Inaugural MUST International Conference (MUSTIC) on
INNOVATION FOR DEVELOPMENT
Meru, 28th to 30th June 2022

Conference Theme:
RESEARCH AND INNOVATION
FOR SUSTAINABLE DEVELOPMENT

HARNESSING OUR ICT SKILL SET AND RESEARCH EFFORTS FOR SUSTAINABLE DEVELOPMENT

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Ladies and Gentlemen,

It is an honor and a pleasure for me to speak to you today at this inaugural conference on *how to harness our ICT skill set and research efforts for sustainable development.*

For some time now, ICTs have become ubiquitous, making them a common place phenomenon in modern society. Almost all electronics are ICT enabled to date, with most people who can read and write having interacted with ICTs one way or the other. For example, mobile phones which have changed the way we think, socialize and do business, are ICT-enabled. According to Statista, a German Company specializing in market and consumer data,

- The number of mobile subscriptions in Kenya rose from 0.13 million in the year 2000 to 61.41 million in 2020.
- This makes sense when you consider that many Kenyans walk with two or more mobile devices wherever they go.

Countries that have had the highest infusion of ICT in their sectors have reaped the most benefits. These benefits can generally be seen alongside the developed *vs* developing countries divide. Developed countries such as the US, Canada, UK, Germany etc. are known to have

- high rates of industrialization, high incomes, high living conditions, equal distribution of wealth, a manufacturing-based revenue generation, low birth, low death rates, high life expectancy, and high degree of self-sufficiency.

On the other hand, developing countries such as Kenya and most of the global south countries have

- low rates of industrialization, low incomes, low living conditions, unequal distribution of wealth, a service-oriented revenue generation, high birth, high death rates, low life expectancy, and high degree of reliance on the developed countries for survival (with many of these countries struggling with over-borrowing to sustain their economies).

ICTs are seen as a powerful solution to the problems affecting developing countries. Indeed, ICTs have the potential of making developing countries to catch up and even overtake developed countries much faster than originally thought.

This brings us to our main question – *how can we harness our ICT skill set as well as our research efforts in order to ensure sustainable development?*

When used as a verb, the word harness refers to the act of collecting and controlling something so that it can be used effectively. With this definition, let us break the above question into two specific parts

1. *How can we enhance our computing curriculums so that our graduates can have the right skill set to enable them make sustainable contributions not only in the service sector but also in the industrial sector?*
2. *How can we enhance our research efforts so that we come up with novel and sustainable solutions to the problems that affect our developing economies?*

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Now, let us look at the first question that touches on the design and implementation of computing curriculums. Computing has several related branches, from which a number of undergraduate and postgraduate curriculums have been developed e.g.

- Computer Science,
- Computer Technology,
- Software Engineering,
- Information Technology,
- Information Systems,
- Business Information Systems/Technology,
- Information Science, etc.

It should be noted at this point that most of the times, the difference between these areas is blurred, to an extent that most computer people cannot clearly tell the difference.

For this discussion, let us assume that we have two main areas in which we can design computing curriculums, namely, computer-based and information-based.

1. *Computer-based* - may include all courses that revolve around the machine we call a computer using the Von Neumann model.
2. *Information-based* - may include all courses that attempt to solve industry-related problems based on the information processing model.

There are two main problems related to the design and implementation of computing curriculums. These include:

1. *Design problem* - many Kenyan bachelor curriculums are more theoretical than practical, which should not be the case.
2. *Implementation problem* - For each practical course, there should be a 2-hour lecture, followed by a 3-hour practice session in a computer lab. The 3-hour lab session is equivalent to 1-hour lecture. Unfortunately, the practice is to schedule a 3-hour lecture cum practical in a computer lab, which under-exposes the students. By contrast, most Physics, Chemistry and Biology courses follow the 2-hour lecture + 3-hour lab arrangement strictly around the country.

Due to these two problems, the average Kenyan computing graduate is far from being hands-on in both hardware and software. They are not industry-ready, and I wonder where we got it wrong.

Regarding the ratio of theory versus practical courses, we should borrow a leaf from Architecture, especially the Bachelor of Architectural Studies/Bachelor of Architecture programmes from the Jomo Kenyatta University of Agriculture and Technology. Here, theory versus practical is 50-50. For example, in a semester, students take 4 theory courses and 1 studio course. The studio course has a weight of 4 theory courses.

This is the model followed by most European Architecture courses that follow the 1999 Bologna Declaration, which harmonized the European University Education leading to the recognition of prior qualifications across member countries.

So, what would happen if computing students spent half of their campus time in the labs, or something closer to that? My guess – there would be an explosion of innovations.

Now, let us look at the second question that touches on the design and implementation of computing research.

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- **First,** we have a funding problem where Kenyan computing scholars have a low research output, mainly due to the fact that most of their projects are not funded. This affects both postgraduate students and academicians.
- **Second,** we have a consumer economy, which is a problem in that we import most ICTs (both hardware and software) from developed countries. This makes our computing research to be mostly applied and market-oriented. While market-oriented studies are OK, it is good to have a fair mix of basic research and applied research so that we can be able to compete with developed countries. It should be noted that developed countries (or their companies) are more likely to fund applied market-oriented research as opposed to basic research that will only produce ICTs that will end up competing with theirs. For example, Microsoft would easily fund anyone investigating the efficiency, effectiveness, impact or uptake of their products such as the C# programming language. However, they are less likely to fund projects that are deemed to be competitors. Now, unless we make effort to correct this scenario, we shall always live in a vicious cycle of dependence on developed countries.
- **Third,** we have a problem of weak research proposals. This is an indictment on the departmental academic panels that sit to assess postgraduate research proposals. Many proposals have very little value in the modern world, which is why they do not make any tangible or sustainable contribution to the economy. Departmental research panels must ask themselves the following questions before approving research proposals.
    - *What theoretical contributions will this researcher make if we approve his/her proposal?*
    - *Does the proposal have practical contributions that can be directly applied to solve the problems affecting the society?*
    - *Will the proposed methodology permit the student to achieve their proposed solution?*

Although research can be replicated in a different context, Kenyans have beaten everyone else at their own game. For instance, we frequently see research topics like:
    - *A Model for ICT Adoption in Secondary Schools in Kenya: Case of Meru County*
    - *A Model for ICT Adoption in Secondary Schools in Kenya: Case of Isiolo County*
    - *A Model for ICT Adoption in Secondary Schools in Kenya: Case of Embu County*
    - *A Model for ICT Adoption in Secondary Schools in Kenya: Case of Kitui County*

Do you think we need to do all this replication? In my opinion, we only need to conduct one of these studies in one County, then we implement its recommendations in all other Counties that have similar characteristics.

- **Fourth,** we have a problem where masters and PhD theses are indistinguishable.
Let us assume that both masters and PhD must make some kind of contributions. Then the question is – *how many contributions should a PhD thesis make and how many contributions should a master thesis make?*

A common publication requirement in Kenya is – at least one refereed journal article for a master's thesis and at least two for a PhD thesis. Based on this, we can say that a PhD thesis should make at least twice as many contributions as a master's thesis.

Now let us look at some common structure for Kenyan theses.
    - *A Machine Learning-Based Model for Detecting Anomalies in Open-Source Software, PhD Thesis*

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- *A Machine Learning-Based Model for Fault Detection in Object-Oriented Software, MSc Thesis.*

So, what is the difference between the above two theses given that each is producing a model? Is it a question of physical length, or is it about the contributions? My advice is that a PhD thesis title should be loaded with more verbs implying a wider and deeper scope than a masters in the same field of study. Moreover, the PhD must make tangible theoretical and practical extensions to existing knowledge. Fellow scholars, let us join hands to produce high quality PhD theses that can recognized and accepted by peers from anywhere else in the world.

Some thematic areas that you could write proposals on

- Computer Security, information security, network security, cyber security etc.
  - *Security cuts across all areas of computing, and is extremely important given that our economies are increasingly becoming ICT-dependent.*
  - *When developing security systems, we should subscribe to the CIA (confidentiality, integrity and availability) model*
- Intelligent Systems
  - *These are systems that portray human intelligence and include all software systems that incorporate artificial intelligence, machine learning, or deep learning etc.*
  - *Most sectors of society such as engineering applications, agricultural applications, marketing applications, medical applications etc., are nowadays produced with some intelligence.*
  - *Developing countries need to embrace this kind of research in order to compete with developed countries.*
- Internet of Things (IoTs)
  - *There is also a lot of research into this area. IoTs are internet-enabled and sometimes intelligent electronic gadgets that are to be found everywhere from wristwatches to household utensils etc. We need be involved in this type of research.*
- Evidence-Based Software Engineering
  - *This is experimental software engineering. While software engineering touches all areas of computing where some software is being developed, including intelligent and mathematical software, this research direction focuses on providing evidence that the developed software is reliable, safe, secure, maintainable etc.*
- Combinations of any of the above areas with non-computing areas such as
  - *Business, agriculture, medicine, engineering, education etc.*

In conclusion, ladies and gentlemen,

We need to harness our ICT skill set as well as our research efforts, especially in prime areas such as security, intelligent systems, internet of things, among others, so that we can ensure sustainable development.

Thank you and have a productive Conference day.