



Digital Infrastructural Requirements for the 21st
Century Higher Education Institutions: The
Imperatives for Global Relevance and
Competitiveness

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Lecture Outline

1. Appreciation & Acknowledgements
2. Introduction
3. Basic Operations of HEIs
4. Ranking Agencies and Digital Infrastructure
5. Digital Infrastructure and Access Challenge
6. IT Infrastructure and the Academia
7. Institutional ICT Infrastructure
8. Recommendations & Conclusion



Appreciation & Acknowledgements



Introduction

➤ The keywords:

- **Higher Education** - refers to all forms of post-secondary education offered in universities, polytechnics, colleges of education and their equivalents.
- **Digital Infrastructure** – the fundamental services/facilities that are necessary for the IT capabilities of a nation, region, city, organizations, etc.
- They include:
 - **Internet Backbone, Fixed Broadband, Mobile Telecommunication, Network Infrastructures, Data Centers, Cloud Computing, IoT, etc.**



Introduction Cont'd

➤ The keywords:

- **Global Relevance and Competitiveness** – having competitive advantage like other World-class universities. This is as dictated by the Global Ranking Agencies:
 - Times Higher Education (THE) World University Ranking
 - Shanghai Jiao Tong University Ranking (SJTUR)
 - Cybermetrics Lab. (Webometrics Ranking)
 - Cybermetrics Lab. (Repositories Ranking)



Introduction Cont'd

- *For a university to flourish and thrive, its investment in its digital infrastructure needs to be as good as its physical infrastructure, and the two need to be seen to blend seamlessly together.*

*– Iain Martin, Vice Chancellor,
Anglia Ruskin University*



Introduction Cont'd

- HEIs/University in the 21st Century?
 - ✓ A degree awarding institution of higher learning that has:
 - a conducive and serene environment for learning;
 - well-equipped (state-of-the-art) laboratories and studios for Teaching & Research;
 - regular supply of electricity & Internet 24/7;
 - qualified and experienced faculty and staff; and
 - comfortable accommodation for students and staff amongst others.



Introduction Cont'd

“Many Nigerian Researchers are still Analog and need to be trained in the use of ICT.”

- The Punch, June 19, 2019.

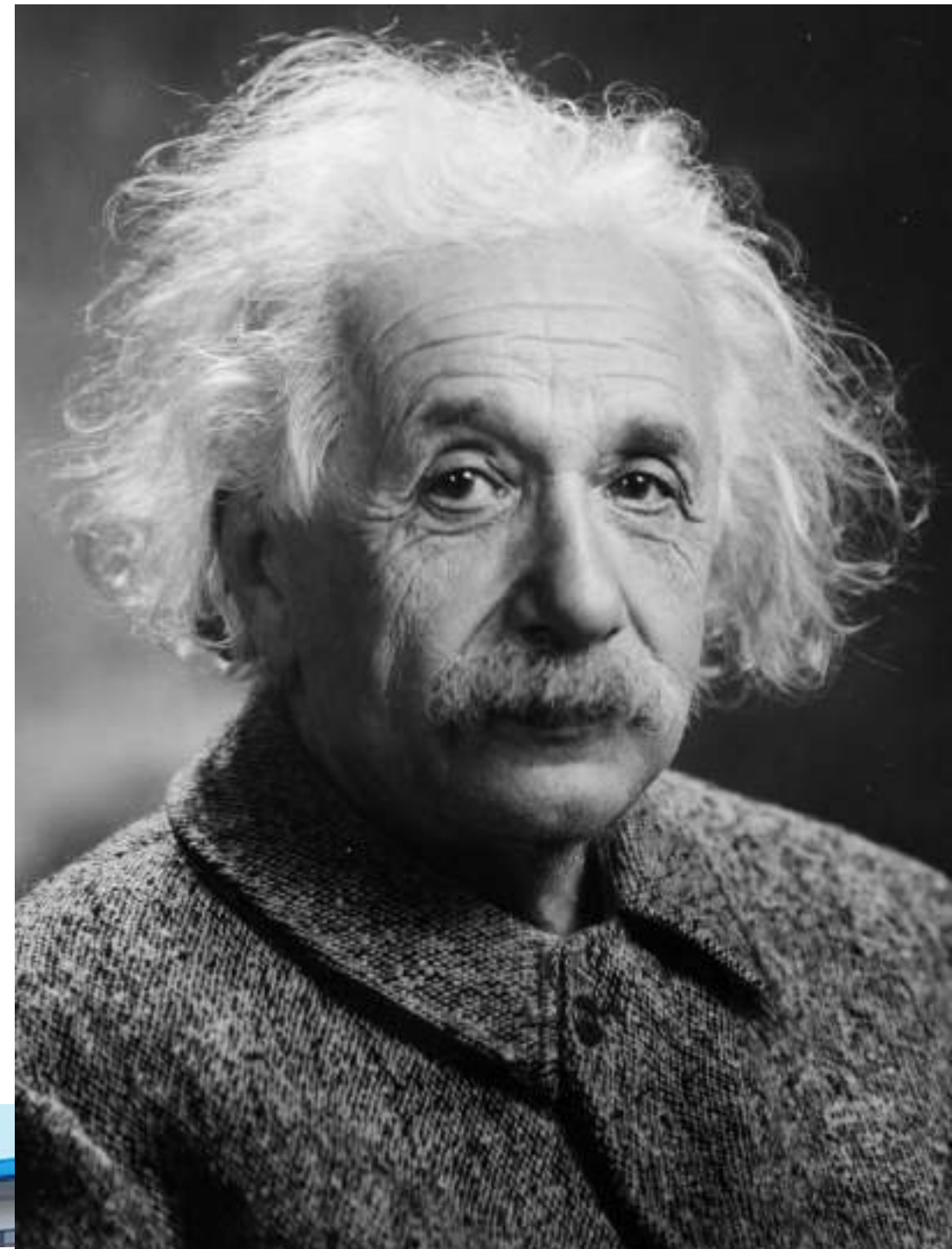
- Prof Elias Bogoro
ES, TETFUND



Introduction Cont'd

“To create the future, we will need a huge shift in thinking, values, and action.”

- Albert Einstein



Introduction Cont'd

Disruptive Technologies:

- ✓ A technology that has the capability alter our lifestyle, work, business and global economy.

DTs include:

- ✓ Mobile Internet
- ✓ Internet of Things
- ✓ Big Data
- ✓ Cloud Computing
- ✓ Advanced Robotics
- ✓ Blockchain Technology
- ✓ Automation of Knowledge Work
- ✓ 3-D Printing
- ✓ Near Autonomous Vehicles
- ✓ Renewable Electricity etc.



Introduction Cont'd

Disruptive Technologies:

“At least 40% of all businesses will die in the next 10 years if they don't figure out how to change their entire company to accommodate new technologies.”

.....John Chambers
Executive Chairman, Cisco System



Basic Operations of HEIs



Basic Operations of HEIs

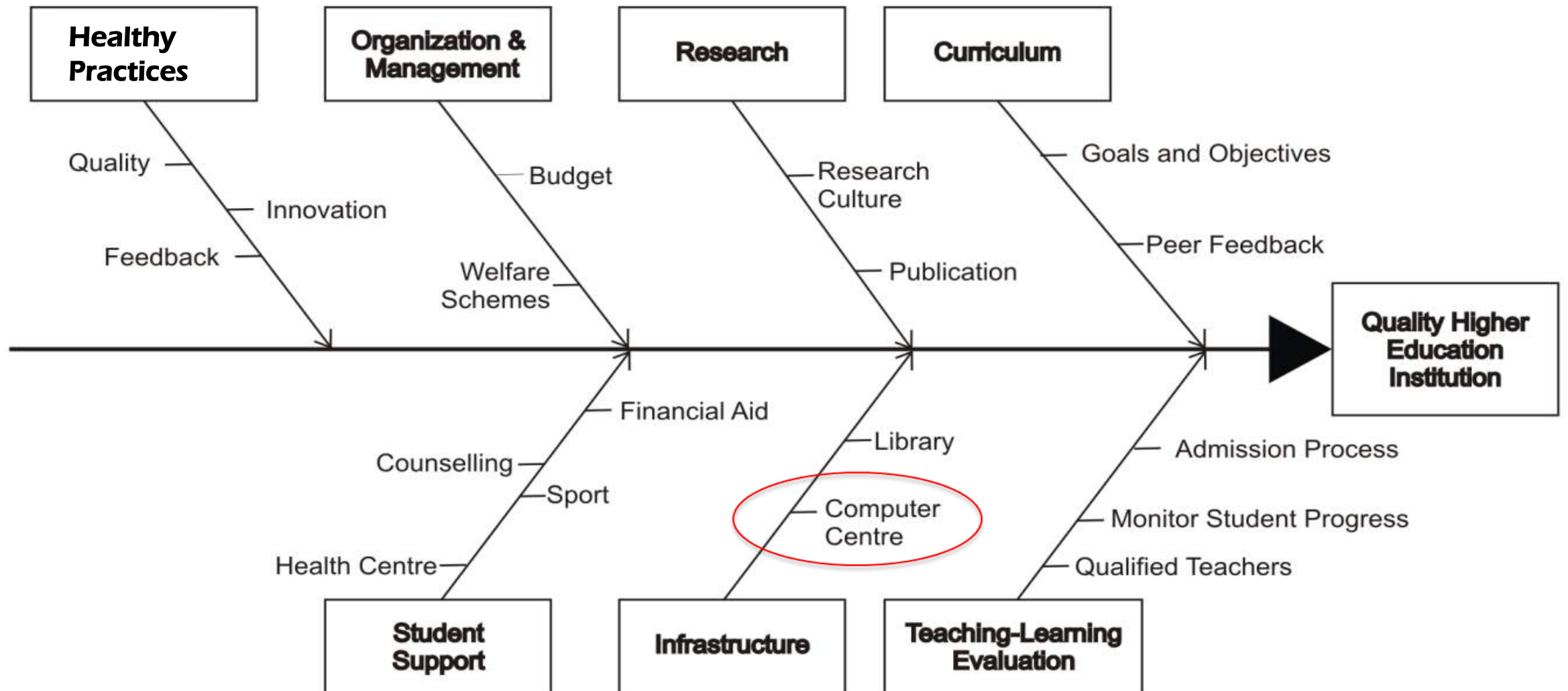


Figure 1: Fish-bone Diagram of Higher Education Operations

[Source: Mishra 2007]



Basic Operations of HEIs Cont'd

- The traditional Computer Centre has been rebranded by many institutions to reflect the current IT trends.
- Research in the digital age requires a new kind of infrastructure
 - digital libraries and databases;
 - access to networks;
 - adequate communications bandwidth; and
 - supercomputers, and various support services (National Academy of Science, 2019).



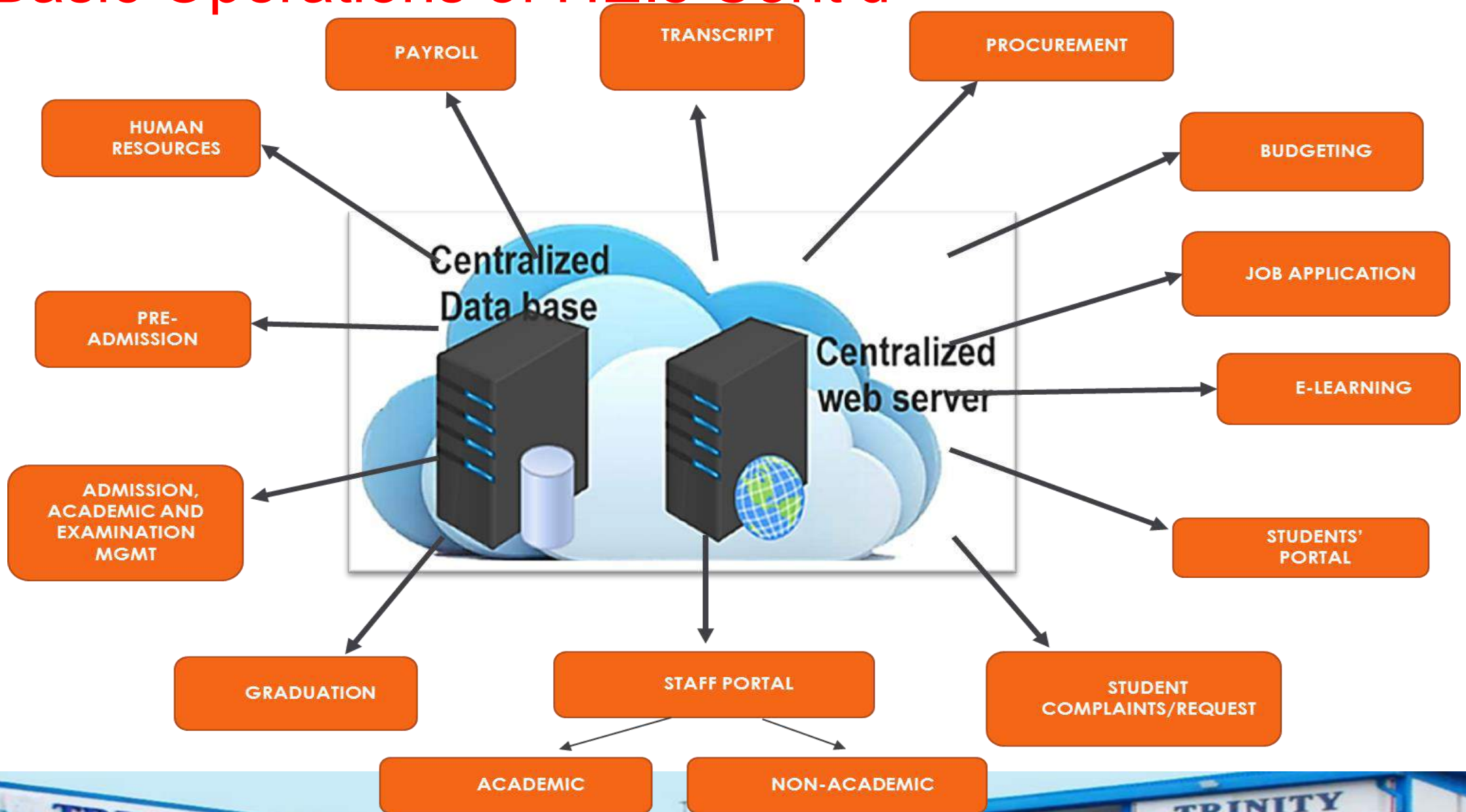
Basic Operations of HEIs Cont'd

- Higher Education Authority Future Focus Forum (2019) presented the Digital Transformation and Empowering Technologies in Higher Education in the following areas:
 - Admissions & Enrolments
 - Teaching and Learning (MOOCs, LMS, Flipped CLR)
 - Digital libraries and databases (Learning & Research)
 - Availability & Access to networks
 - Students Retention
 - Alumni Engagement
 - Students Life & Support
 - Students Recruitment, etc.



Basic Operations of HEIs Cont'd

Institutional Requirements



Ranking Agencies and Digital Infrastructure



Ranking Agencies and Digital Infrastructure

The Ranking Bodies include:

1. THEWUR
2. SJTUR
3. Webometrics
4. Repositories



Ranking Agencies and Digital Infrastructure Cont'd

The Ranking Bodies include:

1. THEWUR

- a. Teaching (30%) [Smart boards, LMS, Broadband, Tablets, etc.]
- b. Research (30%) [Digital Libraries, Databases, Broadband, Plagiarism test, etc.]
- c. Citation (30%) [OERs, Research quality, Web presence, etc.]
- d. International Outlook (7.5%) [Foreign presence – Staff & Students]]
- e. Industry Income (2.5%) [Research productivity]



Ranking Agencies and Digital Infrastructure Cont'd

2. SJTUR Parameters

Dimension	Indicator	Definition	Weight
Quality of Education	<i>Alumni</i>	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
	<i>Award</i>	Staff of an institution winning Nobel Prizes and Fields Medals	20%
Quality of Faculty	<i>HiCi</i>	Highly cited researchers in 21 broad subject categories	20%
	<i>N&S</i>	Papers published in Nature and Science	20%
Research Output	<i>PUB</i>	Papers indexed in Science Citation Index-expanded and Social Science Citation Index	20%
Per Capita Performance	<i>PCP</i>	Per capita academic performance of an institution	10%



Ranking Agencies and Digital Infrastructure Cont'd

3. Webometrics Ranking Parameters

Indicators	Description	Source	Weight
Presence	Size (number of webpages) of the main subdomain of the institution. All subdomains sharing the same (Main and Central) webdomain and all the rich files (pdf, ps, doc, pptx, etc) documents.	Google	5%
Visibility (Impact)	Number of external networks (subnets) originating backlinks to the institution's webpages.	Ahrefs Majestics	50%
Transparency (Openness)	Number of citations from top authors according to the source.	Google Scholar Citations	10%
Excellence (Scholar)	Number of papers among top 10% most cited in 26 disciplines. Data for the five year period (2011-2015) for 2018 ranking.	Scimago	35%



Ranking Agencies and Digital Infrastructure Cont'd

4. Repositories

Objectives are to:

- Support Open Access Initiatives.
- Grant free Access to Scientific and Academic publications to Researchers and Institutions in the developing countries in particular.
- Motivate Scholars and Institutions to create Web presence to reflect their Academic endeavours.
- Measure Global Visibility and Impact of Scientific Repositories.



Ranking Agencies and Digital Infrastructure

4. Repositories Ranking Parameters

S/N	Indicators	Description	Weight (%)
1.	Size	Total number of pages provided	20
2.	Visibility	Number of external links received	50
3.	Rich Files	Number of documents in pdf format from Google	15
4.	Scholar	Total number of entries in Google Scholar	15



Ranking Agencies and Digital Infrastructure

My 8-Point Agenda as Vice-Chancellor, CU

- One unique parameter that deals with Discipline, Spirituality & Infrastructure
- All the 5 parameters in THEWUR
- Two parameters in SJTUR (Alumni & Award)



Ranking Agencies and Digital Infrastructure

My 8-Point Agenda as Vice-Chancellor, CU

1. Disciplined Atmosphere for Learning

a. Evolve a CU Culture

- ◆ *Improved level of Spirituality*
- ◆ *Improved Punctuality at meetings and Chapel Services*
- ◆ *24 Hours Turnaround of memos*
- ◆ *FSP reinvigorated*

b. Provide Infrastructural Facilities

- ◆ **Improve Internet Services [Campus-wide Internet Coverage]**
- ◆ **Improve Teaching Facilities [Smart boards, Tablets (mLearning), LMS, etc.]**
- ◆ **Improve Power/Water Supply [Independent power plant]**



Ranking Agencies and Digital Infrastructure

Mobile Learning Initiative

- My administration pioneered mobile learning in the University Education System in Nigeria.
- All the students of the University were provided with Tablets that serve as a platform for deploying educational resources.
- It:
 - improves internal efficiency;
 - supports learning anywhere, anytime; and
 - offers mobile library and tutorial.



Ranking Agencies and Digital Infrastructure



Ranking Agencies and Digital Infrastructure



The CU Centre for Research & Development



The Elevator & Staircase



Digital Infrastructure and the Challenge of Access



Digital Infrastructure and Access Challenge

Admissions Quota

Applicants through UTME about 1.8m

Admissions:

1. Degree - 418k
 2. ND - 73k
 3. NCE - 74k
 4. NID - 236
- Total - about 566k

About 1.2m candidates without access



Digital Infrastructure and Access Challenge Cont'd

Any model to adopt? Yes

✓ Huge investment in Digital Infrastructure

➤ ODL

➤ MOOCs



Digital Infrastructure and Access Challenge Cont'd

Examples of Open Universities

S/No.	University	Enrollment
1.	Indira Gandhi NOU (India)	3,500,000
2.	Anadolu University, Turkey	1,141,180
3.	Allama Iqbal OU (Pakistan)	1,121,038
4.	Payame Noor University, Iran	818,150
5.	Bangladesh Open University, Gazipur	600,000
6.	University of South Africa, Pretoria	250,000
7.	Cairo University, Giza, Egypt	200,000



Digital Infrastructure and Access Challenge Cont'd

- Gentlemen, if a single country in Africa: **Cairo University** or **University of South Africa** has capacity for **40%** of our yearly intakes then **WE ARE NOT DOING WELL!!!!**



Digital Infrastructure and Access Challenge Cont'd

- Online Courses:
 - Udemy
 - Alison
 - edX
 - MIT & Harvard Courseware
 - FutureLearn



Digital Infrastructure and Access Challenge Cont'd

- The University of the People (UoPeople) Model

Our Mission

- The mission of University of the People is to offer affordable, quality, online, degree-granting educational programs to any qualified student.

Our Goals

- To provide the opportunity for higher education to students from diverse backgrounds through:
 - Utilizing the Internet to provide distance education
 - Offering programs at minimal costs
 - Providing a wide range of financial assistance options
 - Promoting the University's programs in underserved regions of the world



Digital Infrastructure and Access Challenge Cont'd

- The University of the People (UoPeople) Model
- The world's first non-profit, tuition-free, accredited, online, American university.
 - University of the People is tuition-free.
 - No charge for teaching or instruction.
 - UoPeople charges only an application fee and an Assessment Fee per course completed.
 - Those who cannot afford these fees, scholarships are available to help support their studies.



Digital Infrastructure and Access Challenge Cont'd

- The University of the People (UoPeople) Model
- The Programmes:
 - Computer Science (Associate & B.Sc degrees)
 - Business Administration (Associate, B.Sc & MBA degrees)
 - Health Science (Associate & B.Sc degrees)
 - Education (M. Ed).
- Students from 194 Countries



Mr. Shai Reshef
President, University of the People



IT Infrastructure and the Academia



IT Infrastructure and the Academia

- *"Today students are not just looking for handouts and resources stored on their VLE. They want to participate, communicate and collaborate much more with staff and each other through the learning environment."*

– Karen Barton,

Director of the Learning and Teaching Innovation Centre,

University of Hertfordshire



IT Infrastructure and the Academia Cont'd

Necessitated by:

- ✓ Desire to expand Access
- ✓ Growing cost of Tuition
- ✓ Declining Public Sector funding
- ✓ Rise of Alternative Channels to Access Learning (ODL, MOOCs, LMS, etc)
- ✓ Demand for Competency-based Education
- ✓ Personalized Education
- ✓ Alumni Engagement



IT Infrastructure and the Academia Cont'd

- **Digital Infrastructure to Support Tomorrow's Research Communities (National Academy of Science , 2019)**
 - ✓ Digital Libraries & Databases
 - ✓ Internet/Network Access
 - ✓ Broadband
 - ✓ Collaboratoy – Collaboration & Laboratory (Labs without walls)



IT Infrastructure and the Academia Cont'd

The Nigerian Research and Education Network (NgREN) Initiative:

Challenges

- Lack of adequate Internet bandwidth compared to universities in other countries due to high costs.
- Lack of interconnectivity within and outside the country for teaching and research collaborations with inability to:
 - Create and share requisite academic contents
 - Develop high impact collaborative teaching and learning platforms
 - Develop high impact collaborative research programmes
 - Develop advanced science and technology talents
 - Imprint our footprints on the global research and innovation landscape
 - Improve upon our global rankings amongst universities



IT Infrastructure and the Academia Cont'd

NgREN Scope

- **Internet/Telecommunication Services:**
 - At least 155 mbps of Internet bandwidth to each member, hosting of web sites, DNS, IP telephony platform, video conferencing services.
- **Security services:**
 - antivirus, anti spam, intrusion prevention, denial of service protection, web filtering, etc.



IT Infrastructure and the Academia Cont'd

NgREN Scope

- **Planned Services:**

- IPLC to London, repositories setup, access to resources from other RENs, storage services, high performance computing, Identity Federation (authentication, authorization, access control), Managed services, Level 2 and Level 3 Network support, Internet Exchange, IPv4 & IPv6 infrastructure, BGP peering. Subscription to Ebsco host e-journals and eBooks, subscription to Science Direct e-journals



Institutional ICT Infrastructure



Institutional ICT Infrastructure Cont'd

PHYSICAL HARDWARE SERVER

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
<ul style="list-style-type: none"> • HP ProLiant DL380 Gen 10. • Two (2) 42U Cabinets 	<ul style="list-style-type: none"> • HP DL 380 G7 (1.86GHZ, 4GB RAM, 148GB (RAID)). • DL 380 G6 1.86GHZ, 4GB RAM, 150GB (RAID) • DL 380 G5 1.86GHZ, 8GB DUAL PROCESSOR RAM, 300GB • Two (2) 42 U Cabinets 	<ul style="list-style-type: none"> • Sun Microsystem Servers (4 Units of 21U Cabinet Rack Available) • HP Servers, DL 380 G7, DL 380 G6. 42 U Cabinet • 2 Units of 21U Cabinet Rack Available 	<ul style="list-style-type: none"> • HP Servers DL 380 G6 1.86GHZ. • One (1) 42U Cabinet 	<ul style="list-style-type: none"> • HP Servers • Huawei Server for Cloud Computing 	<ul style="list-style-type: none"> • HP 1800 Blade Servers • HP Procurve Servers



Institutional ICT Infrastructure Cont'd

SOFTWARE VIRTUALIZATION

	Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
Server Operation System Software	<ul style="list-style-type: none"> Windows Standard, Linux 	<ul style="list-style-type: none"> Windows Standard, Linux 	<ul style="list-style-type: none"> Windows Standard, Linux, Solaris 	<ul style="list-style-type: none"> Windows Standard, Linux 	<ul style="list-style-type: none"> Windows Standard, Linux, Huawei Virtualization Software 	<ul style="list-style-type: none"> Windows Standard, Linux
Server Virtualization Technology	<ul style="list-style-type: none"> Vmware vSphere and VCenter. 	<ul style="list-style-type: none"> Vmware vSphere 	<ul style="list-style-type: none"> Vmware vSphere 	<ul style="list-style-type: none"> Vmware vSphere 	<ul style="list-style-type: none"> Vmware vSphere 	<ul style="list-style-type: none"> Vmware vSphere



Institutional ICT Infrastructure Cont'd

Application Server

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
<ul style="list-style-type: none"> • Service (DNS) Server. • Dedicated Web Server with Dedicated IPs • Authentication Servers • E-mail Server • Cloud server for Library OPAC • VOIP Server 	<ul style="list-style-type: none"> • Domain Naming Service (DNS) Server. • Web Server. • E-mail Server • Authentication Servers • VOIP Server 	<ul style="list-style-type: none"> • Domain Naming Service (DNS) Server. • Email Servers. • Web Server. • Authentication Servers • VOIP Server 	<ul style="list-style-type: none"> • Domain Naming Service (DNS) Server. • Email Servers. • Web Server. • VOIP Server • Authentication Servers 	<ul style="list-style-type: none"> • Domain Naming Service (DNS) Server. • Email Servers. • Web Server. • Authentication Servers. • VOIP Server 	<ul style="list-style-type: none"> • Domain Naming Service (DNS) Server • Email Servers • E-Library Servers • Teleconference Servers • Web Server • VOIP Server • Authentication Servers



Institutional ICT Infrastructure Cont'd

NETWORKING INFRASTRUCTURE

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
<ul style="list-style-type: none"> • Mikrotic CCR 1036-12G-4S. • Cisco Catalyst WS-C3750G-24PS-S 	<ul style="list-style-type: none"> • GATEWAY Router: MikroTik CCR1036-12G-4S. • CORE Switch: Cisco Catalyst C3560-E 24-Port, 2x10G uplink. • Access Switch: Cisco Catalyst 2960S-24TS-L Switch 	<ul style="list-style-type: none"> • GATEWAY Router: Bifrost(Linux), Router: Cisco 2821 ISR). • CORE Switch: Huawei S9700 X2. • Distribution Switch S7700 X2. • Access Switch: Cisco Catalyst 2960 	<ul style="list-style-type: none"> • GATEWAY Router: Cisco 2800 Series Router • CORE Switch: Cisco 2960 Switch. • Access Switch: Cisco 2950 / 2960 Switches 	<ul style="list-style-type: none"> • GATEWAY Router: Cisco 2821 ISR). • CORE Switch: Cisco Catalyst C3560-E 24-Port. • Distribution Switch: Cisco 2950 / 2960 Switches 	<ul style="list-style-type: none"> • GATEWAY Router: Bandwidth Aggregator and Router. • Distribution Switch: Cisco Switches. - Cisco SF300 Switch DLink Layer 2 Switches



Institutional ICT Infrastructure Cont'd

SECURITY PROTECTION

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
<ul style="list-style-type: none"> • Check Point 1450 Next Generation Threat Prevention & SandBlast 	<ul style="list-style-type: none"> • Open-Source. • Cisco • SonicWALL 	<ul style="list-style-type: none"> • Open-source Bifrost(Linux) Firewall 	<ul style="list-style-type: none"> • Software Firewall (Linux OS). • Authentication System 	<ul style="list-style-type: none"> • Software Firewall. • Authentication. • VLANs 	<ul style="list-style-type: none"> • Software Firewall Authentic ation

FIBER INFRASTRUCTURE

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst.
<ul style="list-style-type: none"> • MTN Fibre 	<ul style="list-style-type: none"> • There is a 1Gbps Fiber Linking all major buildings 	<ul style="list-style-type: none"> • Fiber Cable Ring Link within the campus 	<ul style="list-style-type: none"> • Fiber Cable Ring Link within the campus 	<ul style="list-style-type: none"> • Fiber Cable Ring Link within the campus 	<ul style="list-style-type: none"> • Fiber Cable Ring Link within the campus



Institutional ICT Infrastructure Cont'd

POWER BACKUP SYSTEM

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
<ul style="list-style-type: none"> • CyberPower PR1500LCDR T2UN Line-Interactive • 1500VA 8AC outlet(s). • 15 KVA APC UPS Units 	<ul style="list-style-type: none"> • APC UPS Units. Power Inverter Units 	<ul style="list-style-type: none"> • 2 Units of 10KVA UPS, 1 Units of 6KVA Power Inverter. • 1 Units of 6KVA Power Inverter. 15KVA UPS. 20KVA Automatic Voltage Regulator. 15KVA UPS 2 	<ul style="list-style-type: none"> • 2 Units of 3KVA Power Inverter. • 1 Unit of 2.5KVA Sukom UPS. - 2 Units of 3KVA Power Inverter 	<ul style="list-style-type: none"> • 1Unit of 15KVA Centralized Power Inverter. • 1 Units of 3KVA Power Inverter 	<ul style="list-style-type: none"> • 1 Unit of 10KVA Centralized Power Inverter. - • 3 Units of Zinox 5KVA Power Inverter 1 Unit of APC 3KVA Power Backup



Institutional ICT Infrastructure Cont'd

INTERNET ACCESS

Inst. A	Inst. B	Inst. C	Inst. D	Inst. E	Inst. F
<ul style="list-style-type: none"> • MTN Fibre Optics (10M/10M) • Vodacom (P2P) Radio Connection. (20M/20M) • NCC C-band (512kbp) 	<ul style="list-style-type: none"> • 21st Century x 2 STM1. • MTN. • GLOBACOM 	<ul style="list-style-type: none"> • MainOne Cable. • NIXP. • GUAP 	<ul style="list-style-type: none"> • IPNX. • Onet Radio Connectivity to ISPs. 25mbps Aggregated Link <ul style="list-style-type: none"> - 10mbps from IPNX - 15mbps from Onet) 	<ul style="list-style-type: none"> • A VSAT Connectivity to 1 ISP (1mbps/512kbps). • A Radio Connectivity to other ISP. (47mbps Aggregated Link <ul style="list-style-type: none"> - 45mbps - 2mbps) 	<ul style="list-style-type: none"> • MLTECH. • SUBURBAN Radio Connectivity to ISPs. 30mbps Aggregated Link <ul style="list-style-type: none"> - 15mbps from MLTECH - 15mbps from SUBURBAN. - VSAT Modem



Recommendations & Conclusion



Recommendations & Conclusion

- ✓ The Access challenge is real!
- ✓ The Quality challenge is real!
- ✓ Education tourism is on the increase!
 - A drain on our economy
 - Lost N1.5t yearly to Education Tourism (2013)
 - Ghana raking at least \$1b yearly (@N150 to \$)



Recommendations & Conclusion

✓ UNESCO (2012):

- UK - 17,542 Students
- US – 7,318 Students.
- Ghana – 71,000 Students.
- S/Africa – 1,908 Students.
- Canada – 6,000 (2014) etc.

Can we really match these foreign universities in terms of quality?



Recommendations & Conclusion

- ✓ Investment in Digital Infrastructure is key
- ✓ The 21st Century HEIs, there is need for investments in:
 - 24/7 Power supply
 - 24/7 Internet facility
 - Ubiquitous ICT deployment
 - Currency of Library databases & eServices, etc



Recommendations & Conclusion

- ✓ At this level, government is handicap.
- ✓ PPP is a welcome development
- ✓ Within my first few weeks of existence of Trinity University:
 - ✓ MainOne visited unsolicited, did a personal survey and submitted a proposal on:
 1. Connectivity Services
 2. Data Centre Services
 3. Cloud Services
 4. Managed Services

A welcome development



Recommendations & Conclusion

- ✓ The NgREN initiative has the capacity to place the Nigerian University System on the same pedestal with world-class universities.
- ✓ It will improve dramatically the Access & Quality of education in Nigeria as well as foster Staff/Student exchanges because of the enabling Digital Infrastructure offered by the platform.
- ✓ It has the potential of crashing the ICT by about 70%.



Recommendations & Conclusion

✓ IT Professionals cannot afford to sit of the fence any longer.

✓ Let's collaborate:

✓ Town & Gown

✓ Operators (IT) and Regulators (NUC)

✓ Let's do the University of the People model.

✓ To the Leadership of NCS & CPN.....

Who knows whether you are in office for such a time as this....!!



Recommendations & Conclusion

- ✓ Finally, for the 21st Century HEI to remain relevant and competitive, there must be massive investment and deployment in ICT in all her operations, and most importantly in:
 - ✓ Teaching
 - ✓ Research
 - ✓ Citation, etc.
- ✓ These would enhance the ranking of the University Globally:
 - THE, Webometrics & Reputability, etc.
- ✓ Accord the Researcher global recognition and respect among the comity of World-class Academics.



Thank you for your attention

