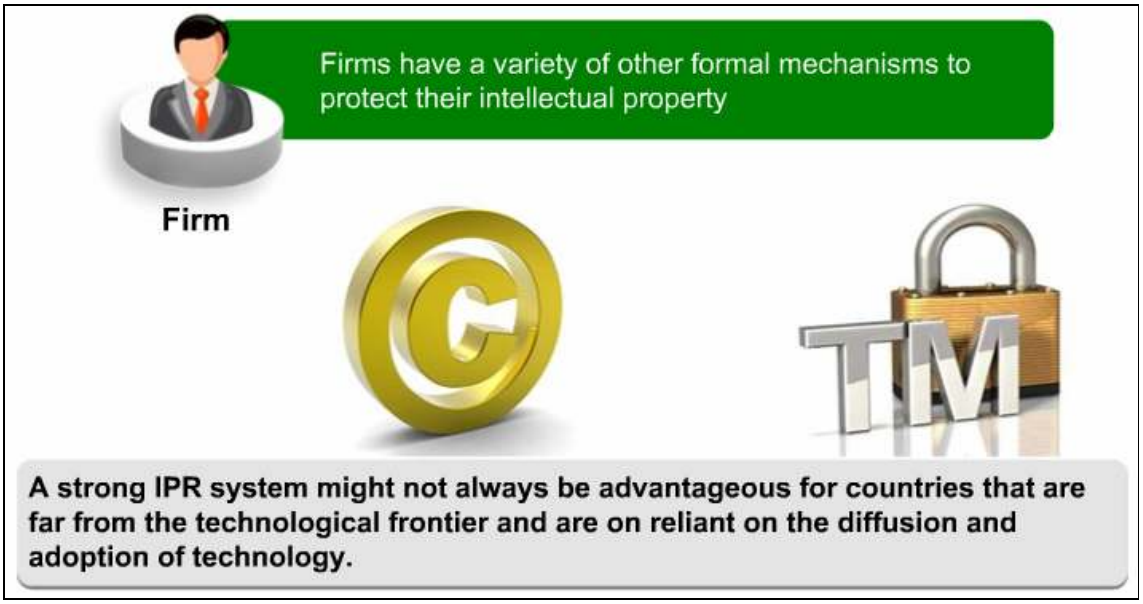
However, patents also have drawbacks, notably the fact that many patents are granted on the basis of inventiveness which is not the same as creating economic or commercial value while they privilege technology-based activities.





Indeed, firms have a variety of other formal mechanisms to protect their intellectual property – such as trademarks and copyright which are arguably a better measure of creativity and innovation in service-based industries.

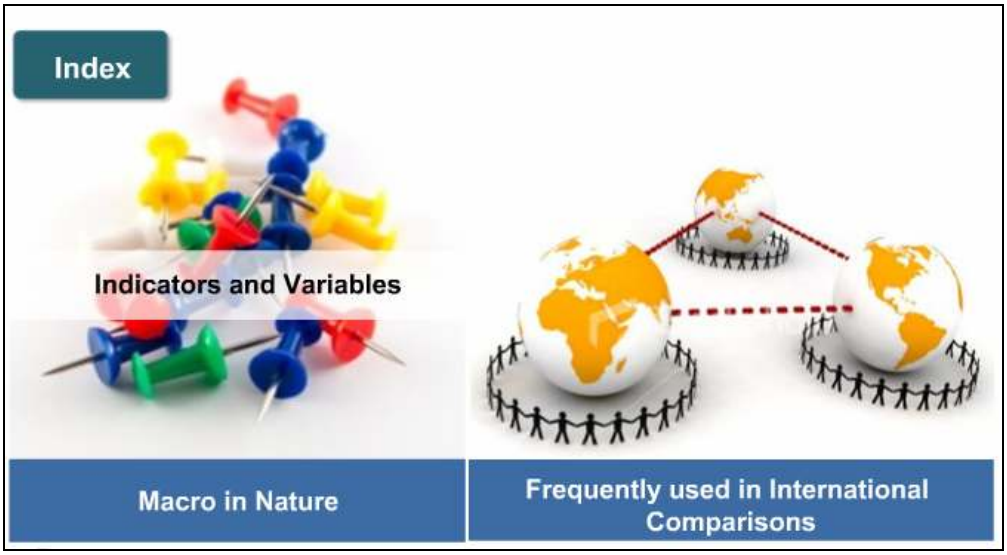
Finally, it will be recalled from module 3 that having a strong IPR system might not always be advantageous for countries that are far from the technological frontier and are on reliant on the diffusion and adoption of technology.



The Promise and Perils of Indices

Recognition that innovation is comprised of multiple activities has led to the emerging and pioneering field of indices.

Indexes bring together a number of different indicators and variables. Unlike innovation surveys, indexes are more macro in nature and are frequently used in international comparisons.



Notable indexes include the World Bank Knowledge Index, the UNCTAD Innovation Capability Index, the UNDP Technology Achievement Index, the Arco Technology Index, RAND Science and Technology Capacity Index, the European Innovation Scoreboard Summary Innovation Index, the World Economic Forum Global Competitive Index, the World Business and INSEAD Global Innovation Index and the NESTA Innovation Index.

Indexes

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Each index varies in terms of the emphasis put on inputs and outputs, the role of framework conditions and the wider economic environment and the importance of the diffusion of technology.

Index

Differs by

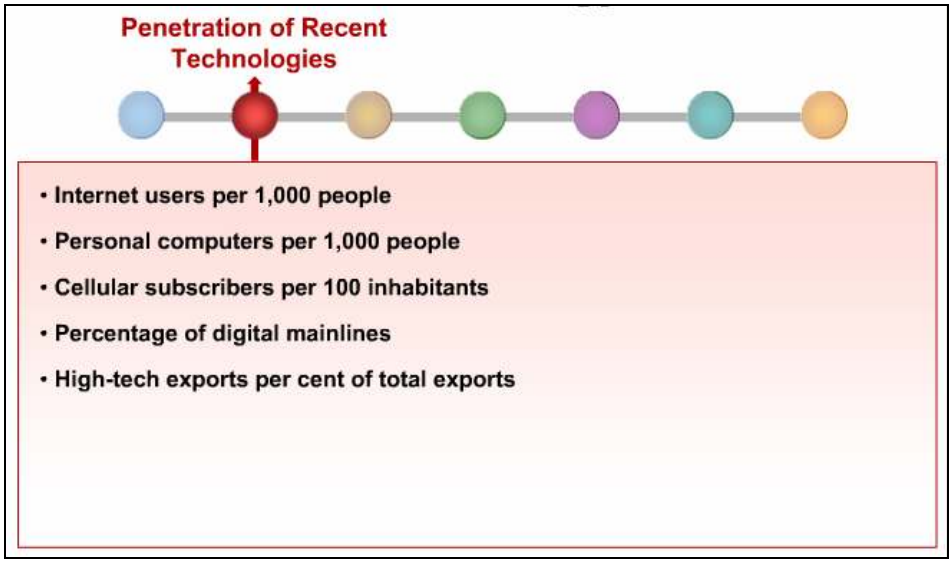
- Inputs and outputs
- Framework conditions
- Economic environment
- Diffusion of technology

Indicator Mix of Technology Indices

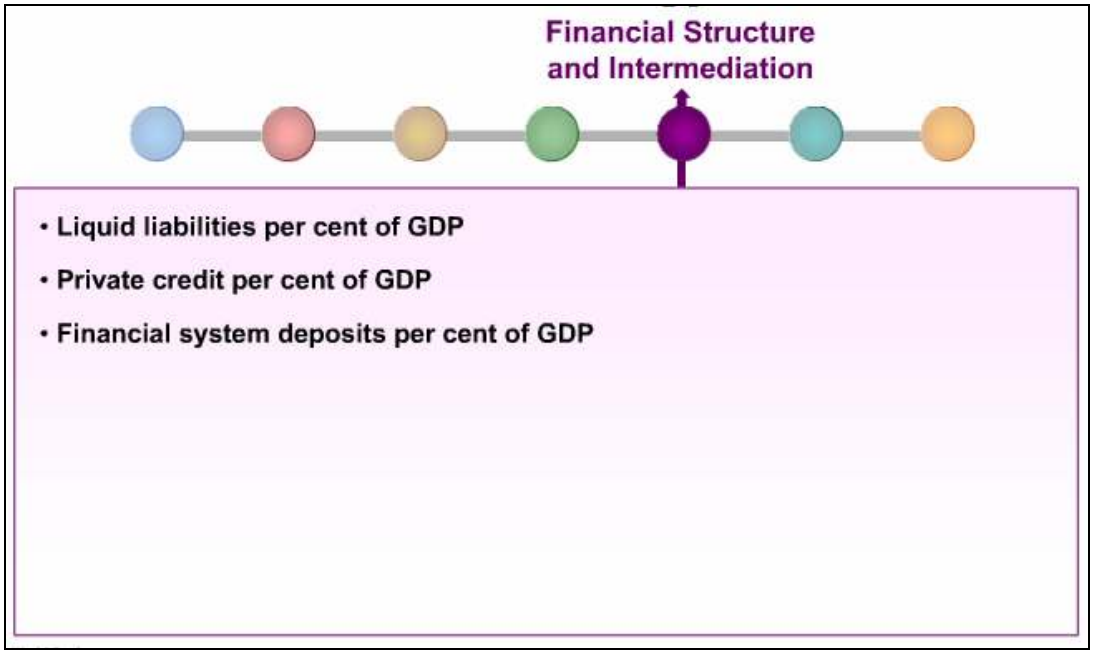
Notwithstanding important differences, prominent technology indices for developing countries draw on indicators that go beyond scientific innovation and invention such as patents granted, R&D intensity and publication of scientific and technical journal articles.

These include:

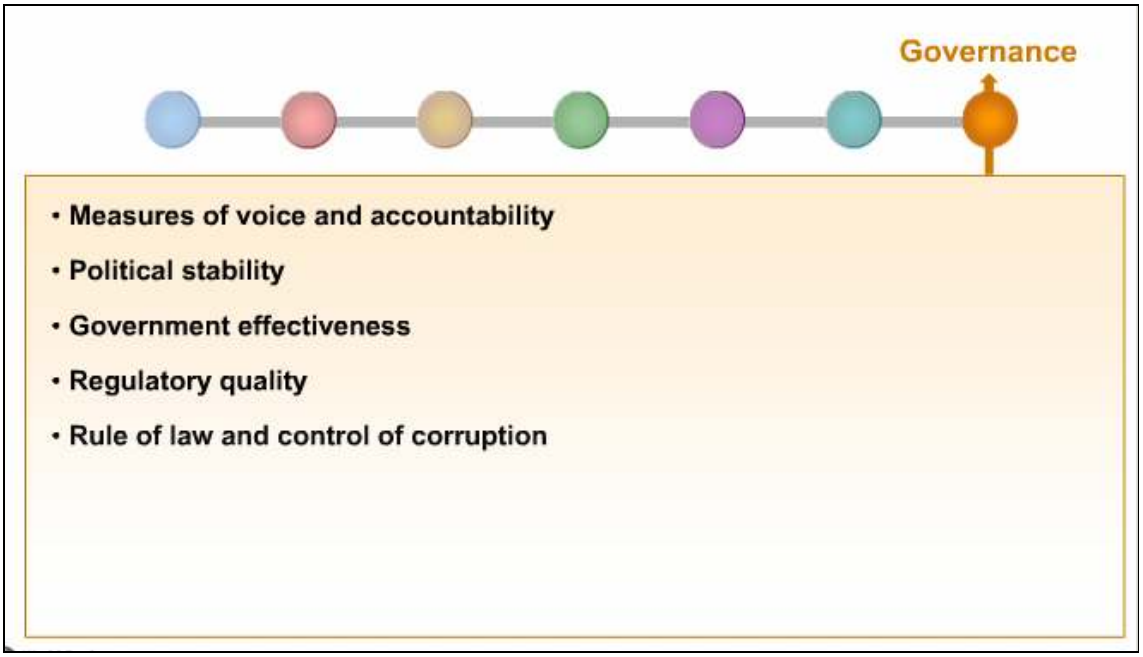
- **Penetration of older technologies** such as electrical power consumption kilowatt-hours; international outgoing telephone traffic per cent of GDP per 1,000 people; main lines per 100 inhabitants; air transport, registered carrier departures worldwide per cent of GDP per 1,000 people; agricultural machinery such as tractors per 100 hectares of arable land; exports of manufactures per cent of merchandise exports and medium-tech exports per cent of total exports.
- **Penetration of recent technologies** such as internet users per 1,000 people; personal computers per 1,000 people; cellular subscribers per 100 inhabitants; percentage of digital mainlines, high-tech exports per cent of total exports.



- **Exposure to external technology** such as FDI net inflows percentage of GDP; royalties and license fee payments per cent of GDP; imports of high-tech goods per cent of GDP; imports of capital goods per cent of GDP and imports of intermediary goods per cent of GDP.
- **Macroeconomic environment** such as the general government balance as percentage of GDP; the annual CPI inflation rate and real exchange rate volatilty.
- **Financial structure and intermediation** such as liquid liabilities per cent of GDP; private credit per cent of GDP and financial system deposits per cent of GDP.



- **Human capital** such as primary educational attainment per cent of population, secondary educational attainment per cent of population aged 15 and over and tertiary educational attainment per cent of population aged 15 and over.
- **Governance** such as measures of voice and accountability, political stability, government effectiveness, regulatory quality, rule of law and control of corruption.



Challenges of Index Selection

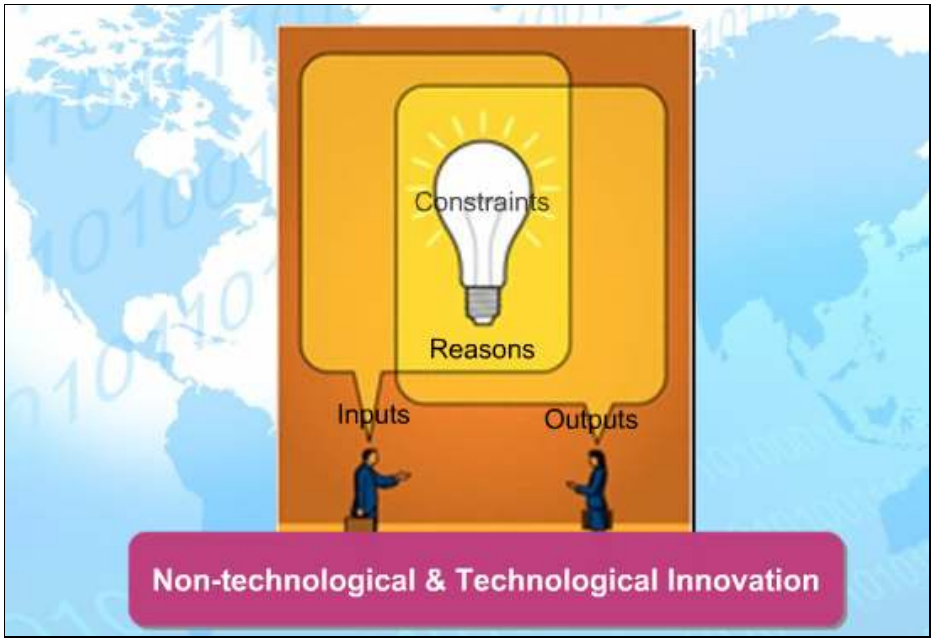
Indexes rely on aggregation procedures, meaning that results can be quite sensitive to which variables are selected and included and how they are weighted. No clear theoretical model can tell us which indicators to select, how to weight them and how to handle cross-country differences in the availability of data.

Notwithstanding these concerns, comparisons of different indexes reveal that rankings cannot be completely overturned or manipulated to produce any desired result. The countries in top positions always tend to be in a good position regardless of the index used, though there is greater variation the further one moves down the ranking – an observation that has implications for developing countries which typically rank lower down on scoreboards.

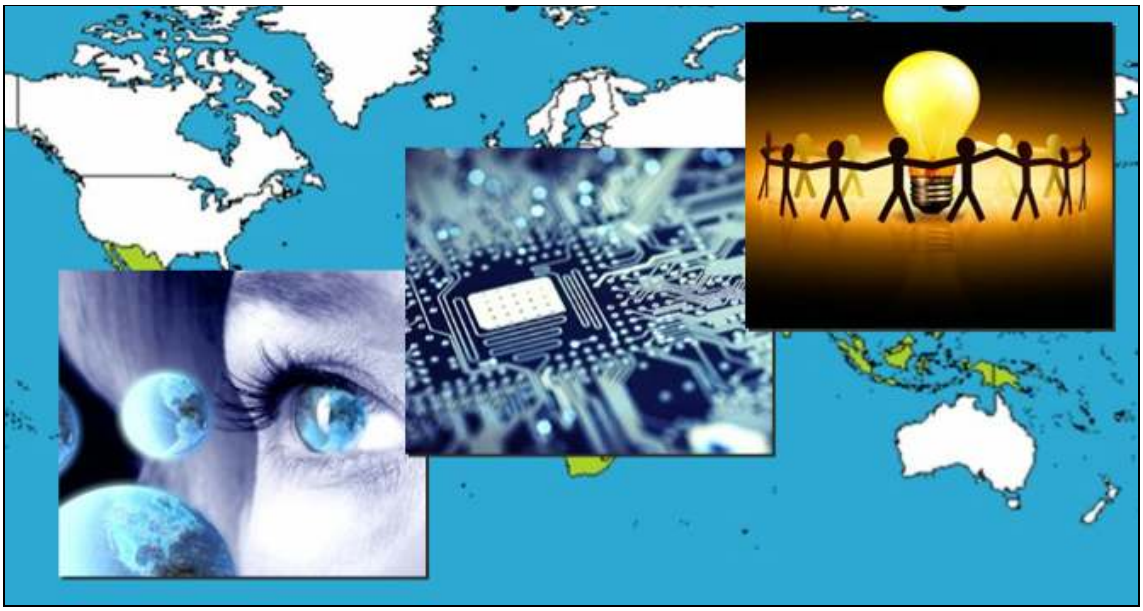
Another interesting finding is that there does not appear to be a major difference in ranking between narrower indexes and broader ones. Broader indexes capture wider institutional conditions, suggesting that innovation and strong economy go hand in hand.

Innovation Surveys: Use and Design

Innovation surveys are another means to collect information about innovation inputs and outputs. They go beyond S&T statistics by also collecting information on non-technological innovation, the reasons for innovating as well as the barriers and constraints to innovation.



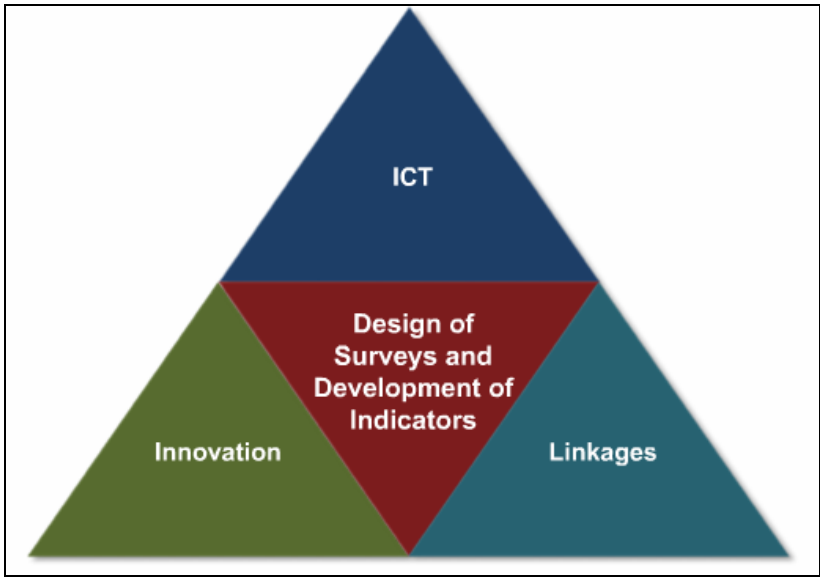
The Oslo Manual provides a framework to ensure that innovation surveys are comparable and rigorous – the European Community Innovation Survey (CIS) being the most well known example. There have been some efforts to develop guidelines for the adaptation of innovation surveys to developing countries.



A prominent initiative was the publication of the Bogota Manual by the Ibero-American Network on Science and Technology Indicators –or RICYT. Different measurement priorities in developing countries inform the design of innovation surveys. In particular, there is less emphasis on measuring technical and economic achievements of firms than their effort to build innovation capabilities which are a precondition for success.

Implications for Developing Countries: Survey Design & Development of Indicators for ICT

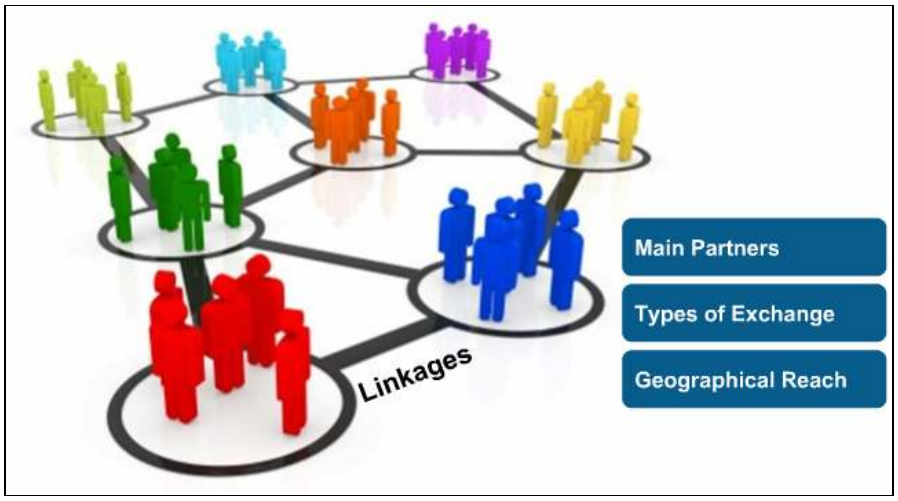
The priority given to measuring capabilities has particular implications for the design of surveys and development of indicators in three areas: ICT, linkages and innovation activities.



First, surveys should focus on ICT. As many firms in developing countries lack even rudimentary ICT and consolidated management systems, surveys should explore the deeper dimensions of ICT implementation, including availability of infrastructure, the purpose of ICT usage (front-office or back-office), the existence of internal ICT management and development capabilities, ICT expenditure and its relationship with wider organizational change.

Implications for Developing Countries: Survey Design & Development of Indicators - Linkages

Another priority area are linkages. Because firms in developing countries benefit greatly from the absorption of knowledge, surveys should measure firm linkages, including the main partners with which firms engage *(*universities, technical and vocational training institutions, technological centres, test labs, suppliers, clients, head office, enterprises belonging to the same group, other firms, consultants, R&D firms, public S&T agencies), the types of exchange undertaken (open information sources, acquisition of knowledge and technology, and innovation co-operation as well as access to financing and to commercial information) and the geographical reach of the exchanges (local, regional, national and international).



Implications for Developing Countries: Survey Design & Development of Indicators – Innovation Activities

Surveys and indicators should also pay greater attention to the specific innovation activities carried out by firms in developing countries.

Reflecting the importance of technological diffusion, activities that count as innovation should be broadened to include the acquisition of technology, including not only the purchase of hardware and software but also the lease or rental of machinery, equipment and other capital goods. At the same time, greater emphasis should be placed on investments made in industrial design and engineering activities, including reverse engineering.