Towards a globally competitive and prosperous nation

INNOVATIONS AND COMMERCIALIZATION OF RESEARCH OUTPUTS BY UNIVERSITIES FOR DEVELOPMENT

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- **Disclaimer: Views expressed here are mine and do not imply endorsement by the Kenyan Ministry of Education**

Presentation Overview

- **Knowledge based economy**
- **Role of University**
- **‘*Triple Helix*’ Model**
- **Legal Frameworks**
- **Some observations/Kenyan situation**
- **Kenyan university success stories**
- **Discussions**
- **Way Forward**

Government's View of Technology

Forum > Head of State addresses Africa Digital Symposium at Strathmore University

Technology to drive my Big Four promises, says Uhuru

President expresses confidence that digital revolution will help him deliver on agenda

BY PATRICK LANG'AT
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AND PSCU

President Uhuru Kenyatta yesterday said that the government will focus on technology to deliver on his Big Four second term promises of affordable housing, universal healthcare, food security, and manufacturing.

He said technology would support affordable healthcare by driving access to information, better financing, stronger training for health workers, and, ultimately, broader access to services.

Digital technology would also support efforts to increase food security by playing a key role in agricultural value chains through better access to inputs, more reliable weather and crop information, tracking of counterfeit inputs, more transparent access to markets and fair pricing.

"M-Pesa, M-Kopa, GroIntel:

PHOTO | PSCU

President Uhuru Kenyatta addressing delegates attending the Digital Economy Symposium at Strathmore University Law School, Nairobi.

> M-Pesa, M-Kopa, GroIntelligence, Andela and others show that we can lead the world with innovations that drive financial inclusion, access to energy and better data to drive our agriculture,"
>
> **President Uhuru Ken**

He said Kenya was also positioning itself to reap the most out of the global digital revolution. The government, he added, would set up a committee on Blockchain and Internet of Things technologies to study the benefits and challenges from the latest digital innovation trends.

Blockchain is the technology

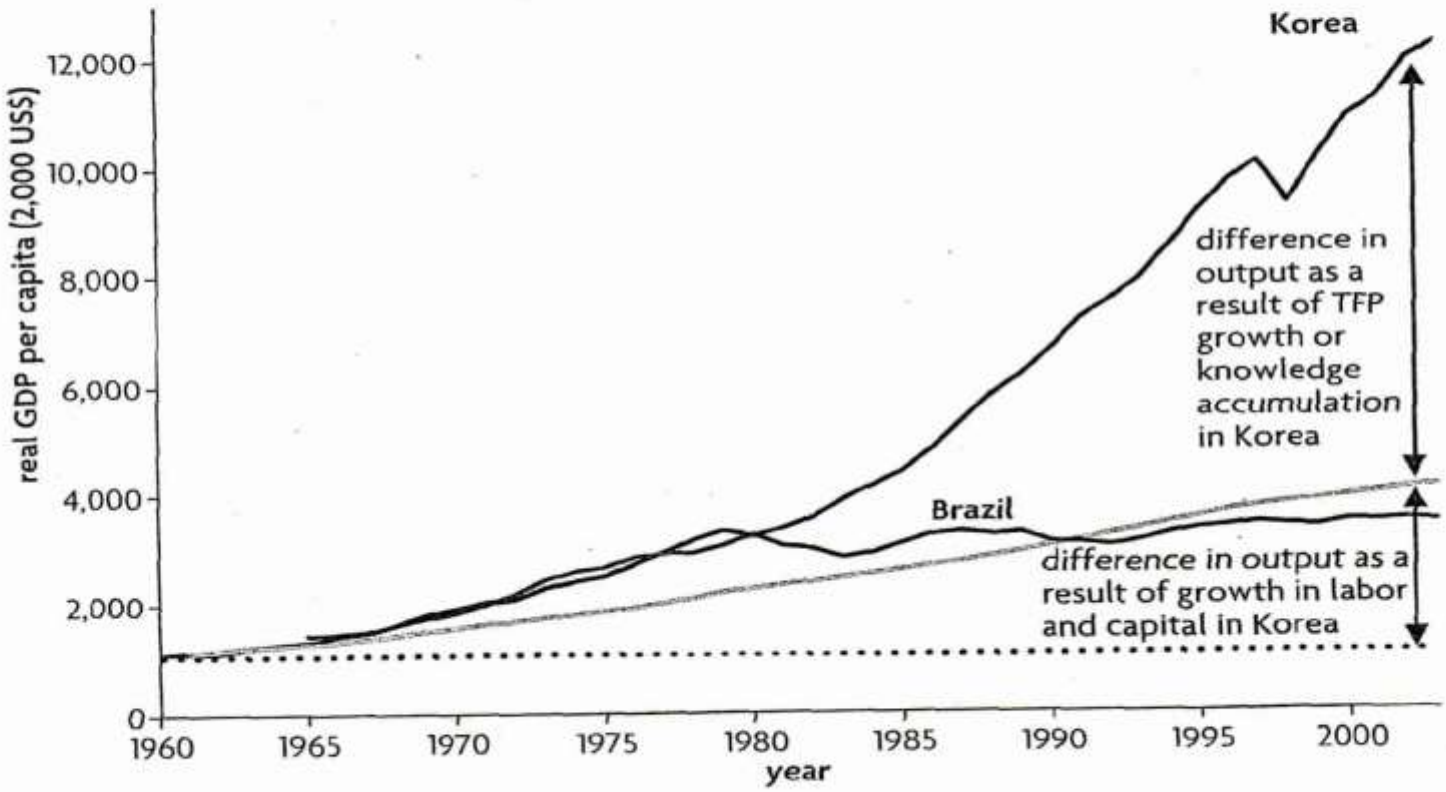
He said the country had been a leader in digital innovation and would not be left behind in the latest trends. The potential for digital dividends was enormous.

"As a matter of fact, the internet and associated digital trade of goods and services have led up to 10 per cent rise in employment in Africa."

ST&I and Economic Development

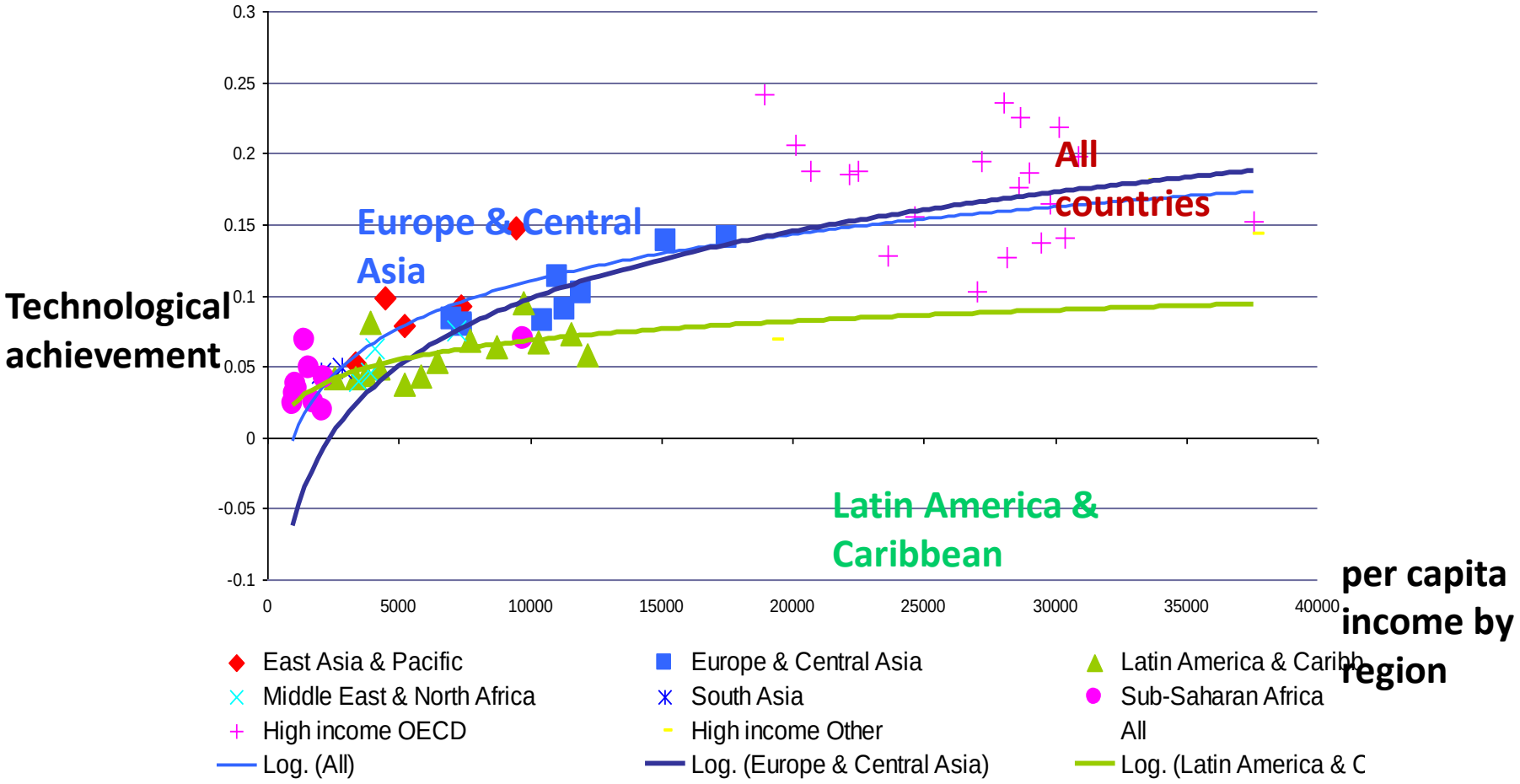
- **Robert Solow (1957)** using economic theory and mathematical analysis to data in USA from 1909-1949:
  - Demonstrated that **7/8 of growth in GDP** was attributed to **technological** development
  - re-analyzed same data later and showed that GDP growth was explained by **30% education** and **64% technology**
  - **In 1987, he was awarded Nobel prize for this finding**
  - **investments in research thus benefit society** (Jones and Williams, 1998)

Figure 1.5. Knowledge as a Factor in Income Differences between Brazil and the Republic of Korea, 1956–90



Source: Calculations based on World Bank internal data. Knowledge for Development (K4D) Program, World Bank Institute.

Innovation Increases people's Income



Countries/economies at each stage of development

Stage 1: Factor-driven (35 economies)	Transition from stage 1 to stage 2 (16 economies)	Stage 2: Efficiency-driven (31 economies)	Transition from stage 2 to stage 3 (20 economies)	Stage 3: Innovation-driven (38 economies)
Bangladesh	Algeria	Albania	Argentina	Australia
Benin	Azerbaijan	Armenia	Brazil	Austria
Burundi	Bhutan	Bolivia	Chile	Bahrain
Cambodia	Botswana	Bosnia and Herzegovina	Costa Rica	Belgium
Cameroon	Gabon	Bulgaria	Croatia	Canada
Chad	Honduras	Cape Verde	Hungary	Cyprus
Côte d'Ivoire	Iran, Islamic rep.	China	Latvia	Czech Republic
Ethiopia	Kazakhstan	Colombia	Lebanon	Denmark
Gambia, The	Kuwait	Dominican Republic	Lithuania	Estonia
Ghana	Moldova	Ecuador	Malaysia	Finland
Guinea	Mongolia	Egypt	Mauritius	France
Haiti	Nigeria	El Salvador	Mexico	Germany
India	Philippines	Georgia	Oman	Greece
Kenya	Saudi Arabia	Guatemala	Panama	Hong Kong SAR
Kyrgyz Republic	Venezuela	Guyana	Poland	Iceland
Lao PDR	Vietnam	Indonesia	Romania	Ireland
Lesotho		Jamaica	Russian Federation	Israel
Liberia		Jordan	Seychelles	Italy
Madagascar		Macedonia, FYR	Turkey	Japan
Malawi		Montenegro	Uruguay	Korea, Rep.
Mali		Morocco		Luxembourg
Mauritania		Namibia		Malta
Mozambique		Paraguay		Netherlands
Myanmar		Peru		New Zealand
Nepal		Serbia		Norway
Nicaragua		South Africa		Portugal
Pakistan		Sri Lanka		Qatar
Rwanda		Swaziland		Singapore
Senegal		Thailand		Slovak Republic
Sierra Leone		Tunisia		Slovenia
Tajikistan		Ukraine		Spain
Tanzania				Sweden
Uganda				Switzerland
Zambia				Taiwan, China
Zimbabwe				Trinidad and Tobago
				United Arab Emirates
				United Kingdom
				United States

Source: The Global Competitiveness Report 2015 – 2016 (World Economic Forum 20

Knowledge-based economy

- **Based on Vision 2030,** Kenya is to transit from **"factor driven"** model of economic development to one that is knowledge-based and ***"innovation driven"***

➢ **Effective ST&I policies:**

  - *high investment in education and training at ALL levels* ***(creative/critical thinking i.e., Centres of Excellence)***
  - ***high-quality*** *scientific research institutions*
  - *extensive relationships between governments, academia, and industry* ***(Triple-Helix),*** *and;*
  - *protection of the* ***intellectual property***
  - ***Nationhood*** (invoke **article 10(2) (Chapter Two)** on *national values and principles of governance*, **article 73 of (Chapter Six)** on *leadership and integrity* and **article 232 (Chapter Thirteen)** on *values and principles of public service* in educational curriculum at all levels of the education system)

✓ Key factors of **strong economies and robust societies** in the **21st century**

(Lowe, 2005; World Economic Forum, 2010/2011)

Role/Functions of a University

Universities hold **three** core, overlapping and integrated functions:*

- provide highest standard/quality **teaching**,
- engage in scholarly quality scientific **research and innovation,** and;
- undertake a **'third stream' role** of dissemination of outputs of research to **'community/industry engagement/outreach' or 'knowledge/technology transfer' – commercialization (ideas to products/services)**

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*(University Act, 2012)

University-Industry Linkages

- Because of **commercialization role (still new)**, Universities have more potential to contribute to R&D – **knowledge-based economy**
- the topic of university-industry linkages **(commercialization)** is increasingly coming to the fore in higher education policy dialogue in Africa*
- many governments establishing universities and taking action to foster university-industry linkages
- Kenyan Universities have increased from **1** in 1983 to >**70** in 2019 (www.cue.or.ke)
- **Huge investment** in higher education underlines importance of trained manpower in national development

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***(African Higher Education Summit, Dakar, Senegal, March, 2013)**

University and Knowledge based economy

- In knowledge economy - **(**It's the **educated people and their ideas)** are key resource

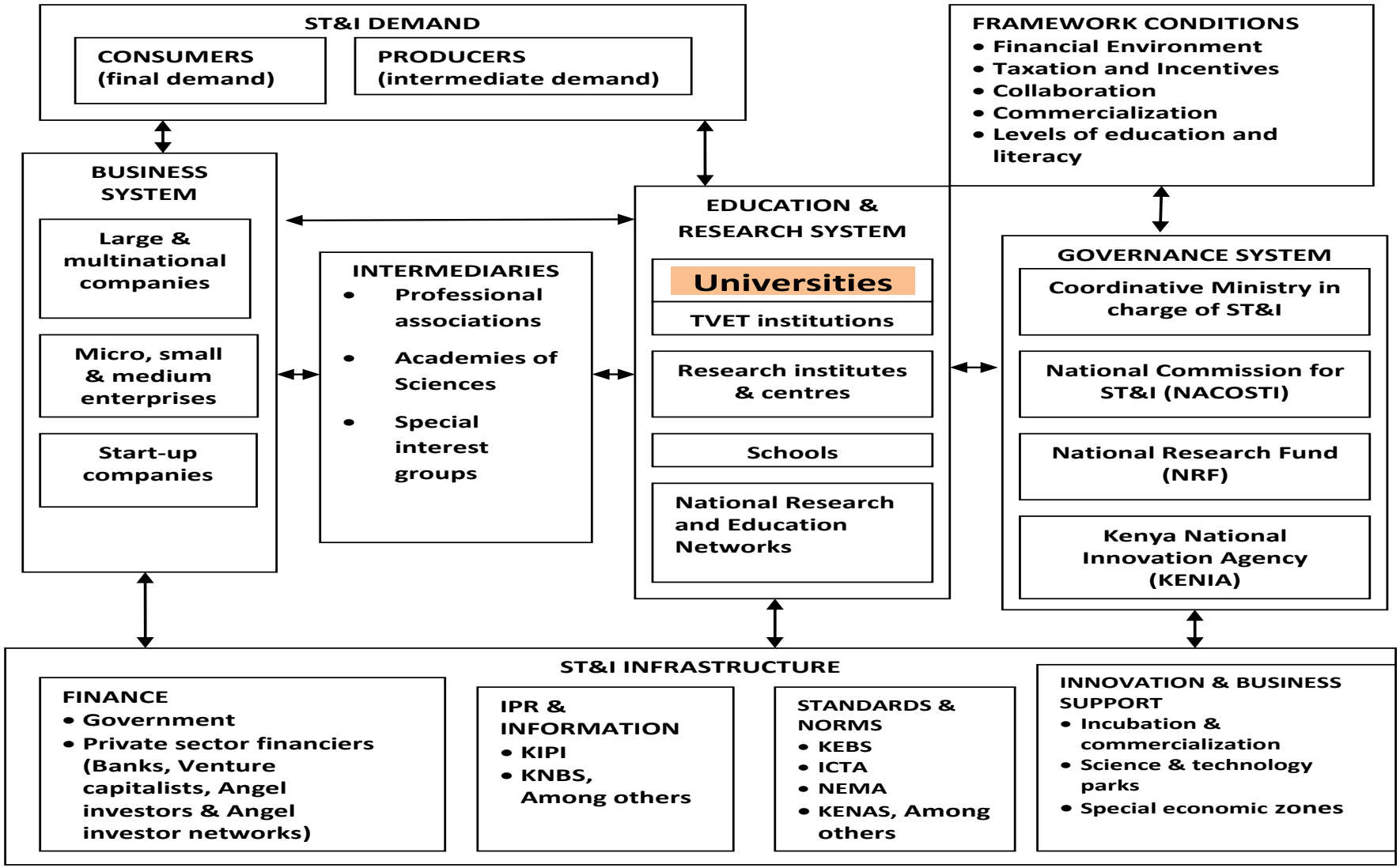
- the creation, dissemination and application of knowledge – a factor of strong economies and robust societies in the **21st century**

- research and development (R&D) is key to economic growth and global competitiveness

- the universities, as **major centres of learning and research** – becoming important as the sources of ideas, knowledge, skills, innovation and technological advances – **Universities at Centre of National Innovation Systems**

(Rooney *et al*., 2005; Khademi *et al*., 2015)

Proposed Kenya's National Innovation System



(Draft, ST&I Policy, 2008)

What an Effective NIS does

- **strengthening networks between:**
  - higher education, technological institutions, academic entrepreneurs, and local industries in support of **R&D projects and technology transfer**,
  - the provision of **risk capital** for new innovative companies and micro-financing for start-ups,
  - **seed coaching and stipends** for academic entrepreneurs

Triple Helix model

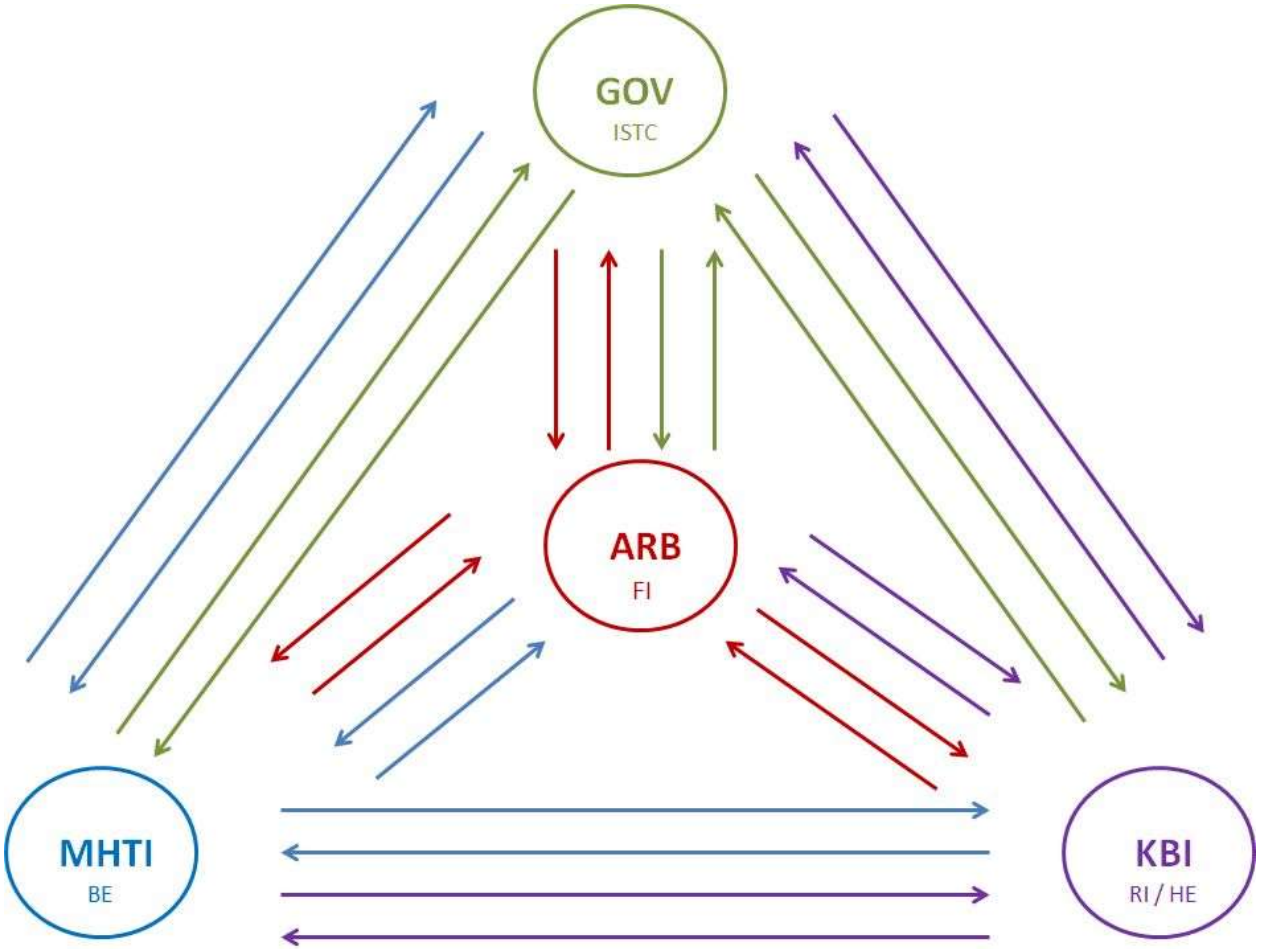
- Studies show universities with closer ties to industry – are more entrepreneurial

- Three key players in NIS are **industry, government, and universities** in a **'*triple helix*'** who need to be brought together and be collectively **energized**
- recently, **there is the inclusion of civic society** to the triple helix, leading to a **'*Quadruple*' model**

- addition to producing **work-ready** graduates, **synergies** between universities and industry **promotes innovation and technology transfer** – *commercialization*

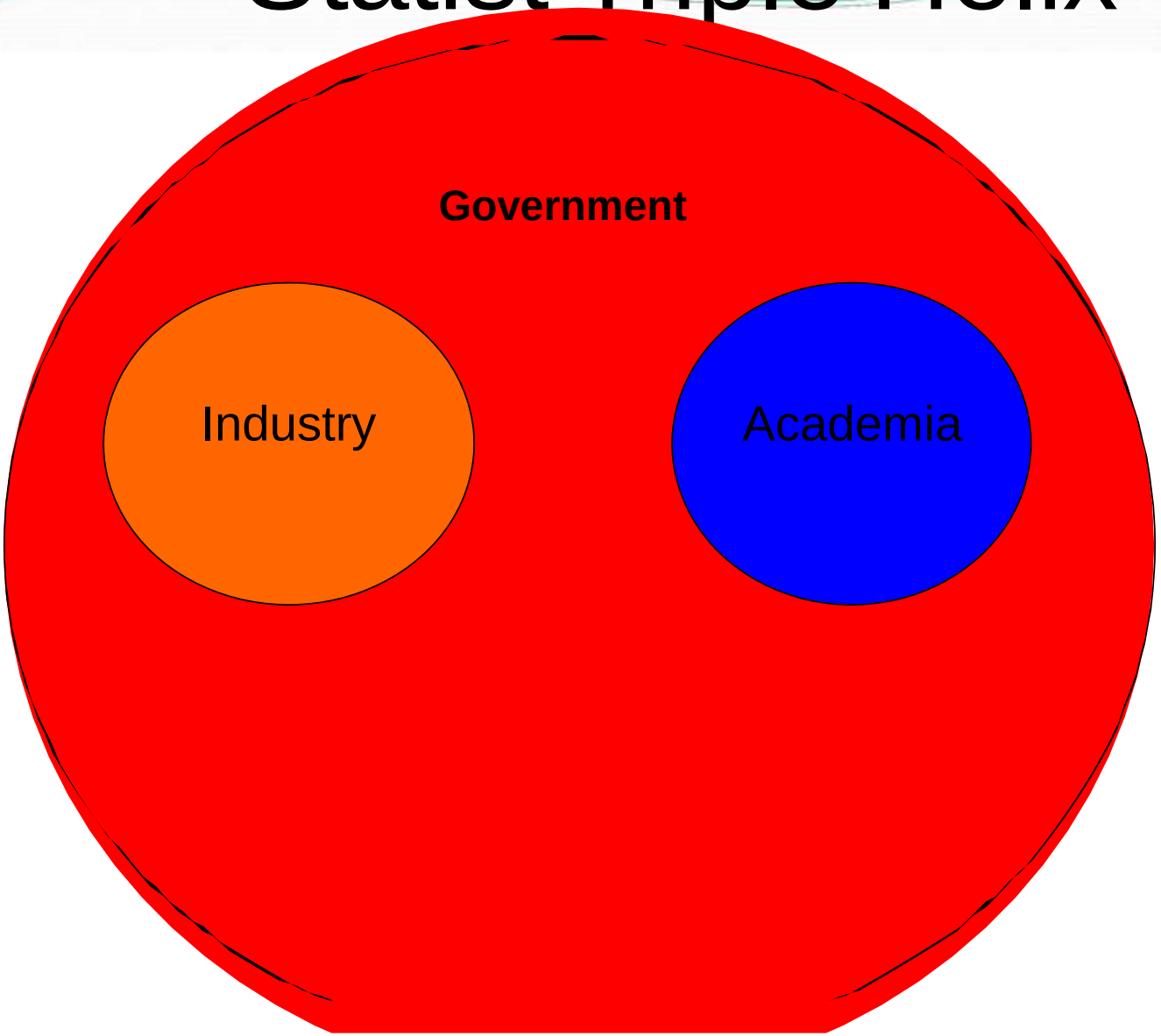
Etzkowtitz and Leydesdorff, (1997); Carayannis and Campbell (2012)

Triple Helix model Cont'd



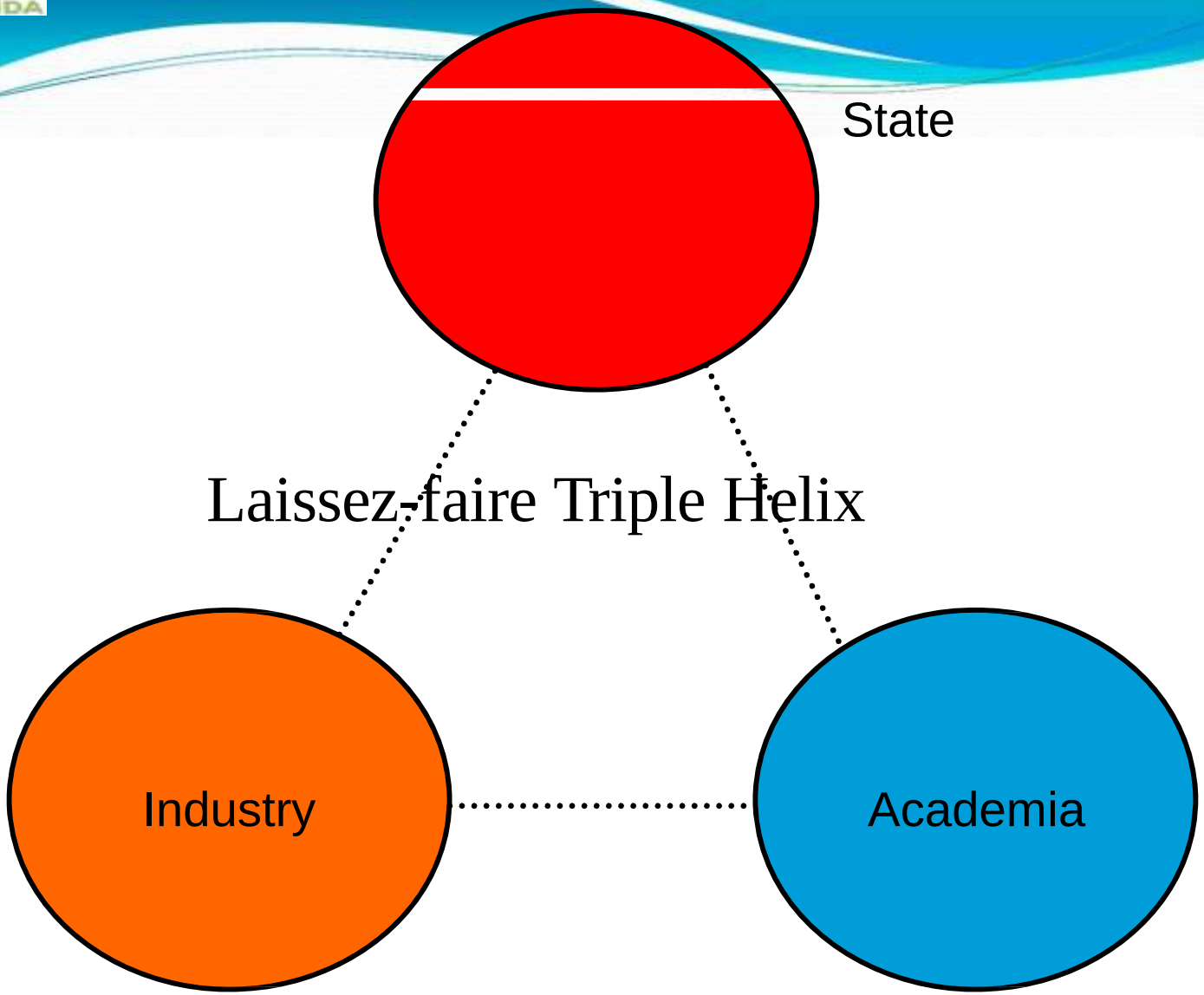
Etzkowtitz and Leydesdorff, (1997)

Statist Triple Helix



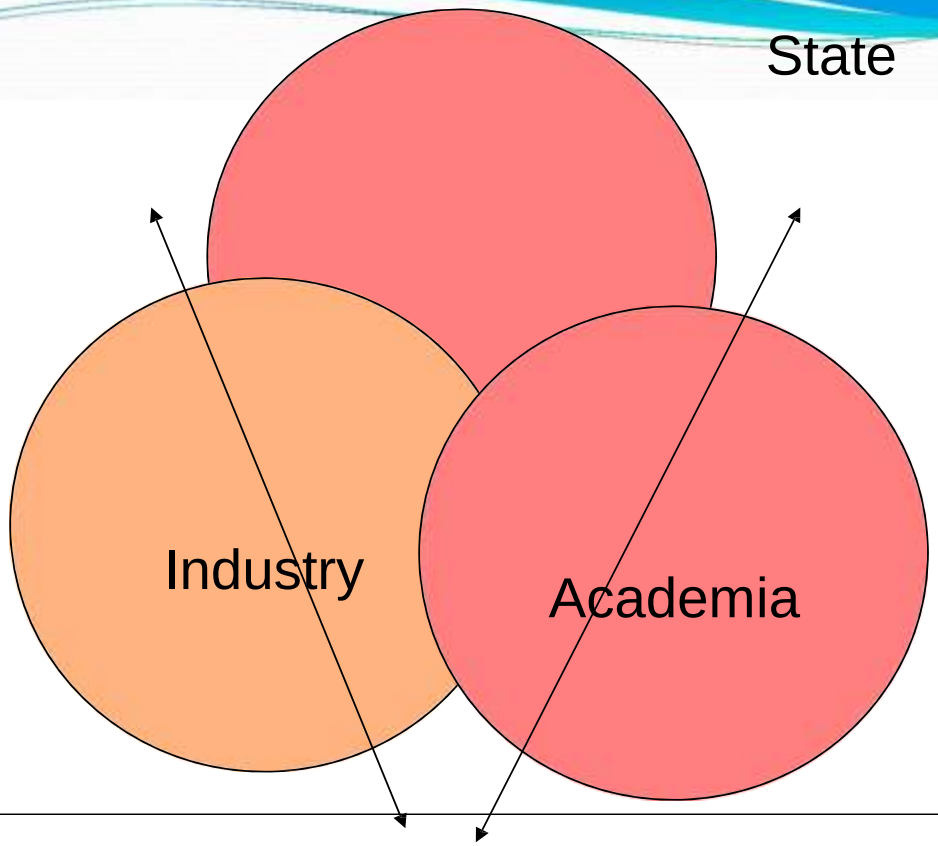
Statist Configuration:

- **Government plays the lead role**
- **Drives university and industry, but**
- **Curtails their ability to undertake transformative and innovative transformations;**
- **Civil society is often actively suppressed**


State
Laissez-faire Triple Helix
Industry
Academia

Laisser-faire configuration

- **Industry plays the lead role;**
- **Limited state intervention;**
- **Government and university plays support roles**
  - **University: skilled human capital**
  - **Government: regulator of social and economic mechanisms**
  - **Civil society is relatively inactive**



Balanced Configuration: Civil Society is the Foundation Stone of the Triple Helix

Balanced configuration:

- **Government, industry and university act in partnership**;
- **Each can take the lead role**: substitution/complementary modes of interaction;
- **Innovation takes place at the intersections of the 3 spheres**
- **Civil society** is actively involved and constitutes **the backbone of the system**

Legal environment for Commercialization

- *commercialization* require not only increased investment in R&D, but also in the **legal frameworks, skills** and **infrastructure**
- In 1960s and 1970s, due to lack of clear policy on technology transfer, commercialization involved long periods – frustrations
- Congress to enact the **Bayh-Dole Act of 1980**
- universities were given the obligation to commercialize innovations resulting from public funding
- United States has **become very advanced** in technology transfer and commercialization of research due to this Act

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(Mowery *et al*., 2004)

Optimal environment for Commercialization Cont'd

- Many OECD enacted similar legislation to Bayh-Dole Act, with universities being given the responsibility for managing and exploiting **IP**

- This gave universities the **'Third Stream' role**, in addition to **teaching** and **research**

- This also gave universities the ability to contribute to the commercialization of innovation

(Molas-Gallart *et al*., 2002; Mowery and Sampat, 2005)

Kenyan Situation

- **commercialization** of university research outputs (still new) **requires appropriate policies and management systems**

- If **knowledge transfer can't be measured,** it also **can't be readily recognized and rewarded** **(Osborne and Gaebler, 1992)**

Some Observations

- A study in 17 universities (15 Public and 2 Private)

- 6 universities did not respond (3 public and 3 Private)

University Commercialization Environment

Study Variable	Number of respondents (N=17)
Geometric Mean Expenditure in KES on R&D (Range)	**21.1 (2M-3.5B)**
Median (IQR) Expenditure in KES on R&D	18.3 (9.5-33.0)M
Commercialization in University Vision and Mission Statements	16
Research in strategic plan	17
Commercialization in Strategic plan	17
University has guidelines on Commercialization	13
University has innovation policy	14
University informs industry on their products	11
University has financial target on commercialization	10

Commercialization Environment

Cont'd (Commer. Office)

Variable	% respondents	No. of respondents (n=17)
University has a dedicated entity for commercialization		6
Number of spin-off companies started since university started or last 10 years		
• 0		12
• 1		3
• 2		1
• 3		1

Intellectual Property Rights (IPR)
Cont'd

Variable	% respondents	No. of respondents (n=17)
patents that universities have sought in last 5 years/since establishment		
● 0		9
● 2		2
● 4		2
● 8		1
● 13		2
● 20		1
Number of patents issued locally		38/47
Number issued elsewhere		1/47

Addressing Energy Demands

Production of Biodiesel From Waste Cooking Vegetable Oil –

Dr. Betty Mbatia (Technical University of Kenya)

Biodiesel is being produced from Waste cooking oil collected from hotels and chips restaurants.

Waste oil & fat from hotels and restaurants

Closed loop Biodiesel reactor

A TUK-TUK engine running on 100% Biodiesel

Revitalizing Textile Industry

Natural dye from a local weed Mexican marigold

Prof. Richard Mibey, - Moi University

Mexican Marigold weed

- This innovation revived the textile industry by providing sustainable and cost effective dyes

- Its application is saving Rivatex East Africa a facility of Moi University the cost of importing dyes to the tune of over 20M annually.

Development of Bio-fertilizer – Dr. Joseph Mwafaida, Pwani University

- Production Bio-fertilizer - Composted garbage after 4 months
- Price: Kshs 500
- Approx 55 bags per compost pit (3 X 4m)
- 5 bags per cubic meter (M^3) of raw garbage

Salsy Innovate (KU)

- Salsy Innovate ltd is a technology firm providing payment systems mainly to schools, colleges and universities.

- Have partnered with a number of strategic partners including banks and retail outlets to ensure quality and innovative products for our customers.

University of Nairobi Science & Technology Park and Fablab

- **Developed Fabfi, a wireless Mesh Network, wifi solution to extend the accessibility of wifi communication internet in a cheap and affordable way. A company, Fabcom Co. Ltd was founded from the park.**

Fabfi set up

Fabfi reflector on a tower in Nairobi

University-Industry Partnerships

Example : Jomo Kenyatta University of Agriculture & Technology: - Partnership with Nissin Foods Holdings Co., Ltd to foster food security technology in Kenya

Noodles and Instant Porridge


AGRO-SCIENCE PARK
FISH FARM


CHELALANG
CHELALANG

CERTIFIED BEANS SEEDS

Chelalang *Tasha* *Ciankui*

For Medium to High Altitud

- HIGH YIELDING; 7 to 10 Bags/Acre
- EARLY MATURING; 2.5 to 3 Months
- GRAIN HAS NO ACIDS, NO GAS AND COOKS FAST

PLANT 25 Kgs Per Acre pure stand

AVAILABLE AT EGERTON AGRO-SCIENCE PARK (FISH FARM) OFFICE NEXT TO CHEMISTRY

Some funded projects with Success stories

Improve Maize Variety Resistant to Striga weeds – Prof. Mathew Dida (Maseno University)

Striga weed causes severe yield losses, sometimes the farmers loose 100% of their harvest.

The agricultural sector suffers close to 7 billion USD in losses as a result of this infestation of the weed.

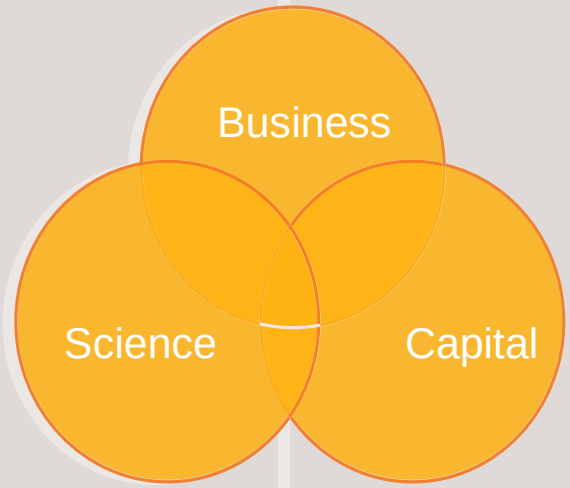
The project developed a seed variety that withstands striga weed infestation

Models Commercialization

Old approach = **Science** ▸ **Capital** ▸ **Business** ▸ = **Results: slower process, increased risk**

Linear model

New approach =



Synergistic model

Results

= **Demand based, outward focused innovation, Increased speed, Improved scope Scalability, Multi-dimensional innovation**

Old and new approaches to innovation

Economic impact of commercialization to community

- Employment to community
- Consumptions of products of community
- Technology increasing community productivity
- Multiplier effect creating demand for other products/services
- Suppliers to university
- Spending in community by faculty
- Fees paid by students
- Enhanced quality of life.

Discussion/Conclusions

- Because of **small markets and low purchasing** power in Africa, **global firms** are unlikely to develop specialized products for Africa
- **universities are well-placed** to fill this role of increasing productivity, quality control and value addition, particularly SMEs
- Innovation to **transform** of Africa from a continent dependent on **natural resources to one that is innovation-based**

Discussion/Conclusions

- Structures for commercialization are in place but **poorly resourced** **(broaden RM)**
- There is need for **mainstreaming** commercialization of research in Universities **(Culture change - entrepreneurship) – VCs/councils will be key – i.e., leadership**
- Industries and universities need to talk with each other (***Linkages***)
- Research should be appealing to industry/users **(applied research) *i.e.*, fit-for-purpose**

WAY FORWARD

- Universities need to be **proactive (ivory tower)**
- Invest in **internal capacity** (IP, marketing and entrepreneurial training) **– avoid early disclosures**
- Engage in high quality relevant research even if not **cutting edge**
- Broaden promotion criteria **(innovate or perish)**
- Focus on home-grown solutions for Kenya/Africa
- Build multidisciplinary through strong collaborations
- Go beyond **IP** filing to licensing
- Invest in **training and infrastructure** to attract best of best

Restructuring

- Universities must **ready *themselves*** *for* restructuring (i.e., **a common term in private sector**)
- Mergers, acquisitions and strategic alliances, downsizing and outsourcing **may become unwelcome vocabulary in Universities**. It will be either **reinvention or extinction**
- Maseno can become a **research intensive university** molded on your:
- Unique and differentiated profile,
- Mission and setting,
- Characteristics of your academic community
- Scope of your constituent colleges, schools and departments, and;
- Your willingness to commit to public service and community engagement
- **developing your own niche (Lake??)**

"Wisdom acquisition is a moral duty. It's not something you do just to advance in life" - Charlie *Munger*

(American businessman, lawyer, investor, and philanthropist)

Thank You