The Role of University Education towards Self-Reliant Development and SDGs - A Case Study of Africa (Engineering and Science) -

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------------JKUAT Vision-------------
To be a University of Global Excellence in Training, Research and Innovation for Development

-------------JKUAT Mission---------------
To offer Accessible Quality University Education, Training, Research and Innovation in order to Produce Leaders in the Fields of Agriculture, Engineering, Technology, Enterprise Development, Health and other Applied Sciences to Suit the Needs of a Dynamic World

-------------JKUAT Slogan(Motto)----------
Setting Trends in Higher Education, Research and Innovation

Overview of JKCAT, JKUCAT and JKTU

1977: Start of the Plan

1981
Middle Level College (JKCAT)
First Intake of Students (Agriculture, Diploma Technology, Technician)

1988
University College (JKUCAT)
Promoted to University (Degree of JKU)

1994
Full Fledged University (JKTU)
Start of Graduate School (Master, Doctor of JKTU)

2000
Developed into one of the top-class universities in the fields of Agriculture, Science and Engineering in Kenya

Changing the Campus

Face to Face Cooperation
MONOZUKURI Spirit

JICA Experts at JKCAT

Experts dispatched by the Government of Japan

A Motto of JKUAT

<example of JKUAT STUDENT PRACTICE-1 (B.Sc.)>

MONOZUKURI based on Creative Design/Drawing

Monozukuri

A Japanese word (2 in one) meaning

Excellence
“products”

Skill
Monozukuri overtones

Pride
“process of making or creation”

Spirit

Zest

In the ability to
• make things,
• good things,
• very well

Japanese MONOZUKURI, Design Thinking, Fab.Lab, SS-KAIZEN, TQM...
For Goal 4 (Quality Education) institutions of higher education and training will play a critical role

Achievement of Goal 4 will contribute to realization of the other 16 goals


### Engineering and Science

- Engineering and science constitute the engine for sustainable development, especially for Africa.
- Hence the need to enhance engineering and science education in Africa.
- With the youthful population and abundant natural resources that has recently attracted foreign interests, Africa stands at a crossroads in its development trajectory.
- Education and training, buttressed by technological advancements, are necessary tools for the continent to unlock its potential, and to set free the “African giant”.

### Situation of Engineering in Africa

**Situation in Kenya: Case of Registered Engineers**

<table>
<thead>
<tr>
<th>Category</th>
<th>Males</th>
<th>Females</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registered Consulting Engineers</td>
<td>272 (98.2%)</td>
<td>5 (1.8%)</td>
<td>277</td>
</tr>
<tr>
<td>Registered Engineers</td>
<td>1298 (96.8%)</td>
<td>43 (3.2%)</td>
<td>1341</td>
</tr>
<tr>
<td>Registered Graduate Engineers</td>
<td>4974 (92.3%)</td>
<td>413 (7.7%)</td>
<td>5387</td>
</tr>
<tr>
<td>Graduate Technicians</td>
<td>1128 (98.5%)</td>
<td>17 (1.5%)</td>
<td>1145</td>
</tr>
</tbody>
</table>

- Local presence of foreign engineering firms who prefer to import their own skilled labor;
- Reluctance of the graduates to take up poorly paid positions in rural areas; and
- Shortage of engineering technicians who support the professional engineers. Generally, for the effective operation of the engineering industry, the ratio professional engineers to technicians should be of the order of 1:5 or 1:6. In Africa, however, this ratio is more of the order of 1:1 or 1:1.5.

### Need for Engineering and Science Capacity

Africa is in dire need to expand her engineering and science capacity and capability:
- For its infrastructural development in tandem with her growth trajectory;
- For accelerating its industrial development, especially in manufacturing;
- For producing its ever-increasing needs in terms of renewable energy to overcome the acute power shortages;
- For empowering Africa to take control of the extraction industry of its rich natural resources; and
- For sustaining agricultural productivity and the need for food security base;
- For water harvesting in order to curb the challenges faced as a result of lack of water.

### Challenges in Engineering and Science Training

- Insufficient output from the engineering and science training institutions to meet the countries’ requirements;
- Lack of practical experience and skills of the graduates produced;
- Outdated equipment for training,
- Limited opportunities for industrial attachment and internship for engineering and science students and graduates,
- Mismatch of curricula with the needs of the industry
- It is now self evident that engineering and science curricula need to be linked with their practical results through a “hands on” approach in the form of “lab. based education”
- Lab. based education and Project based learning” which are common in Japan, that showcases the roles engineers play in developing solutions for contemporary issues.

### Special features for SMASE/SMASSE

Continuous learning process by teachers through INSET to improve classes with the concepts of:

- Participatory classes by students (student-centered)
- Practical-oriented (Experiment)
- Hands-on and Minds-on Activities
- Practice of ASEI-PDSI

### Engineering and Gender

- Gender imbalance in engineering training
  - With regard to gender imbalance, it is reported that the overall percentage of young women pursuing higher education in Africa in the disciplines of science, technology, engineering and mathematics (STEM) is relatively low, for example only 10% of the engineering workforce is female in South Africa and 8% in Kenya.
  - Taking note of the global impact of women in sustainable development, there is urgent need to address the issue of perception and encourage more women to study engineering since women are well positioned to integrate engineering practice in daily lives and chores of citizens.
  - There is also the challenge of lack of policies to implement gender parity
Addressing the Engineering/Science Education in Africa challenges

The future of engineering and science education in Africa lies heavily on strategic decisions evolved by the African people themselves within the African context. For a bright future, African governments/universities will have to:

- invest in modern infrastructure and laboratories
- update curricula to accommodate industry demands, while at the same time seeking to rationalize the requirements for accreditation of engineering/science programs by the regulating bodies
- re-orient teaching styles in engineering/science faculty from the current magisterial or masterly mode to the Project-Based Learning approach
- Closely linked to improving teaching methodology in engineering/science faculty is the need for pedagogical training of engineering lecturers as well as short-term attachment in industry to keep pace with advancements in technology and design.
- The faculty and study also require extensive use of state-of-the-art ICT in engineering/science education and training.

Initiatives for improving Engineering Education in Africa

- Tuning Africa Project (2012) for curricula reform, involving over 20 African Engineering Faculties;
- Africa-UK Engineering partnership (2010) to promote collaboration among African-UK engineers e.g. in curricula reform;
- UNESCO Engineering Initiative (2011) to address major challenges in engineering education e.g. curricula reform, QA, accreditation;
- African Engineering Education Association (2006) to promote networking among engineering educators,
- The Federation of African Engineering Organisations (2012) to act as an umbrella body for all African engineers,
- AU funded Pan African University of STI at JKUAT,
- African Women in Science and Engineering, and
- Nelson Mandela.

Promoting Digital Literacy (Examples of Initiatives)

1. Government laptop project
- The Government of Kenya will provide primary school pupils with laptops at a cost of KSh 17 billion.
- Eight firms tendered to the Information and Communication Technology (ICT) Authority.

2. Avallain digital learning programme
- 10,000 children in 200 schools across the country have so far been enrolled to an interactive digital content platform.
- The project aims at supplementing the government’s efforts to promote digital content at the primary school level.
- Public schools and non-formal schools in urban and slum-based areas are target beneficiaries of the project dubbed a-Academy.
- The programme has so far seen the production of Science and English for primary school children.

Taifa Laptop – Locally designed and assembled laptop

- JKUAT rolled out Taifa Laptop to the Kenyan market.
- The computing device was conceived and designed by JKUAT
- It was a maiden product of the Nairobi Industrial and Technology Park (NITP).

Pan African University (PAU)

- PAU was made by the AU Heads of State and Government Summit in 2010, and institutes that form the Pan African University (PAU). The decision to establish PAU was taken during the event.
- It was a maiden product of the Nairobi Industrial and Technology Park (NITP).

Admissions

<table>
<thead>
<tr>
<th>Fields</th>
<th>PAU STI</th>
<th>East</th>
<th>Central</th>
<th>North</th>
<th>South</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAU LESI</td>
<td>Basic Sciences, Technology and Innovation</td>
<td>Kenya</td>
<td>Nigeria</td>
<td>Tanzania</td>
<td>South Africa</td>
</tr>
<tr>
<td>PAU GHSS</td>
<td>Life and Earth Sciences</td>
<td>Nigeria</td>
<td>Cameroon</td>
<td>Algeria</td>
<td>South Africa</td>
</tr>
<tr>
<td>PAU WES</td>
<td>Governance, Humanities and Social Sciences</td>
<td>Nigeria</td>
<td>Cameroon</td>
<td>Algeria</td>
<td>South Africa</td>
</tr>
<tr>
<td>PAU SS</td>
<td>Water and Energy Sciences (incl. Climate Change)</td>
<td>Nigeria</td>
<td>Cameroon</td>
<td>Algeria</td>
<td>South Africa</td>
</tr>
<tr>
<td>PAU II</td>
<td>Space Science</td>
<td>Nigeria</td>
<td>Cameroon</td>
<td>Algeria</td>
<td>South Africa</td>
</tr>
</tbody>
</table>

PAU/PAU Council Members

- President: Prof. Tolly S.A. Mbwette (Tanzania)
- Vice President: Dr. Paulo Corrigan (Angola)

Focus Points: Innovation with actions (Basic Sciences, Bio-technology and Engineering)
**Case of Mr. GULMA, Sadiq Abubakar,**
**M.Sc. Civil Engineering (Environmental & ASAL)**
**VC, JKUAT**
**DVC(AA), JKUAT**

**PAUSTI Master Students** at Civil Eng.Lab at JKUAT for Research Activities
(left: M2 student from Uganda, right: M2 student from Cameroon) 
<July, 2014>

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**Africa-aJ- JAPAN Project/JICA**

This project will strengthen the knowledge and skills in the fields of
- agriculture,
- engineering,
- science,
- and biotechnology

of both PAUSTI and JKUAT students.

"aJ" is unique since it promotes the full utilization of local/indigenous knowledge, resources, experiences and wisdom generated and accumulated in Africa to solve Africa’s problems.

**Example of Research & Innovation Outputs**

Completion of Motorized Block Press, and improved Manual Press

By Clement Nduati Nganga, Moses Njeru, Peter Ngugi

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**Examples of Innovation Activities at JKUAT**

- **Biotechnology**
  - Tissue-culture Aloe vera
  - Tissue culture banana seedlings
  - Oyster mushrooms

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**Collaboration and Partnership**

**Joint Seminar**

JKUAT and Okayama Univ. 19/Oct/2015

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**Addressing the gender disparity**

Women’s Training for 20 Years

13/June/2014 @JKUAT

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There are nine (9) on-going sub-projects for Appropriate Technology in energy:

<table>
<thead>
<tr>
<th>Sub-project</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV</td>
<td>1</td>
</tr>
<tr>
<td>Small wind energy</td>
<td>2</td>
</tr>
<tr>
<td>Small hydro power</td>
<td>2</td>
</tr>
<tr>
<td>Biomass generation</td>
<td>3</td>
</tr>
<tr>
<td>Hybrid system</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

**BRIGHT Project**

- Solar PV
- Small wind energy
- Small hydro power
- Biomass generation
- Hybrid system

Kenya Oishii Project / Nisshin Foods Holdings

**Joint Venture between JKUAT and NISSIN HD** (May, 2013)

University ↔ Industry

**MoU**

E-Just

**MoA**

E-Just

**Concluding Remarks**

- Sub-Saharan Africa is experiencing unprecedented economic growth by attracting significant foreign investment especially capital development.
- The foreign investment projects have to be undertaken by foreign skilled labor due to the acute shortage of domestic skilled labor especially in the areas of engineering and technology.
- Therefore there is a dire need for engineers in Africa.
- Concerted efforts need to be geared towards engineering and science education, training and practice.
- Universities in sub-Saharan Africa must markedly improve the standard of education if the region is to move beyond the stage of assembling products and achieve sustainable industrial growth.
- Engineering and science education and training, buttressed by technological advancements, are necessary tools for the continent to unlock its potential, and to set free the “African giant”.
- With support from Japan, JKUAT is playing a role in addressing the challenge but we still need more institutions to meet the targets.

**Value addition for enhanced food security**

- Merits/Uniqueness:
  - Face to Face Cooperation
  - Monozukuri and Hitozukuri
  - 5S-KAIZEN
  - Lab. Based Education
  - Approach to encourage creativity towards African Innovation
  - Capacity Development (System + Human Resources + Teamwork)

- Challenges:
  - Encouragement of Quality Japanese Approach
  - Sustainability of Collaboration/Global Human Network
Thank you