

ICT Research Capacity: Challenges & Strategies in Kenya

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Research : Systemic problem

- No National Research Policy
- No national funding mechanism for Research
- Kenyan universities have no funding mechanism for increasing the PhD throughput
- Kenyan universities do not explicitly measure their performance based on the PhD throughput, journal articles published or the patents registered per year
- Low research outputs by Schools , faculties departments
- Staff commitment to research contingent invariably upon promotional opportunities or student supervision rather than promoting scholarship to improve learning outcomes.
- Research Quality is often questionable

ICT in University Education:

All Kenyan universities now offer at least one ICT professional degree programme.

- there is a very limited pool of ICT faculty available in Kenya, especially at doctoral levels.
- Many of the ICT faculty also has no professional experience in ICT industry as engineers, software developers, or in the emerging area of computer and network security.
- There are very few ICT graduate degree programmes in Kenya and only the University of Nairobi has a small number of doctoral ICT candidates (7) registered locally.
- Current doctoral staff at Universities are an endangered species due to mobility
- Most students who pursue graduate ICT degrees in other countries such as South Africa, UK, or USA never return on study completion. There will be an even greater shortage of ICT faculty in the future as more universities continue to increase enrolments in ICT degree programmes.

Opportunities 1

- Huge demand in Kenya for ICT applications in business (especially the SME sector), government, hospitals, and educational institutions.
- Since imported software applications are expensive, there is an opportunity to set up software houses in universities or close to universities and use students and faculty as software developers.
- the large global business process outsourcing or the call centre market has not benefited universities.
- Some of the existing private sector partnerships with large ICT companies such as Microsoft, Cisco, Oracle, Safaricom, or Zain could be approached to establish specialised ICT labs in Universities and also to setup software houses.

Opportunity 2

- **The Government of Kenya has set aside KShs. 900 million in the current 2008-2009 budget to establish a Business Process Outsourcing (BPO) Park in Kenya as part of its commitment to Vision 2030 with the goal of transforming Kenya into a premier destination for outsourcing by 2012 and creating 15,000 new jobs primarily for global clients.**
- **In addition to the BPO Park the following projects are set for completion : (1) Undersea fibre cable - TEAMS & SEACOM - by June 2009 and (2) Terrestrial fibre cable - connecting all major towns and districts countrywide - by May 2009. This will stimulate demand for both local and global outsourcing as the cost of bandwidth decreases and quality of connectivity improves countrywide.**
- **The lack of undersea optical fibre access means that ICT international partnerships for software development and Business Process Outsourcing (BPO) opportunities are limited. The emergence of other ICT Centres of Excellence in the region (e.g., Rwanda, Mauritius, and South Africa), means that universities might not benefit from the ICT developed talent and might also not retain their critical personnel.**

Strategic Objectives

- to develop and implement institutional ICT policies and strategic plans;
- to strengthen the ICT human capacity in Kenyan universities;
- to provide adequate networked campus infrastructure to serve the teaching, learning, and management needs of the universities;
- to extend the reach and enhance the capacity and quality of the national university interconnection infrastructure;
- to increase the international internet bandwidth and reduce the cost of high quality service;

Strategic Objectives

- to facilitate educational content creation, sharing, and delivery;
- to increase the quality and quantity of national ICT human capacity in strategic areas; and
- to improve the socio-economic development of the country using ICT innovations and research.

Organisational Restructuring of ICT at UoN

Year	Organisational Restructuring	Line Functions(LF)	Sections
1969	Computer Centre	Technical	Computer Operations
1977	Institute of Computer Science	Academic	Dept of Computer Science
		Technical	Computer Operations
1986	Institute of Computer Science	Academic	Dept. of Computer Science
		Technical	Computer Services
1992	Institute of Computer Science	Academic	Dept. of Computer Science
		Technical	Computer Operations
			Management Information Systems
2002	Dept. of ICT Services	Communication & Network Services	
		Management Information Systems	
		Learning Technologies	
2002	School of Computing and Informatics	Computer Science	
		Information Systems	
		Telematics	

School of Computing & Informatics

On-going programmes:

- Diploma (Computer Science) exit point for BSc(C.Sc),
- BSc. (Computer Science),
- Bachelor of Education (Information and Communications Technology)
- MSc (Computer Science) {specialist course}
- Postgraduate Diploma (Information Systems), exit point for MSc (IS)
- M.Sc. (Information Systems), {conversion Course}
- M.Sc.(Applied Computing) and
- Ph.D.

Research groups

- Artificial Intelligence Research Group (AI);
- Distributed Systems Research Group (DS);
- Information Systems Research Group (IS).

Currently, some of the research activities within these three groups includes:

- Natural language processing (NLP): Research in Swahili and other local Kenyan languages, development of text-to-speech systems etc. (AI)
- Localization <http://africanlocalization.net/>
- Telemedicine (AI group)
- Local language Interfaces for the Visually challenged (AI & DS)
- Grid computing: This involves the use of intelligent agents, scheduling, issues of quality of service etc. (AI & DS groups)
- Mobile phone telephony (AI & DS group) <http://www.mopra.org/>

Research groups Activities

- ICT policy and e-governance, e-strategies (IS group)
- Geographical Information Systems (GIS): National Spatial Data Infrastructure, Modelling and decision support (IS group)
- Electronic learning technologies (IS group)
- ICT for development and technology forecasting (IS group)
- Application of ICT in organisational change management (IS group)
- Growth Modelling: Epidemiology , Biomass partitioning (IS)
- Village e-Science for Life
- Information systems Support for Nomadic communities (IS & AI)
- Electronic learner modelling (AI & IS group)

SEVENTH FRAMEWORK PROGRAMME

FP/7: Relevant Challenges

1. Pervasive and
Trusted Network
and Service
Infrastructures

2. Cognitive
Systems,
Interaction,
Robotics

4. Digital Libraries
and Content

1. Pervasive and Trusted Network and Service Infrastructures:

- Grid Computing
- Multi-Agent Systems in Grid Computing
- Resource Allocation
- Mobile Telephony



2. Cognitive Systems, Interaction, Robotics

- Multi-Agent Systems and Scheduling
- Language Technology
- Machine Learning



4. Digital Libraries and Content

- Expert Systems
- Multilingual Content Development
- E-learning
- Content Development



END



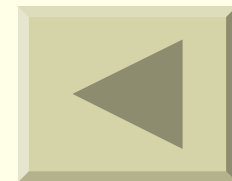
Capacity-building and Mobility at SCI

Partner	Programme	Period	No. of Scholarships	Successful Completion	Retention
UoN/DAAD	PG Diploma Computer Science	1980 1994	2-3 annually	All	3
UNESCO	PG Diploma Computer Science	1985 1989	1 annually (regional)	Most	0
ODA/TCT (UK)	PhD (UK) MSc (UK)	1985-92 1985-88	7 3	6 3	0 3
IDA/World Bank	PhD (UK) HND	1992 1992	1 1	1 1	0 0
	PhD (UK)	1983-86	1	1	1
Other	PhD (Finland)	2001-05	1	1	1
	PhD (USA)	2001-05	1	1	0
Commonwealth Secretariat	MSc PhD (split)	1995 2004-2006	1 1	1 1	1 1
VLIR	PhD (split)	1998-2002	3	2	2
	PhD (split) MSc (Belgium) MSc (UoN)	2003-2008 1998-2002 1998-2002	4 8 2	Pending 6 1	1 0
	----- UoN Local Registration	----- 2007-2010	----- 4	----- Pending	-----
TOTAL (excl. PG Diploma)			37	24	10



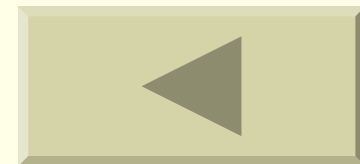
To improve the socio-economic development of the country using ICT innovations and research

- **this strategic objective also aims to align the ICT professional education as well as the integration of ICT into university education with the socio-economic development agenda of the country**



To strengthen the ICT human capacity in Kenyan universities. 1

- **Establish a competitive scheme of service for ICT professionals and faculty working in Kenyan universities.**
 - **Such a scheme would take into account the employment market in the country of competent ICT professionals.**
 - **The outcome of such a scheme would be an increase in retention and motivation of the ICT professionals and faculty.**
- **Recruit an adequate number of ICT professionals. The envisaged increase in levels of integration of ICT into university education will require an increased number of qualified ICT professionals and faculty.**
- **urgent need to recruit and train doctoral level faculty in Kenyan universities.**
- **necessary to conduct a compressive assessment of the ICT human capacity (professionals and faculty) in Kenyan universities.**
- **Develop ICT management best practices**



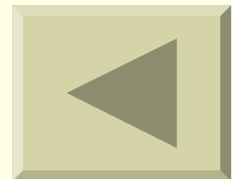
To increase the quality and quantity of national ICT human capacity in strategic areas 1

- Integrate ICT into the teaching and learning processes of all degree programmes as well as in conducting all other institutional business.
- Integrate the teaching of humanities and social sciences in ICT degree programmes
- Enhance the quality of ICT degree programmes offered in Kenya
- Align the ICT professional degree enrolment in Kenyan universities to the national ICT education strategy.



To increase the quality and quantity of national ICT human capacity in strategic areas 2

- Strengthen ICT doctoral programmes in all universities.
- Although all universities offer one or more ICT undergraduate degree programmes,
 - only three universities (UoN,JKUAT,Stratmore) have graduate programmes at Masters Level and
 - only two (UoN,JKUAT) at doctoral level.
- There is a diminishing number of full time, doctoral level establishment faculty in Kenyan universities. UoN (6 of 18), JKUAT (3 of 6), Strathmore U(3 of 6) Egerton (2 of 7), KU (0 of 9), Kabarak (0 of 8),USIU (2of 6)



ICT Degree Programmes in some Kenyan Universities

Degree Course	Public Universities	Private Universities
Computer Science	Yes (all)	Yes (African Nazerene U, Daystar Univ, Kiriri Women Un. , Kabarak Univ)
Computer Eng.	Yes (Moi, KU, JKUAT)	No
Electronic Eng.	Yes (UoN, JKUAT, Moi)	Yes (Daystar)
Information Systems	No	Yes (USIU, Stratmore U, Daystar U)
Software Eng.	Yes (KU)	No
Computer Technology / IT	Yes (KU, JKUAT)	No



Grid Computing

■ Elisha T. O. Opiyo: opiyo@uonbi.ac.ke

■ Publications

- **[2004] Elisha T. O. Opiyo**, Erick Ayienga, Katherine Getao, Bernard Manderick, Okello-Odongo, Ann Nowé(2004). **Issues in grid computing in the context of education.** *International ICT workshop:Application of ICT in enhancing higher learning education*, Dar-es-salaam Tanzania, April 2004.
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Multi-Agent Systems in Grid Computing

- Eric Masiga Ayienga: ayienga@uonbi.ac.ke
- Publications
 - **[2004] Eric Ayienga**, Okello-Odongo, Bernard Manderick, and Ann Nowe, “**Multi Agent Systems for Efficient Quality of Service Routing in Grids**”, European Research Consortium on Informatics and Mathematics (ERCIM) News, No. 59, October 2004, pp. 40–41.
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 - **[2006] Eric Ayienga**, Elisha Opiyo, Bernard Manderick, Okello-Odongo, Ann Nowe “**Multiagent Systems for Bandwidth Optimization in Wireless Grids**”. 2nd Annual International Conference on Sustainable ICT Capacity in Developing Countries SREC06, August 6-9, 2006, Makerere University, Kampala, Uganda



Resource Allocation

- Eric Masiga Ayienga: ayienga@uonbi.ac.ke
- Elisha T. O. Opiyo: opiyo@uonbi.ac.ke
- Publications
 - **[2009] Erick Ayienga, Opiyo Elisha T. O., Katherine Getao, Bernard Manderick, Okello-Odongo, “The El Farol Bar Problem Approach to Resource Allocation in Ad Hoc Wireless Networks”**. In Proceedings of the International Conference on Research for Sustainable Development and Institutional Capacity Building”, 2nd to 5th February 2009, Naivasha, Kenya
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Mobile Telephony

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waiganjo@uonbi.ac.ke
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 - **Sigmoid weighted adaptive predictive text entry for short message service (SMS)**, Peter W. Wagacha and Dennis Chege. Proceedings of the 2nd Annual International Conference and Workshop on Sustainable Research Excellence in Computing (SREC '06), Makerere University, Kampala, Uganda 6th - 9th August 2006.



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- Eric Masiga Ayienga: ayienga@uonbi.ac.ke
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 - **[2008] Opiyo Elisha T. O.**, Erick Ayienga, Katherine Getao, Bernard Manderick, Okello-Odongo, Ann Nowé (2008). **Game Theoretic Multi-Agent Systems Scheduler for Parallel Machines with Fixed Parameters**, in the Proceedings of The Fourth International 4th Annual International Conference on Computing and Research- SREC08, Makerere University, Uganda, 3-6 August, 2008.
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Language Technology 1..

- Wanjiku Ng'ang'a: wanjiku.nganga@uonbi.ac.ke
- Peter Waiganjo Wagacha: waiganjo@uonbi.ac.ke
- Publications
 - **Word Sense Disambiguation: Extending Swahili Language Technology with Machine Learning.** W. Ng'ang'a. *PhD Dissertation, Helsinki University Press, Helsinki University, Finland (2005).*
 - **Towards computer-assisted translation of African languages: Requirements, Challenges and Achievements.** W. Ng'ang'a. *Conference proceedings of the West African Languages Congress, 2004, Ibadan, Nigeria.*
 - **Semantic Analysis of Kiswahili Words using the Self Organizing Map.** *Nordic Journal of African Studies* 12(3): 407-425 (2003).

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- **Bootstrapping Morphological Analysis of Gikuyu Using Unsupervised Maximum Entropy Learning**, Guy De Pauw, Peter Waiganjo Wagacha
- **Automatic Diacritic Restoration for Resource-Scarce Languages**, Guy De Pauw, Peter W. Wagacha and Gilles-Maurice de Schryver
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Machine Learning

- Rasna Walia: rwalia@uonbi.ac.ke
- Publications
 - **Collaborative Filtering: A Comparison of Graph-Based Semi-Supervised Learning Methods and Memory-Based Methods** (In Proceedings of the 4th Annual International Conference on Computing and ICT Research, 2008)
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- Eric Masiga Ayienga: ayienga@uonbi.ac.ke
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 - [1997] Saatchi, R., **Ayienga, E.M.**, Travis, J.R. and Rippon, F., (1997), "***An expert system developed to assist digital electronic teaching***", IEE Journal in Engineering, Science and Education, Vol. 7, No. 2, pp. 81-87.



Multilingual Content Development

- Wanjiku Ng'ang'a: wanjiku.nganga@uonbi.ac.ke
- Publications
 - **African Language Technology for Multilingual Local Content Development.** *Conference Proceedings of IST-AFRICA 2008, Windhoek, Namibia.*
 - **Multilingual Content Development for eLearning in Africa.** *Conference proceedings of the 1st e-Learning Africa Conference, Addis Ababa, Ethiopia (2006).*
 - **Multilingual technology for teaching mathematics.** *Olga Caprotti, Wanjiku Ng'ang'a, Mika Seppälä. Proceedings of the International Conference on Engineering Education, Instructional Technology, Assessment, and E-learning (EIAE 05), December 10-20, 2005.*
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E-learning

- E.I Omwenga: eomwenga@uonbi.ac.ke
- Publications
- **“Towards an Education Evaluation Framework: Synchronous and Asynchronous e-Learning Cases”**.
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- **A model for introducing and implementing E-learning for delivery of educational content within the African context.**
Omwenga E.I., Waema T. M., Wagacha W.P.



e-Content

- E.I Omwenga eomwenga@uonbi.ac.ke
- Publications
- **Development and application of an objectives-driven e-content structuring and deployment model (odc-sdm).** Omwenga, E.I., Waema, T.M., Eisendrath, G..P.C. and Libotton, A
- **A Novel Approach to e-Content Development Process: Complexity Reduction and Process Automation .** Omwenga E.I Njoroge M.N.
- **Complexity Reduction in the Formative Evaluation Process using the QuizIntegrator**
Omwenga E.I., Chepken C, Duble B

