

Understanding innovation for effective science, technology and innovation (STI) policy making: Some basic conceptual and practical issues

Bitrina Diyamett

**Science, Technology and Innovation Policy
Research Organization (STIPRO)**

Outline of the Presentation

- Background
 - Why is innovation crucial and how it normally happen .
- The meaning and characteristics of innovation
- Relationship between science, technology and innovation (STI).
- Innovation and successful industrialization
- Current state of the Manufacturing Sector in Tanzania.
- Promoting innovation through policy.

Background cont..



- Innovation – especially technological - has long been accepted as being central to social and economic development of countries.
 - Innovation enables the productive sectors to produce more quality products with less; and therefore contribute to GDP growth and incomes of individuals through employment generation; especially if this concerns sectors that are rich in employment such as the manufacturing.
 - According to Ahlstrom 2010, a vibrant, innovative and inclusive private sector is more important for the wellbeing of a nation than any foreign aid and welfare redistribution programs.

Background cont..



- However in the current free market economy, innovation is not only important, but indispensable
 - Competition in both the domestic and export markets.
- Other countries' firms who are innovative and therefore producing higher quality goods at lower costs, can dominate a country's domestic market (we have witnessed this for Tanzania, processed food, clothing, drugs and other health care products).
- Of course innovation – especially for poor countries – is not the only thing at play when it comes to competitiveness – there is whole issue of corruption and poor infrastructure.

Background Cont..



- Fortunately the two are seriously being addressed by the current administration; it is important to seriously focus on innovation if we are to achieve agenda 2025.
- In more developed countries, innovation in the private sector is to a large extent enabled through clear cut market mechanisms;
- But for poor countries such as Tanzania, where markets are weak, intervention by the government through policies is absolutely necessary to build innovation capabilities.
- **But effective policies require understanding of some basic issues on innovation.**

The meaning and characteristics of Innovation



- The essence of innovation is novelty.
- It can both be in the process of introducing something new and useful, and the new thing itself.
- It is a concept of very general use – not only limited to technology and economics, but also non technological things such as the new educational curriculum, new social system, etc.
- Innovation in economic context is defined as marketing of new or improved products and widespread use of new or improved processes.
- **Terminological distinction between innovation and invention:** While invention refers to creation of something new, innovation is actual putting of the new thing into the market place or any socially and economically beneficial use

The meaning and characteristics of Innovation Cont..



- Innovation is systemic in nature, and an entrepreneur cannot innovate alone.
- he/she needs other actors in what is termed as a system of innovation, whether at the national or sectoral levels such as the manufacturing sector.
- The important actors in the innovation process are normally the producers themselves (firms and farms, who are at the center of innovation), their suppliers, their buyers, their competitors, policy organizations, and research organizations (Nelson, et al., 1993, Lundval, 1992, Edquist 1997).
- Innovation is context specific (what works in one country, does not necessarily work in another)

Relationships between science, technology and innovation (STI)



- We have so far spoken about innovation only, but a major reference, e.g. in policies are the science, technology and innovation (STI) concept.
- This concept has in most cases wrongly been used as one thing, rather than interrelated, but individual aspects of science, technology and innovation, with tremendous negative policy implications.
- The individual component of STI resides in two major different organizations: while science takes place in the institutions of higher learning and public research organizations, innovation takes place in the productive sectors, with technology trading somewhere between the two organizations.

Relationships between science, technology and innovation (STI) cont..



- Research organizations designs new technologies as the results of their research outputs and the productive sector use both new and old technologies.
- Unfortunately, with practical policy issues such as capacity building and funding of STI, the focus has to a large extent been on Universities and R&D organizations, neglecting the productive sector where innovation resides.
- But what is important – with direct impacts – on the lives of the people is innovation, and not science and static technology.

Relationships between science, technology and innovation (STI) Cont..



- This notwithstanding, however, technology is primary, and it has always been there even before formal scientific methods.
- technology is one of the means through which mankind reproduces and expands its living conditions.
- It is the making, usage, and knowledge of tools, machines, techniques, crafts and systems human kind uses to solve life's problems and/ or acquire their needs.
- Technology is not static, it has been improving over time – people have been innovative since time in memorial.

Relationships between science, technology and innovation (STI) Cont..



- However, as technology grew in sophistication, it required formal scientific discoveries for its improvement – and science and technology became much closer.
- Here is when the use of science comes in: it helps in discoveries that improves existing technology and in designing new ones.
- However, for such new technologies to be useful, they have to be put into social and economic use, which is innovation – as defined above.

Relationships between science, technology and innovation (STI) Cont..



- Summing up, the role of science is in the improvement of existing technologies (incremental innovation) and coming up with new ones which must be put in social and economic use, to be innovation – completely new innovation.
- The higher the technology, the more it requires science for its improvement or design of a new one.
 - it is the reason those nations that are producing high tech products such as the aerospace , micro electronics and biotechnology, invest more in R&D.

Relationships between science, technology and innovation (STI) Cont..



- Innovation in low tech sectors does not require a lot of science; can be improved only through interaction with other actors in the systems of innovation, especially the users.
- Historically, incremental innovation was achieved only through tinkering; where research (science) was used, it was to assist in this tinkering – example of Japan is instructive here.
- Japan's R&D during the catching up period (1945-1972) was focused on adaptation of imported foreign technologies rather than on generating new ones.

Relationships between science, technology and innovation (STI) Cont..



- As Japan built her innovation capabilities this way, increasingly they were able to come up with new innovations that are R&D intensive.
- This means a better connection between science and technology is achieved by building innovation capabilities of the productive sector, largely through other means, gradually moving up the innovation capability ladder towards science intensive innovations.
- However, this does not mean that general scientific competence is not important for countries at the lower end of technology. To the contrary, investments in science is absolutely necessary – but has to be done strategically.

The role of innovation in successful industrialization



- Process of industrialization is a bout value addition and production of competitive goods – it is about manufacturing; it is diversifying the industrial base and moving into sophistication.
- Given the free market and competitive business environment, there is no any other alternative to successful industrialization, but to build local innovation capabilities.
 - “no amount of savings and investment, no policy of macroeconomic fine-tuning, no set of tax and spending incentives can generate sustained economic growth unless it is accompanied by the countless large and small discoveries that are required to create more value from a fixed set of natural resources (Romer, P. (1986).

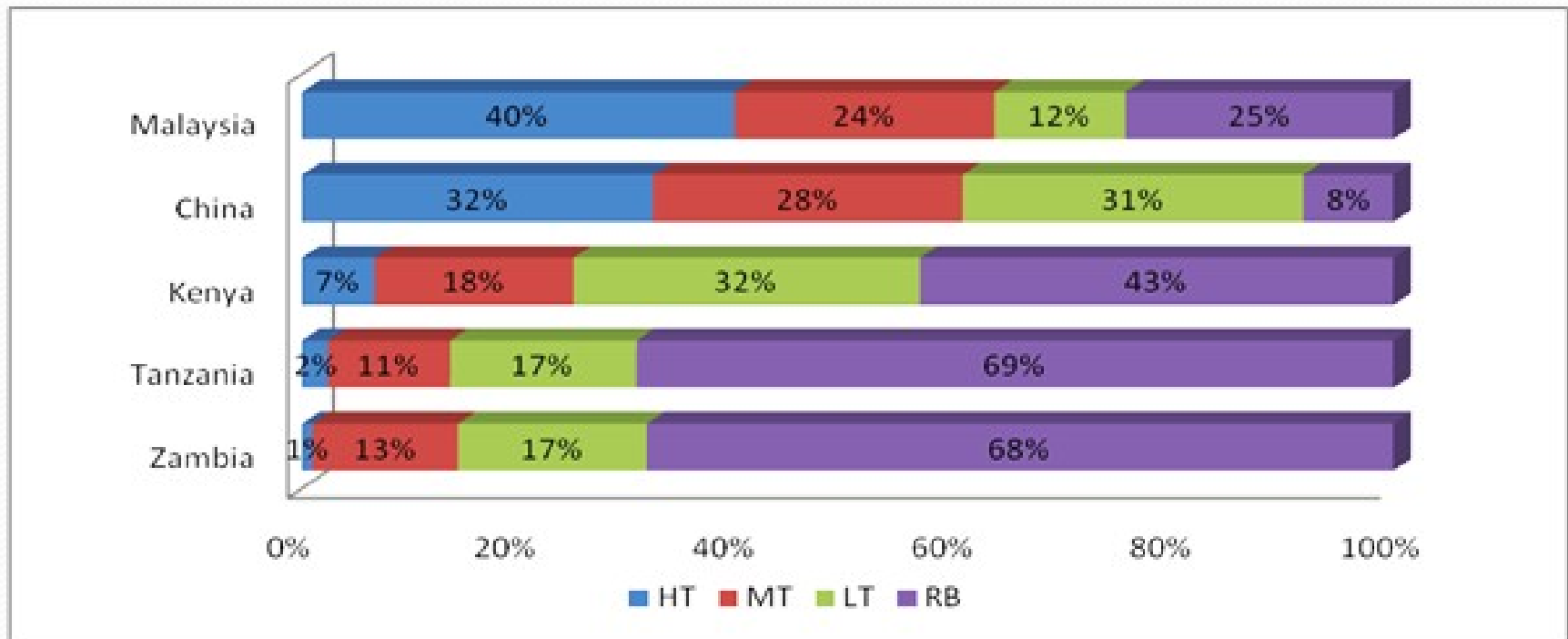
Current state of the Manufacturing Sector in Tanzania



- Contribution to GDP averaged 8% in the past decade – with up and downs (Mordo intelligence, 2017): was as low as 5.4% in 2014
- While for Tanzania to achieve a semi-industrialized status by 2025, it requires a contribution of about **40% (at least between 20% and 40%)**
 - The sector is currently very small in size, and largely low tech and resource based, with very low value addition.
 - Innovation largely adoption of old technologies and small modifications (NEPAD, STIPRO) – driven by routine activities rather than proactive endeavour for innovation (**living aside some recent initiatives in ICT soft ware**)
 - The below picture compares Tz manufacturing sector with selected countries:

State of the Manufacturing Sector in Tanzania cont..

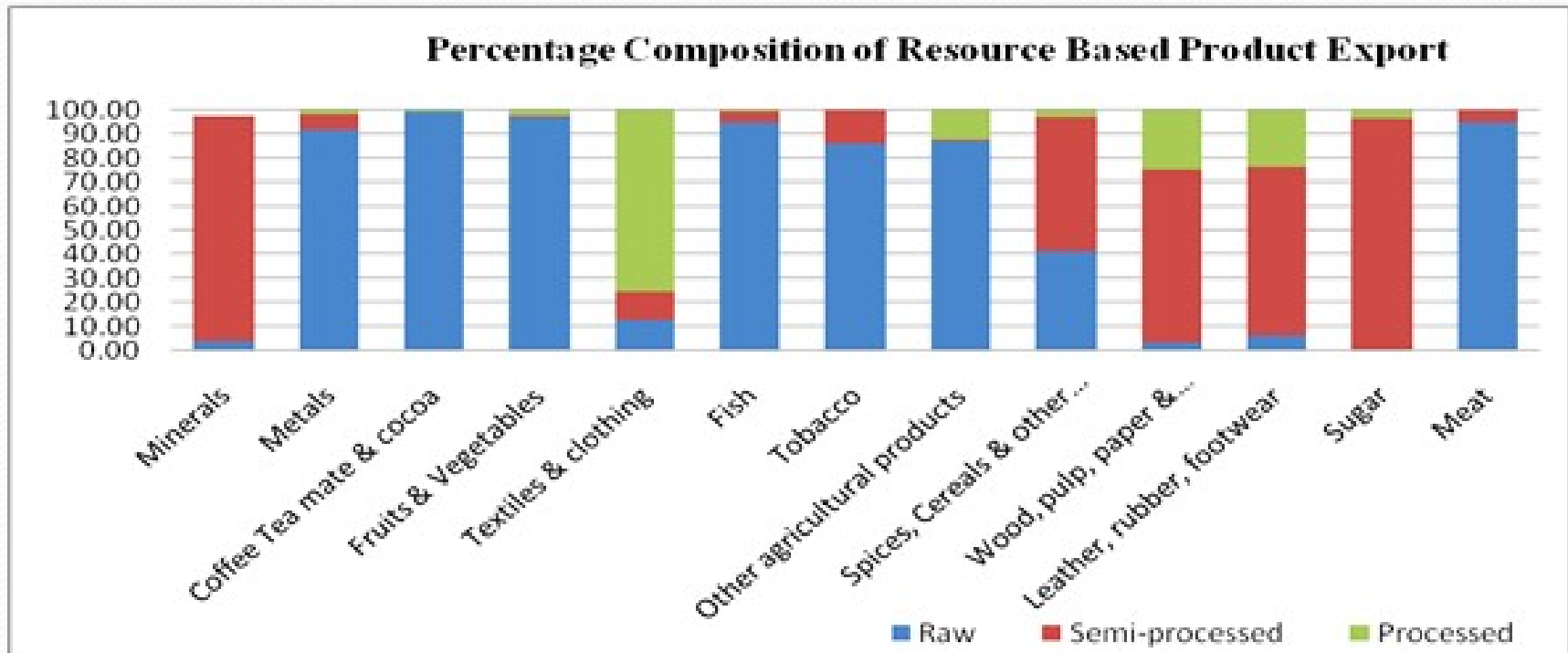
Figure : Structure of Manufactured Exports by Technology Classification (Tanzania competitiveness report, UNIDO, 2012)



State of the Manufacturing Sector in Tanzania cont..



Fig: Processing Degree of Resource-Based Exports (Tanzania competitiveness report, UNIDO,2012)



Current state of the Manufacturing Sector in Tanzania cont..

- Given the current status, Tanzania needs to do three major things in the process of industrialization:
 - To expand its low tech sector (invest more in value addition for natural resources).
 - To move up the innovation capability ladder
 - To diversify the manufacturing sector (currently very limited to few sub-sectors)
- All of the above require innovation: since this cannot happen through clear cut market mechanisms, good innovation policy is indispensable if Tanzania is to realize semi-industrialized status by 2025/ or any other time.

Promoting innovation through policy



- Policy is a cause of action taken by the government to address a certain problem in society.
- it is a deliberate system of principles to guide decisions and achieve rational outcome.
- For innovation, we can say it is a cause of actions to remove obstacles to innovation.
- Policies are implemented through policy instruments targeted at inducing the desired change (or to avoid undesired change), which is believed to stimulate innovation.

Promoting innovation through policy Cont..

- However to decide on a right instrument, one has to understand the causes of the problems.
- For instance to address problems of weak linkage between the university (researchers and scientists) and industry, one has to first know the reason for such weak linkage.
 - It can either be because the industrialists are not aware of research outputs and vice versa, or there is inadequate finance for innovation.
- The two reasons require different policy instruments to address the same problem of weak linkage.

Promoting innovation through policy Cont..



- Here comes the importance of evidence for policy and the role of policy researchers such as STIPRO
- Following are three types of policy instruments that different countries are using to facilitate innovation (Borras & Edquist, 2013:

1. *Regulatory instruments*

- These can be various, but one example is when patent and university laws are changed in order to allow public universities to own patents and to create the necessary organizational arrangements to stimulate its commercialization.
- Example is the Bayh-Dole Act of the US

Promoting innovation through policy: regulatory instruments Cont..

- Remember that regulation can effect innovation in a more indirect way; for instance an environmental regulation forbids a specific polluting chemical substance, or forces a reduction in industrial waste.
- This induces product innovations or process innovations, because the regulation forces firms to find alternative solutions.
- Here care needs to be taken because regulation can at times be counterproductive by stifling innovation rather than promoting it.

Promoting innovation through policy Cont..

2. *Financial incentives instruments*

- One of the most widely used financial instruments is public support to research organizations, primarily public universities and public research organizations
 - Which are the supply side of the innovation policy instruments
- Others – on the demand side - even more important, but rarely used, are: tax incentives for R&D performed at firm level; tax incentives for retraining of the work force; innovation grants, subsidies; financial support for joint R&D between firms and universities/R&D organizations.

Promoting innovation through policy Cont..

3. *Soft innovation policy instruments*

- These are voluntary and non-coercive
- They are not subjected to obligatory measures, sanctions or direct incentives or disincentives by the government or its public agencies.
- The focus is dissemination of information that can voluntarily be used by the innovators. Examples are:
 - Dissemination of information about a certain research outcome that is important for innovators.
 - Dissemination of information about certain standards that are not obligatory – both national and international

Promoting innovation through policy Cont..

- Because innovation is systemic, these instruments needs to be used in mixes (Borras & Edquist,2013).
- Preferably instruments from the supply side have to be used with instruments from the demand side.
- As we provide funds for research and train scientists, we should also directly support current innovators.

Asanteni kwa kunisikiliza
Zaidi kuhusu haya, tembelea:
www.stipro.or.tz