ESCWA Technology Centre

Egypt's National Innovation System: A Vision for the Way Forward with Emphasis on Technology Transfer

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Objective

- To establish a new vision/mission of Universities and Research Institutes In Egypt
- In this new paradigm, Universities are not mere educational and research institutes, they are principally Knowledge centers with the mission of :
  - Developing localizing, developing and disseminating knowledge and know how with objective of creating economic and developmental value
- In this new paradigm, universities are at the core of the national innovation system which is the driving engine of the nation's development and economic growth.

Agenda

- Scope and methodology of study
- Measuring economic growth and development
  - Development indices
- Innovation and innovation systems
- Sources of knowledge, know-how and technology
- Technology Transfer
  - US technology transfer history : case study
- Where does Egypt stand on innovation
  - Status of Egypt's innovation system and policies
- The way forward
- Summary

Scope of Study

- This study is part of a group of studies sponsored by ESCWA in 5 Arab countries with ASRT as key stakeholder and sponsor from Egypt

- Objective of the study is to analyze policies for TT and innovation in Egypt compared to regional and international norms and propose updated updated policies with an objective to enhance the effectiveness of Egypt's NIS

- An upcoming study will propose a legislative framework to implement the proposed policies via laws, regulations or institutional policies .

Methodology

The study followed the following approach

- Data gathering
  - Existing previous studies related to innovation
  - National and international reports on innovation, human development, education, scientific research, ICT
  - National and institutional policies, strategies and roadmaps
  - Related laws and legislations
  - Discussion and interviews with key people in stakeholder bodies and institutions
  - International literature (papers, books)
  - Discussions and interviews with US chief innovation strategy architect
  - Personal experience
- Study and compilation of existing indices and analysis of Egypt's position relative to peer and developed nations
- Identification of gaps & weak points in Egypt's NIS and policy
- Workshop to present outcome and recommendations

Measuring Economic Growth & Development

Why not just use GDP and GDPpc ?!

- GDP and GDPpc are just measures of the health of the economy and not the welfare of the country and its ability for sustainable development

- Sustainable development has three dimensions;
  - Economic growth
  - Social welfare and development
  - Environmental preservation

- We need some sort of a balanced score card for measuring nations' performance in terms of sustainable development

Measuring Economic Growth & Development

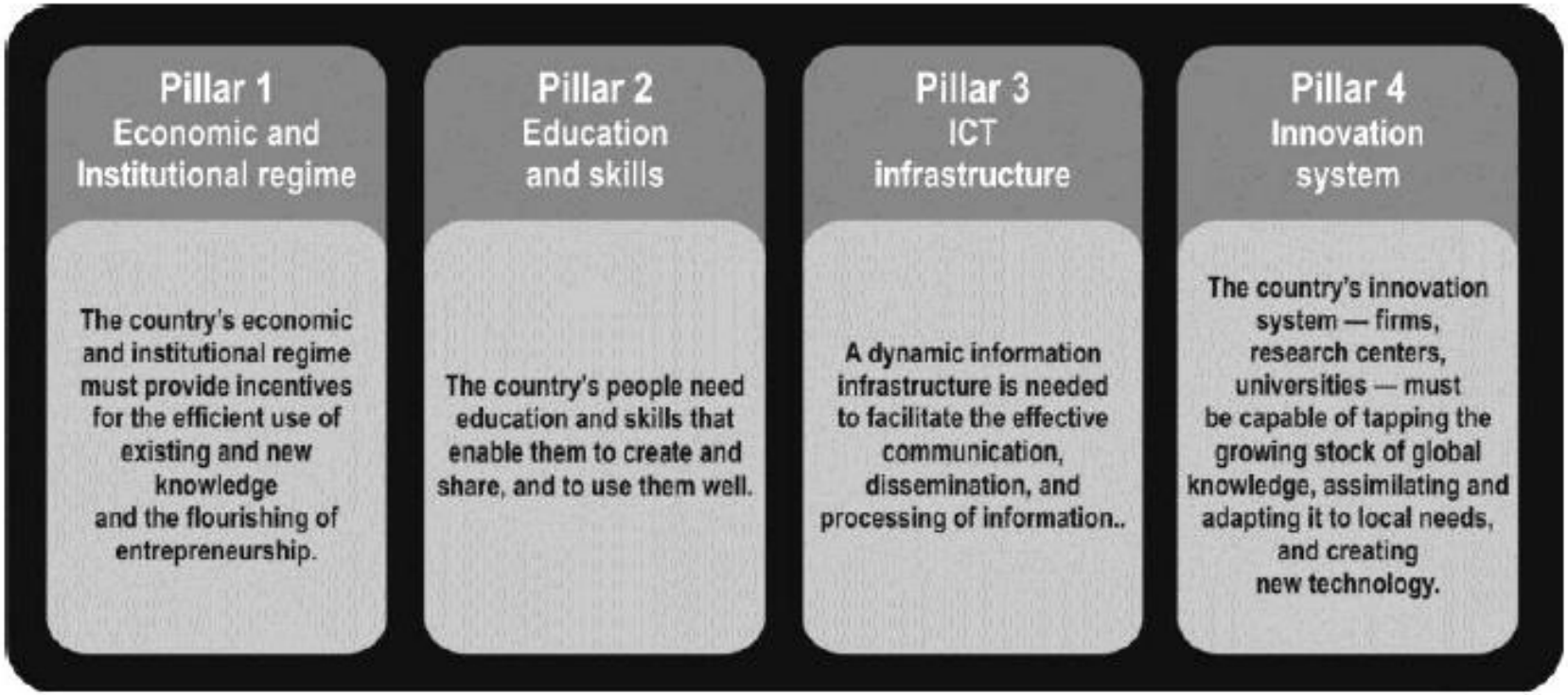
Three Major Indices

- Global Competitiveness Index
  - World Economic Forum
- Knowledge Economy Index
  - World Bank
- Global Innovation Index
  - United Nations – WIPO

Global Competitiveness Index (GCI)

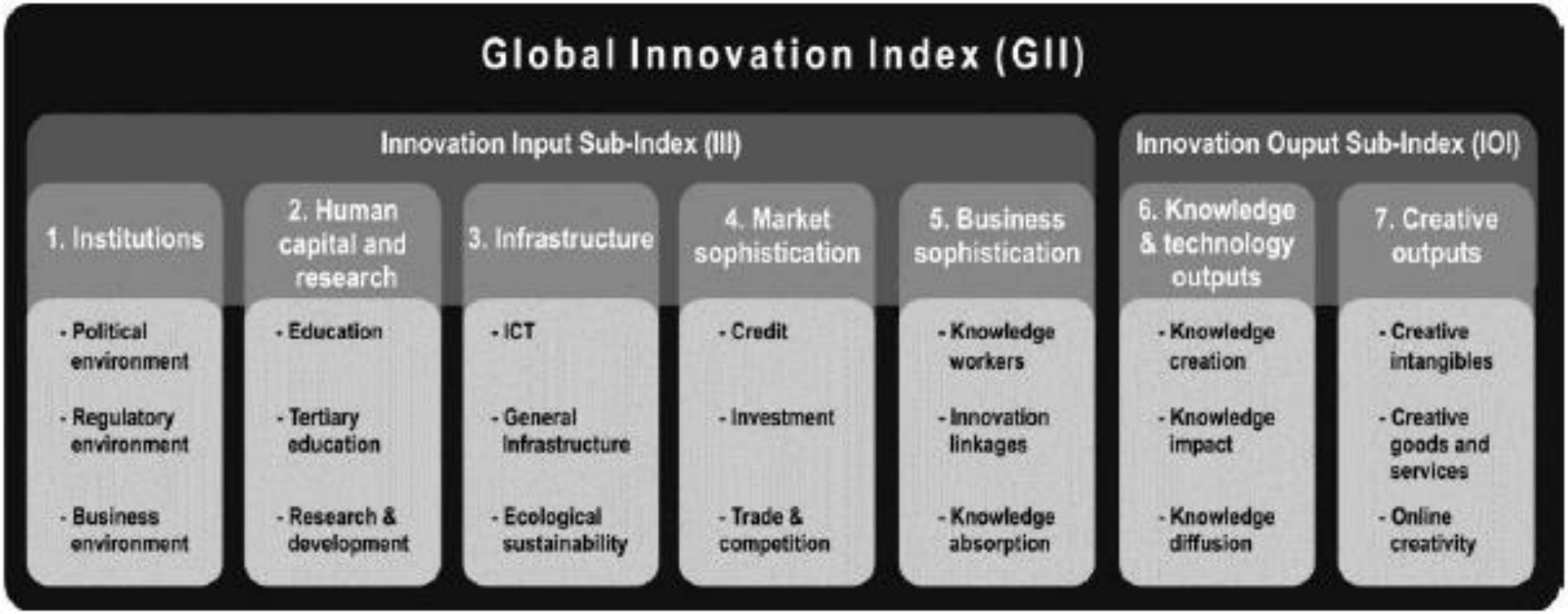
- Relatively complex – based on 12 pillars
- Mainly deals with the economy
  - Measures ability to produce and market goods on foreign markets
- Notion of competitiveness is more suited for companies rather than nations

Knowledge Economy Index (KEI)



- Based on 4 pillars
- Measures country's readiness to develop knowledge economy
- More suitable than GCI since KE drives sustainable economic growth

Global Innovation Index (GII)



- Measures ability of a nation to build a knowledge society through the transformation of knowledge and know-how into developmental value
- It is mapped onto a formal innovation system that does the job !
- Measures input and output sub-indices and system efficiency

What is Innovation and why is it important ?

"Innovation is the ability to access, absorb, develop, diffuse and utilize knowledge and transform it into ***sustained and inclusive developmental value***"

Encompasses economic, social & environmental dimensions

Foundation for knowledge economy and knowledge society

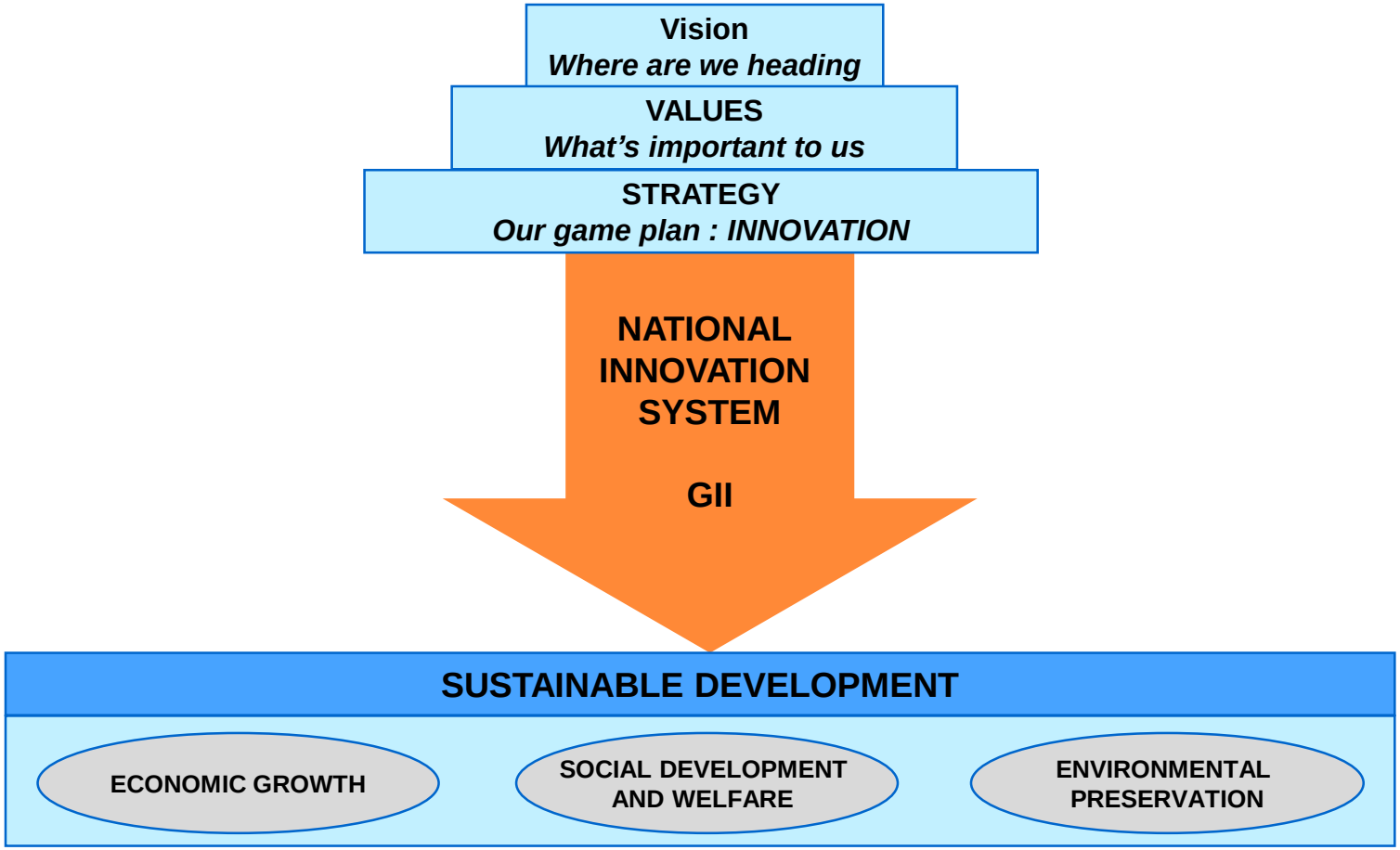
Deals w/ a system with measurable i/p, o/p & performance indices

Main tool to drive achievement of UN SDGs

A Gap Between Strategy and Action

The Balanced Score Card

The Balanced Score Card of Nations !

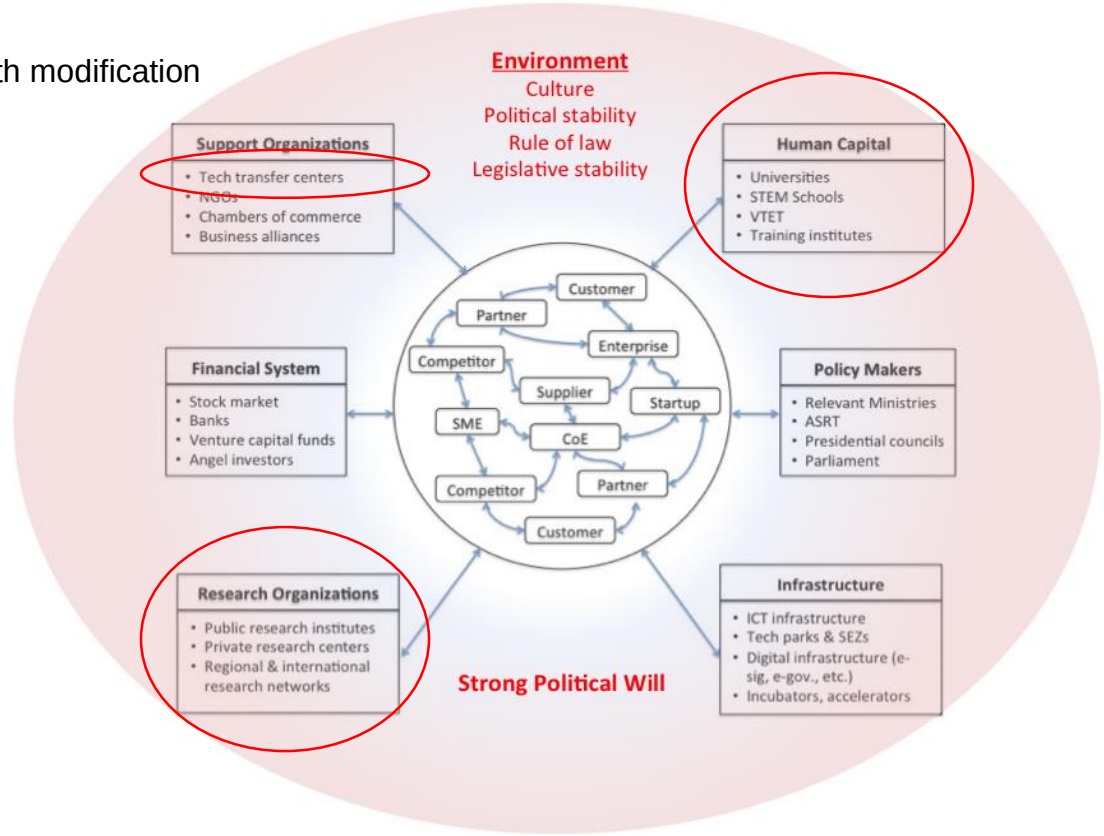


What is an Innovation System ?

An innovation system is a set of interacting organizations from research, academia, and industry charged with the production, communication, storing and utilization of all elements of specialized knowledge required to create economic and developmental value

Conceptual National Innovation System Model

Source: R. Gallo et al, 2010 with modification



- Inner circle is the core of the NIS which transforms knowledge into value
- Connective tissue represents legislation, policies, programs, etc. which drive knowledge diffusion
- Red circles are sources of knowledge, know-how and technology

Sources of Knowledge, Know-How & Technology

- Knowledge, know-how and Technology Transfer (TT)
  - Domestic
  - Foreign
- Human Capital (reservoir of knowledge, know-how, experience)
  - Employment and consultancy ----- Acquiring filled reservoirs !!!
  - Development (education and training) ------ Filling existing reservoirs !!!
- Scientific Research
  - Localize, adapt and improve foreign technologies
  - Develop new technologies, IP and products

Developing TT does not only develop a source of knowledge and know-how but more important it develops the mechanisms of diffusion of such knowledge, know-how and technology which readily affects the efficiency of the NIS

History of Technology Transfer

USA Pioneering Role

- Before 1980
  - Federal government retained ownership of government funded projects
  - Only non-exclusive licenses available to companies
  - ➢ Resultant: Many printed publications ; little conversion into product
  - ➢ In 1980 the government held 28000 patents, fewer than 5% had been licensed

- Bayh-Dole Act, 1980
  - Universities own new discoveries under federal funding and have right to patent
  - University must share revenues with inventors
  - Universities to give licensing preference to small businesses
  - Government retains march-in rights
  - University must report back on progress to funding agency
  - ➢ Resultant: In FY2008 (one year), 648 products introduced, 5039 licenses, 595 companies formed all resulting form government funded projects.

History of Technology Transfer

USA Pioneering Role (Cont.)

- Stevenson-Wydler Technology Innovation Act of 1980
  - Technology transfer is a mission of the the federal government
  - Fed. government labs **must** seek opportunities to transfer technology to industry
- Federal Technology Transfer Act (FTTA) of 1986
  - TT is a priority of Gov. Owned Gov. Operated (GOGO) labs & their **personnel**
- Executive order 12591, 1987
  - Grant companies title to patents in exchange for royalty
  - Implement royalty sharing and cash awards with inventors (gov't employees)
- The National Competitiveness Technology Transfer Act, 1989
  - TT is a mission of Gov. Owned, Contractor-Operated labs and their **personnel**

Technology Transfer Impact Measurement

Federal Interagency Working Group (IWGTT)

- A Federal Interagency Working Group (IWGTT) has been established to measure the impact of TT through:
  - Number of patents filed
  - Number of patents granted
  - Number of licenses
  - Earned royalty income
  - Number of licenses terminated for cause
  - Other relevant parameters unique to the agency

Status of Egypt's NIS

Egypt has a rather rich innovation ecosystem !

- Two technology transfer networks
  - ASRT sponsored network of TICOs for domestic TT
  - ICTI network of ETTICs for foreign TT
- Large number of Universities and research institutes
- Large number of scientists & engineers
- Large number of expat scientists & engineers
- Adequate funding bodies for science and innovation
- Wealth of recently emerging supporting organizations
- Innovation is clearly on the agenda of several gov't bodies
  - MoHESR, ASRT, STDF, MoIFT, ICTI, MCIT, ITIDA, TIEC
- Emerging social innovation initiatives
- ICT innovation cluster example

Where is the problem ?!

Weak innovation system and lack of national innovation policy…

Scientific Research

- TT is not a priority mission for gov't institutes & Universities
  - Neither research institutes/universities nor their personnel are accountable for TT
  - Research personnel are not rewarded for industry oriented research
- Fragmentation and lack of coordination
  - Big critical mass of research and researchers outside umbrella of MoSR
    - Universities, ministries of energy, agriculture, health, petroleum, etc...
  - No coordination of research conducted in different organizations
- Low quality funding
  - Pre Bayh-Dole style !
  - High level of bureaucracy especially when funding private organizations
- No IP & TT policies in most institutes and universities
  - Weak industry-academia collaboration
- Low funding levels for scientific research

Education and Human Capital

- Highly stressed education system due to no. of students & their growth
  - High class densities, inadequate schools in terms of quantity and quality
  - Lack of qualified teachers
  - Low wage levels of teachers
  - Private tutoring
  - Retarded education system in terms of curricula and methodology
  - Shy STEM schools initiative

- Highly centralized University education system
  - University management not accountable for clear objectives
  - Huge sizes of Universities ; difficult to manage and to maintain quality
  - Inadequate university admission system
  - Low wage levels of faculty
  - Very low or zero budgets for research

Education and Human Capital (Cont.)

- TVET system suffering low quality & mismatch w/ market requirements
  - TVET is highly fragmented with no integrated system for QA & accreditation
  - Weak employer engagement in workforce development
  - Weak linkage between TVET providers and employers
  - Mubarak-Kohl has been a relatively successful experience

- Brain drain and weak leverage of Egyptian expats
  - Egypt among highest Arab countries in terms of brain drain
  - Limited or weak programs to limit or reverse brain drain

The Way Forward

1- Institutional Reform

Institutional Reform:
A Policy of Inclusion and Integration

- Create an Overarching National Innovation Council and/or Agency
- Restructure / spread gov't research institutes to ensure integration and coordination
- Linking Domestic and Foreign TT Networks
- Launch Export Oriented Innovation Clusters
- Develop an Inclusive and Comprehensive NIS

The Way Forward

2- Effective Innovation Policies for Sustainable Development and Growth

Technology Transfer

Industry – Academia/Research Relationship

- Technology transfer policy is key to building an effective NIS
- A new paradigm should be sought for University/Research in Egypt
  - Mission of University and Research institutes should be reformulated to include knowledge and technology transfer
  - Universities and Research institutes should be empowered to act on their mission. This includes the right legal infrastructure and right resources.
  - Management and personnel of Universities and research institutes should be accountable for knowledge and TT objectives
  - Management and personnel should be rewarded for knowledge and TT achievements

New 4-D paradigm Mission, Empowerment, Accountability, Reward (MEAR)

Technology Transfer

Industry – Academia Relationship

- Mission
  - Redefine the role and mission of Universities and research institutes as major agents of technology transfer.
  - Change promotion policy of academics to credit them for TT, patents & industry research
  - Link graduation project and graduate theses to industrial and community problems
  - Encourage universities and government research institutes to conduct technology marketing and commercialization activities including presentations at conferences, workshops and exhibitions targeted to the industry and organization of such events.
- Empowerment
  - Establish IP and TT policies at the institution level in all Egyptian research centers and Universities.
  - Expand and develop TICOs network to include all relevant Egyptian Universities and research institutes
  - Establish policies and systems in universities and research institutions to ensure all innovation, patents, and industry related activities pass through official channels to preserve the rights of the home organization.
  - Provide funding for universities to establish incubators and technology parks
  - Encourage Universities to specialize and build on their strengths in terms of research and technology.
- Accountability
  - Institutions must report on TT activities and on utilization of funds in this regard.
  - Drive towards a new management system at Universities and research institutes with clear accountability
- Reward
  - Vesting the IP rights of gov't-funded research with the university or research institution and their staff.
  - Incentivize universities that participate in the innovation process through IP licensing and TT.
  - Pass legislation to allow universities, academics & research staff to manage start-ups and own equity in them
  - Adopt IP policies that include reward of inventors through royalty sharing

Scientific Research

Adopt policies to :

- Mission
  - Redefine the role and mission of research institutes as agents of TT
  - Change promotion policy of research staff to credit them for TT, patents & industry research.
- Empowerment
  - Fund research in tech start-up and industrial firms with less bureaucratic constraints.
  - Increase government spending on R&D programs and grants
  - Support research in private sector through *tax credit for R&D, deduction of R&D and patent costs from tax* and *export rebate.*
  - Introduce new flexible procurement laws for Universities and research institutes and allowing direct procurement of equipment and materials from outside the country.
  - Introduce new laws to exempt Universities and research institutes from tax on IP and technology licensing and to exempt technology start-ups from taxes on revenue for 5 years following inception.
- Accountability
  - Hold management staff and research personnel accountable for TT objectives achievement
  - Pass legislation to allow GOCO research centers and centers of excellence
- Reward
  - Reward applied research/patents with validated industry impact
  - Reward research institutes based on their TT achievements and industry impact

Case Study

Electronics Industry New Innovation Strategy

Novel Internal Situation

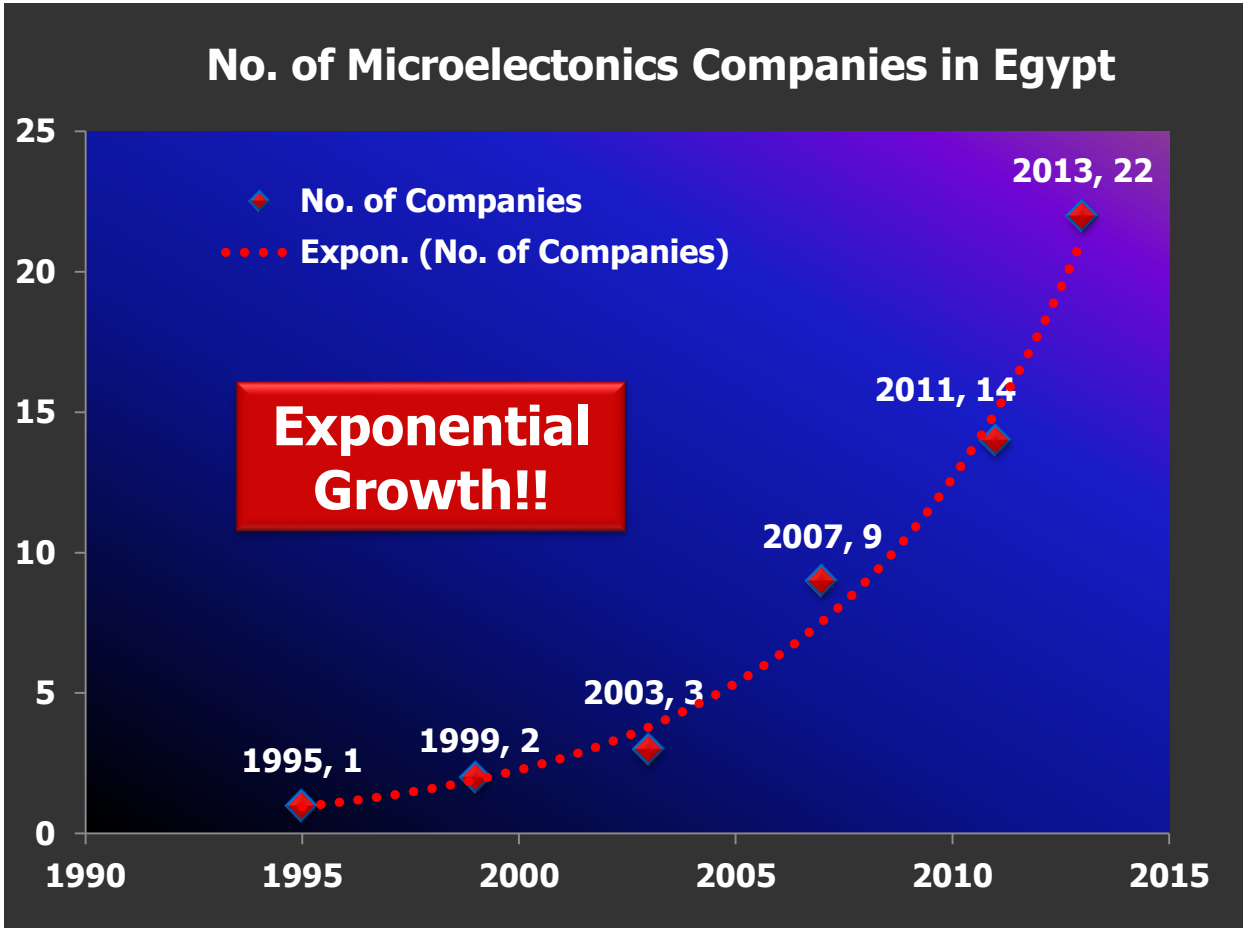
National Electronics Industry Pioneering TT & Innovation

- Emergence and growth of a new indigenous national semiconductor industry in the last decade with the following attributes:
  - Fabless
  - Focused on IC design, development and innovation
- Emergence of companies developing MEMS technology and products
- New and existing companies focused on design and development of systems and solutions as well as embedded systems
- New trend has been driven by individual initiatives and benefited from government support mainly through ITIDA
- ***A young and vibrant generation that inspires hope and confidence***

Si-Ware Systems

An Innovation Success Story

- A company driven by innovation ; 120 designers, subsidiaries in USA and France
- More than 40 US and international patents and patent applications
- Si-Ware inertial sensor platform used by Northrop Grumman, Panasonic, Bosch, etc.
- Si-Ware's wireless charging attracts wide attention and news coverage. ***CES 2015***
- Si-Ware's spectrometer wins prestigious Prism award for
  - Best innovative product WW in test measurement & metrology


No. of Microelectonics Companies in Egypt
No. of Companies
Expon. (No. of Companies)
Exponential Growth!!
1995, 1
1999, 2
2003, 3
2007, 9
2011, 14
2013, 22
0
5
10
15
20
25
1990
1995
2000
2005
2010
2015

New Strategy for Egypt's Electronics Industry

Two Main Pillars

To

Foster research, development and innovation in advanced & high-value adding fabless semiconductor & systems industries

And

Leverage local / regional market opportunities while growing manufacturing capacities

To

Empower the industry to be the largest contributing sector and the main growth driver for the Egyptian economy

Strategic Initiatives

1. Campaign to attract key CM, system & fabless players to operate or forge JVs in Egypt
2. Establish innovation park(s) for Fabless & systems companies hosting MEMS CoE & clean rooms
1. Establish SEZ with right infrastructure, legislation, incentives, tax, customer benefits
2. Leverage trade agreements to boost existing companies' exports (TV, set-top box) to Europe
3. Go To Africa campaign: support & incentivize existing companies to boost exports to Africa
4. Avail funding mechanisms and R&D grants for ASIC and system product development
5. Leverage local market and fulfill government needs through local companies
6. Support existing ASIC companies to develop sales / marketing and boost sales in China & US
7. Offset program to obligate government suppliers to source % of product content from Egypt
8. Launch a capacity building program to enhance skill level of the required workforce
9. Design incentive mechanisms to repatriate Egyptian expats & retain human capital
10. Improve Broadband by at least an order of magnitude to enable efficient outsourcing setup.

Summary

- Efficient technology transfer mechanisms and policies are mandatory for innovation and for establishing an effective NIS as a path for sustainable development
- Egypt has a relatively rich innovation ecosystem, and innovation is on the agenda of several gov't bodies, however,
  - There is significant regression in terms of high level gov't awareness and political will
  - Institutional restructuring is key for a more coherent and integrated system
  - Redefinition of the mission and role of gov't universities and research institutes as agents of TT is key for a successful NIS. This needs to happen in a 4 dimensional paradigm (MEAR)
  - Education needs very special attention and creative/bold initiatives are needed to address severe challenges facing education at different levels
  - IP management, protection and IPR enforcement need to be addressed
- Negative framework conditions are a fundamental threat to an effective NIS
  - Corruption should be curbed down,
  - Rule of law should be enforced,
  - Policies and legislation stability should be guaranteed