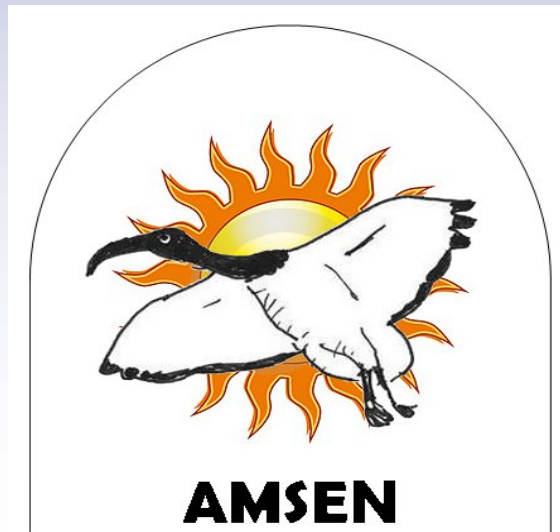


African Materials Science and Engineering Network (AMSEN) – A Carnegie-AIS RISE Network: Progress and Achievements

L.A. Cornish (Director)



Nodes in AMSEN

DST/NRF Centre of Excellence in Strong Materials,
University of the Witwatersrand, South Africa

Prof. L.A. Cornish (Founding Director)



University of Namibia, Namibia

Prof. F.P.L. Kavishe (Founding Secretariat)



University of Nairobi, Kenya

Prof. G.O. Rading (Founding Deputy Director)



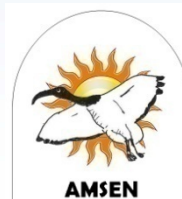
Federal University of Technology, Akure, Nigeria

Prof. J.O. Borode



University of Botswana, Botswana

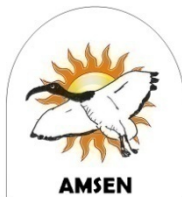
Prof. P.K. Jain





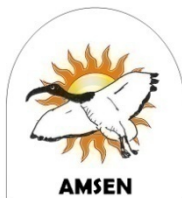
AMSEN's Mission

- Become a base for African students to be trained, and for African researchers to collaborate
- Work on problems for Africa
- Train students for either an academic career, industry, or one which can influence government decisions **in Africa**
- Promote social responsibility for development



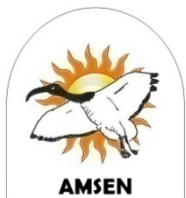
Aims

- Build Faculty capacity → Build the next generation
- Relevant research
- Training + mentoring by **co-supervising students with more experienced staff within the Nodes**
- Exploit the respective strengths of individual partner institutions for the collective benefit to build capacity
- Encourage intra-Africa cooperation among the five Universities and encourage sharing of both manpower and equipment, by **co-supervision of students between Nodes**
- Widen the exposure of the students via multiple supervision and exposure within the Nodes



Communication methods

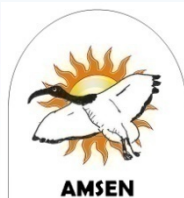
- Mostly e-mails
- Visits within Research Teams: mentoring & equipment access (e.g. UoN→UNAM; UB→UoN; UB→Wits;
- RISE Reports / Annual Report (to university): inputs and outputs, progress...
- Monthly updates to RISE website
- Short reports from the students
- Publications in journals are strongly encouraged, as well as making presentations at conferences



Research Team	Research Team Members	Research Team	Research Team Members
Corrosion	Prof. F.P.L. Kavishe (UNAM)	Ceramics	Prof. I. Sigalas (Wits)
	Mr J. Van der Merwe (Wits)		Prof. J.O. Borode (FUTA)
	Dr P.A. Olubambi (FUTA)		Dr J.O.T. Adewara (FUTA)
	Prof. L.A. Cornish (Wits)		Dr P.A. Olubambi (FUTA)
	Prof Archbong (UNAM)		Dr B.O. Adewuvi (FUTA)
Alloy Development	Prof. G.O. Rading (UoN)	Polymers	Prof. P.K. Jain (UB)
	Prof. L.A. Cornish (Wits)		Dr V. Ochieng (UoN)
	Dr N. Sacks (Wits)		Prof. G.O. Rading (UoN)
	Prof. F.P.L. Kavishe (UNAM)	Concrete / clays	Prof. F. Kavishe (UNAM)
	Prof. J.O. Borode (FUTA)		Dr S. Ekolu (Wits)
	Dr B.O. Adewuvi (FUTA)		Prof. F. Kavishe (UNAM)
	Prof. J. Kihiu (UoN)		Prof. G.O. Rading (UoN)
	Mr S. Coetzee (UB)		Dr S.O. Abuodha (UoN)
Computational Physics	Prof. T.E. Lowther (Wits)		Dr S.W. Mumenya (UoN)
Solar cells and Thin Films	Prof. B. Aduda (UoN)	Nanotechnology	Prof. S. Iyuke (Wits)
	Dr T.S. Sathiaj (UB)		Prof. F. Kavishe (UNAM)
	Prof. J.M. Mwabora (UoN)		Prof. J.O. Borode (FUTA)
	Dr B.O. Adewuvi (FUTA)		
Composites Research	Dr J.A. Omotovinbo (FUTA)	Phase Diagram Research	Prof. L.A. Cornish (Wits)
	Dr K.K. Alaneme (FUTA)		Prof. P.K. Jain (UB)
	Prof. R. Paskaramoorthy (Wits)		Prof. M.J. Witcomb (Wits)
	Prof. G.O. Rading (UoN)	Solar cells and Thin Films	Mr S.H. Coetzee(UB)
	Prof. F. Kavishe (UNAM)		Prof. B. Aduda (UoN)
	Prof. S. Singh (UNAM)		Dr T.S. Sathiaj (UB)
	Prof. I. Sigalas (Wits)		Prof. J.M. Mwabora (UoN)
	Prof. J. Morris (SABINA)		

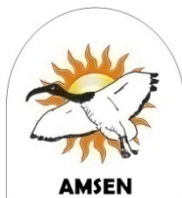
Activities

- XRD Workshop: Hands-on practice on operation and spectra analysis, XRD Unit, U. B, 22 - 23 Feb 2011.
- DST-TAP Foundry Course on Metallography, Interpretation and Measurement of Microstructures and Fractures. Course conducted by George Vander Voort, MINTEK, SA, 6 - 10 June 2011.
- Hardness Testing Workshop, 28 - 29 July 2011, by Apollo Scientific Engineer, Chris Manning.
- SEM-EDX Training: Demonstration and Practice Workshop, UB, 1 -5 August 2011
- Inter-Node visits
- PASMAT



Progress to date: Achievements

- One provisional patent has been lodged
- AMSEN Workshops continue to be run and well-received
- A. Olasiende (FUTA), using her Women in Science Prize: TATA Fellowship 2010 to present in Perth, Australia
- More papers!
- AxioObserver A1 Microscope now being used, after 2-day workshop, at FUTA
- Two Faculties promotion
- O. Olaniran is undertaking PhD at TUT, South Africa: supervised by Dr Olubambi
- B. Odera is in the Materials Science International Team, after attending the MSI Workshop, Ringberg, Germany
- Filled student vacancy at UB: Mr Mokaloba, Mech. Eng., M.Phil (part-time)



Student degree progress

Wits: MSc now submitted and upgraded to PhD, and 3 PhDs

UoN: 1 MSc completed and 1 ongoing, 2 PhDs

UNAM: 1 MSc graduated 2010/2011 and 1 MSc submitted & accepted 2011), 1 GDE near completion; 2 MScs, 1 PhD to start in 2011

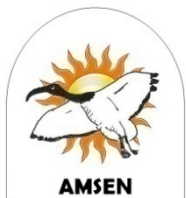
FUTA: 3 PhDs (previously, one went to TUT, SA)

UB: 1 PhD, 3 Mphils

Total:

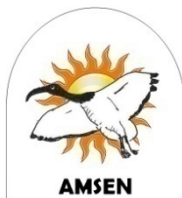
3 MSc complete

10 PhD, 7 MSc and 1 GDE



2011 Presentations

1. **B. Odera**, Addition of niobium and vanadium to Pt-based superalloys, Ringberg, Germany, March 2011
2. **F.O. Aramide**, Synthesis of electro ceramics from clay-based materials, PhD Progress seminar, FUTA, April 2011
3. **D.O. Folorunso**, Production of ultra-fine refractories from indigenous clay deposits for high temperature applications, PhD Progress seminar, FUTA, April 2011
4. **I.O. Oladele**, Development of sisal fibre reinforced polypropylene composites for structural applications, PhD Progress seminar, FUTA, April 2011
5. **J. Mwero**, Partial Replacement of Portland Cement with Sugar Cane Fibre Ash, UNAM, April 2011
6. **B. Odera**, Addition of niobium and vanadium to Pt-based superalloys, Advanced Metals Initiative, 13th May 2011
7. **A. Olaseinde**, Heat Treatment and Corrosion Behaviour of 2101 Duplex Stainless Steel Cathodically Modified with Ruthenium , Advanced Metals Initiative, 13th May 2011
8. **AMSEN Seminar** , Wits, 1st September 2011,



AMSEN / CoE-SM Seminar

1st September 2011

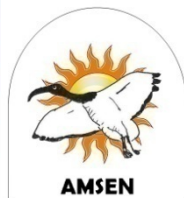
I.O. Odalele - Development of sisal fibre-reinforced polypropylene

R.M. Genga - Optimisation of milling and SPS processes of sub-micron WC-cemented carbides

A. Olaseinde - Heat treatment and corrosion behavior of 2101 duplex stainless steels cathodically-modified with ruthenium

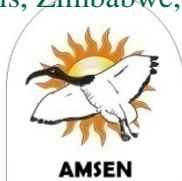
D. Fiawoyife - Effect of temperature and carburizing on the fatigue temperature of AISI 316L austenitic stainless steels

A. Apata - Solidus projection of the Ni-V-C system



2011 Conference publications (9 in 2010)

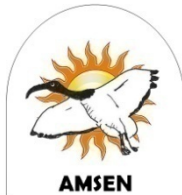
1. **B.O. Odera, L A Cornish, M B Shongwe, G O Rading and J.M. Papo**, A Study of Some As-cast and Heat Treated Alloys of the Pt-Al-V System at the Pt-rich Corner, ZrTa 2011 AMI Conference, 13th-14th October 2011, South Africa.
2. **O.A. Olaseinde, J.W. Van Der Merwe, L.A. Cornish and P.A. Olubambi**, Electrochemical Study of Fe-21Cr-1Ni Duplex Stainless Steels with Minor Ruthenium Addition at Different Temperatures, ZrTa 2011 AMI Conference, 13th-14th October 2011, South Africa.
3. **O.A. Olaseinde, J.W. van der Merwe, L.A. Cornish and P.A. Olubambi**, Comparison of Electrochemical Behaviour of 0.15wt% Ruthenium Addition to 2101 DSS with 2101 DSS and 316 Austenitic SS in Acidic with and without Chloride Media, International Corrosion Congress, Perth, Australia, 20th-24th November 2011.
4. **L. Chipise, N.R. Batane, P.K. Jain, L.A. Cornish and S.H. Coetzee**, Solidification projection surface for the Ni-Ru-Zr ternary system, Microscopy Society of Southern Africa Conference, Pretoria, South Africa, December 2011.
5. **A.O. Apata, L.A. Cornish, M.J. Witcomb, G.O. Rading and P.K. Jain**, Preparation and Characterization of Ni-V-C Ternary Hard Alloys, Microscopy Society of Southern Africa Conference, Pretoria, South Africa, 4th-9th December 2011.
6. **B.O. Odera, L A Cornish, M B Shongwe, G O Rading And J.M. Papo**, Solidification Projection of the Pt-Al-V System at the Pt-Rich Corner, Microscopy Society of Southern Africa Conference, Pretoria, South Africa, 4th-9th December 2011.
7. **O.A. Olaseinde, L.A. Cornish, J.W. van der Merwe and P.A. Olubambi**, Effect of Ruthenium Additions on the Microstructure of 2101 Duplex Stainless Steel, Microscopy Society of Southern Africa Conference, Pretoria, South Africa, 4th-9th December 2011.
8. **S.H. Coetzee, L.A. Cornish, M.J. Witcomb and P.K. Jain**, Solidification Reactions in the Ni-Ru-V System, Microscopy Society of Southern Africa Conference, Pretoria, South Africa, 4th-9th December 2011.
9. **A.O. Apata, L.A. Cornish, M.J. Witcomb, G.O. Rading and P.K. Jain**, Microstructural Characterisation of As-cast and Heat Treated Vanadium-Carbon-Nickel Alloys, abstract accepted and paper in preparation for the Africa Materials Research Society Conference, Victoria Falls, Zimbabwe, 12th-16th December 2011.
10. **C.M. Muiva, S.T. Sathiaraj and C. Moditswe**, Chemical synthesis and characterisation of nanosized semiconducting structures of Bi₂Se₃, abstract accepted and paper in preparation for the Africa Materials Research Society Conference, Victoria Falls, Zimbabwe, 12th-16th December 2011.
11. **L. Chipise, N.R. Batane, P.K. Jain, L.A. Cornish and S.H. Coetzee**, Preliminary solidification projection surface for the Ni-Ru-Zr ternary system, abstract accepted and paper in preparation for the Africa Materials Research Society Conference, Victoria Falls, Zimbabwe, 12th-16th December 2011.



2011 Journal papers (2 in 2010)

1. **C. Yah, S. Iyuke, E. Unuabonah, G. Bathgate, G. Simate, G. Matthews and J. Cluett**, Continuous Synthesis of Multi-Walled Carbon Nanotubes from Xylene Using the Swirled Floating Catalyst Chemical Vapour Deposition Technique, *Journal of Materials Research*, under review (Manuscript Number: JMR-2010-0326.R1)
2. **D.O. Folorunso, F.O. Aramide, S. Aribo and J.O. Borode**, Adaptation of Igbara-Odo potter's clay as a suitable core-mix, *FUTA Journal of Engineering and Engineering Technology*, for 2011
3. **F.O. Aramide, D.O. Folorunso and S. Aribo**, Formulation of refractory lining for solid fuel fired cupola furnace from locally sourced kaolin and potter's clay, *Leornado Electronic Journal of Practice and Technologies*, for 2011
4. **I.O. Oladele, J.A. Omotoyinbo and J.O.T. Adewara**, Investigating the effect of chemical treatment on the constituents and tensile properties of sisal fibre, *Journal of Minerals and Materials Characterization and Engineering*, Vol. 9, No. 6 (2011) pp.569-582
5. **J.N. Mwero, S.O. Abuodha, S.W. Mumenya, G.O. Rading and F.P.L. Kavishe**, Sugarcane Waste Fibre Ash: Composition, Particle Size Distribution and Pozzolanic Properties, *ICASTOR Journal of Engineering*, Vol. 4, No. 2 (2011) pp. 137-144
6. **L. Nyemba, S. Iyuke and F.P.L. Kavishe**, Reinforcement Effects of Carbon Nanoballs on Sulphonated Styrene Butadiene Rubber Ion Exchange Membrane, accepted for *Applied Mechanics and Materials*, ISSN: 1660-9336
7. **C. M. Muiva, S.T. Sathiaraj and J.M. Mwabora**, Crystallization kinetics, glass forming ability and thermal stability in glassy $Se_{100-x}In_x$ chalcogenide alloys, *Journal of Non-Crystalline Solids*, in press, 2011
8. **C.M. Muiva, S.T. Sathiaraj and J. M. Mwabora**, Thermal and compositional defects in chemical spray pyrolysed indium selenide (In_2Se_3) thin films: Effects on film properties, submitted to the *Journal of Opto-Electronics and Advanced Materials*

+ more in final stages of preparation



Promotional

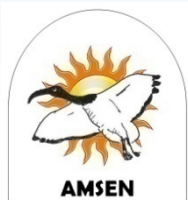
1. **L.A. Cornish, F.P.L. Kavishe and T. Capecchi**, Genesis of a new Network: African Materials Science and Engineering Network (AMSEN), Proceedings of the International Conference on Regional and Interregional Cooperation to Strengthen Basic Sciences in Developing Countries Conference Ed. Christer Kiselman, 1st - 4th September 2009, United Nations Conference Centre, Addis Ababa, Ethiopia, 255-263, 2011, ISSN 0502-7454; ISBN 978-91-554-7910-7.
2. **P K Jain**, Non-grid rural electrification: Combating energy poverty in Africa, UNDP/ GEF funded Lesotho Renewable Energy Based Rural Electrification (LREBRE) project team.
2. **L.A. Cornish**, Networking into Africa: Update from the African Materials Science and Engineering Network, 11th International Conference on Polymers and Advanced Materials (XI ICFPAM) (Incorporating Biomaterials Africa), University of Pretoria, South Africa, Book of Abstracts, p. 331, 22 - 27th May 2011.
3. **L.A. Cornish, M.B. Shongwe, B. Odera, S. Samal, A.M. Ukpong, A. Watson, L.H. Chown, G.O. Rading and M.J. Papo**, Putting it all together: several approaches to developing Pt-based superalloys, Tutorial Lecture, 11th International Conference on Polymers and Advanced Materials (XI ICFPAM) (Incorporating Biomaterials Africa), University of Pretoria, South Africa, Book of Abstracts, p. 332, 22 - 27th May 2011.
4. **P.K. Jain**, Materials Research at the University of Botswana, A poster presentation at the Workshop on New Materials for Renewable Energy (smr2269), 17-21 October 2011, ICTP, Trieste, Italy.



Pan-African School of Materials (PASMAT)

6th – 17th September 2011

- Fracture Mechanics: Prof. Wole Soboyejo, of Princeton and AUST
- Phase Diagrams and Microstructures: Prof. Lesley Cornish
- Parallel and Supercomputing
- BioMEMS for Cancer Drug Delivery
- Nanoparticle Synthesis
- Organic Electronics
- Sponsored by SIG/RISE
- **Attended by 5 AMSEN students**

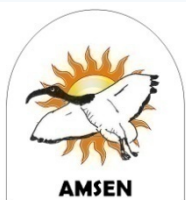




**2nd AMSEN Workshop:
20th – 24th March 2012,
Nairobi, Kenya**

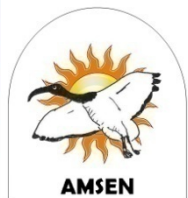
Planned!

Being organised by Prof. G. Rading



Challenges & Solutions

- Communication is very difficult at times, especially with Nigeria, e.g. keeping Prof Morris informed: **network being upgraded + mobile phones**
- Obtaining visas, especially to and from Nigeria
- Infrastructure not always good; manufacturers give little support
- Problems with transferring money: exchange rates and getting invoices
- U. Botswana and U. Namibia have difficulty in finding students ...
resolved
- University rules + sometimes takes a long time to get the students into the programme!
- Some researchers do not want to network - just want the money!... **Help**
- Balancing of supervision: workload and discipline issues...
- A student will finish GDE only: **tighten admission procedures**
- Conflicting needs e.g. UB will only accept a paper for promotion purposes if 1st author... **Help**
- Cost Recovery – **Institution demands top-slice**





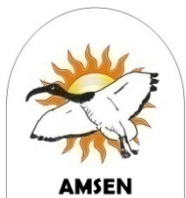
Thank you!

A special thanks to the Carnegie-IAS Regional Initiative in Science and Education, African Academy of Sciences (AAS) and Science Initiative Group (SIG) for giving us the opportunity to build the Network

Student Composition

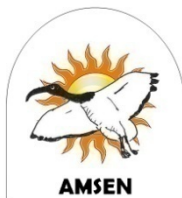
N.B.: Development & retention of faculty members

- **FUTA:** own staff
- **UB:** 1 own staff + 2 “prospectives” + 1 vacancy (own staff!)
- **UNAM:** 2 “prospectives” + 2 “others”
- **UoN:** 1 own staff + 2 “prospectives” + 1 staff member from Jomo Kenyatta University of Agriculture and Technology
- **Wits:** 2 FUTA staff + 1 UoN staff + 1 from another Nigerian institution



Advantages of Networking: Equipment

- Network theme → some commonality in equipment
- By building up the equipment base → ↑ increased access from other Nodes ↑ Every Node should become an expert in at least one area: travel to a different Node is cheaper than to USA / EU
- Researchers with reasonable equipment at their base feel more satisfied and empowered, especially if they can access the specialised equipment fairly nearby = cost effective + time to train students on equipment
- Access of equipment enables the return of a researcher after graduation for short “sabbaticals”, which will increase the probability of keeping that researcher “research-active”.
- Use AMSEN funds for leverage for other funds for more expensive equipment, e.g. UB, UoN, UNAM, FUTA



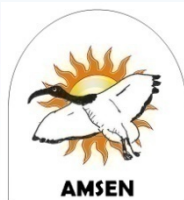
Advantages of Networking: People

- More people involved in a Network than in a single institution → greater spread of expertise → discipline more robust (less likely to depend on one expert)
- Complementary expertise, at staff & student levels, e.g. Prof. Jain has learned more about phase diagrams from Prof. Cornish and has taught others
- Researchers return to their home institutions & can promulgate their knowledge and experience
- Other University members can be utilised, e.g. Dr D. Billing gave the X-ray diffraction Workshop at Wits, July 2010, Dr S. Ndlovu helped FUTA students, October – December 2010.
- Other Universities involved, e.g. Prof. R. Sadiku at TUT, through Dr Olubambi
- Greater sharing of ideas, cultures & inspiration
- Increased service rendering: LAC reviewing for Kenya Journal of Mechanical Engineering



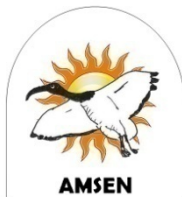
Advantages of Networking: Co-supervision

- Students benefit from access to complementary expertise
- Less experienced researchers to learn to supervise in a “safe” environment with no harm to the student (time-wasting and wrong approaches), because there is at least one senior and experienced researcher for each student, e.g. 1 student at Wits, 2 at UoN, at least 2 at UB, and all students at FUTA
- Load is shared, amongst supervisors, and so supervisors can assist more students → more intensive supervision overall (3 reports: writing, practice & professionalism) → less experienced supervisors to develop more quickly → earlier promotion (= stay!) Two promotions at the University of Nairobi (UoN): Prof Mwabora and Dr Mumanya + AMSEN student appointed: Mr Mwero



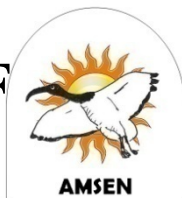
Advantages of Networking: Collaboration

- Meaningful Research Teams with complimentary expertise
- RISE Networking allowed contacts which could not have been otherwise made, e.g. Prof. J. Morris' (SABINA) will co-supervise Mr Oladele (RISE Meeting in Benoni, October 2010) → botanical input to a very engineering biased project.
- More research intensive universities can help the less research intensive universities, e.g. Wits helping both UB and UNAM
- Workshops have wider benefits, than just AMSEN
- Extend collaborations, e.g. TUT due to Dr Olubambi; FUTA can access Engineering Materials Development Institute, Akure; Wits can access Mintek: support in kind!
- Increased credibility
- “Away students” have comparative freedom for research, without a teaching load and other duties – minimal duties?
- AMSEN helped provide the impetus for UB to establish their BSc Materials programme, because strengthened materials



Advantages of Networking: Different University Cultures

- Exposure to different relationships with the hinterland industries & different university cultures → ↑ understanding & ↑ flexibility → more able to cope with other differences in their working lives in academia / industry
- The relationships between the Network Nodes are more equal than the typical North: South collaborations → more equal benefits to the partners → ↑ sustainability, since there is a benefit for all
- “Away students” have more social similarities → more to offer, e.g. Mr B. Odera has become the Chairman of the Student Committee in the DST/NRF Centre of Excellence, Wits

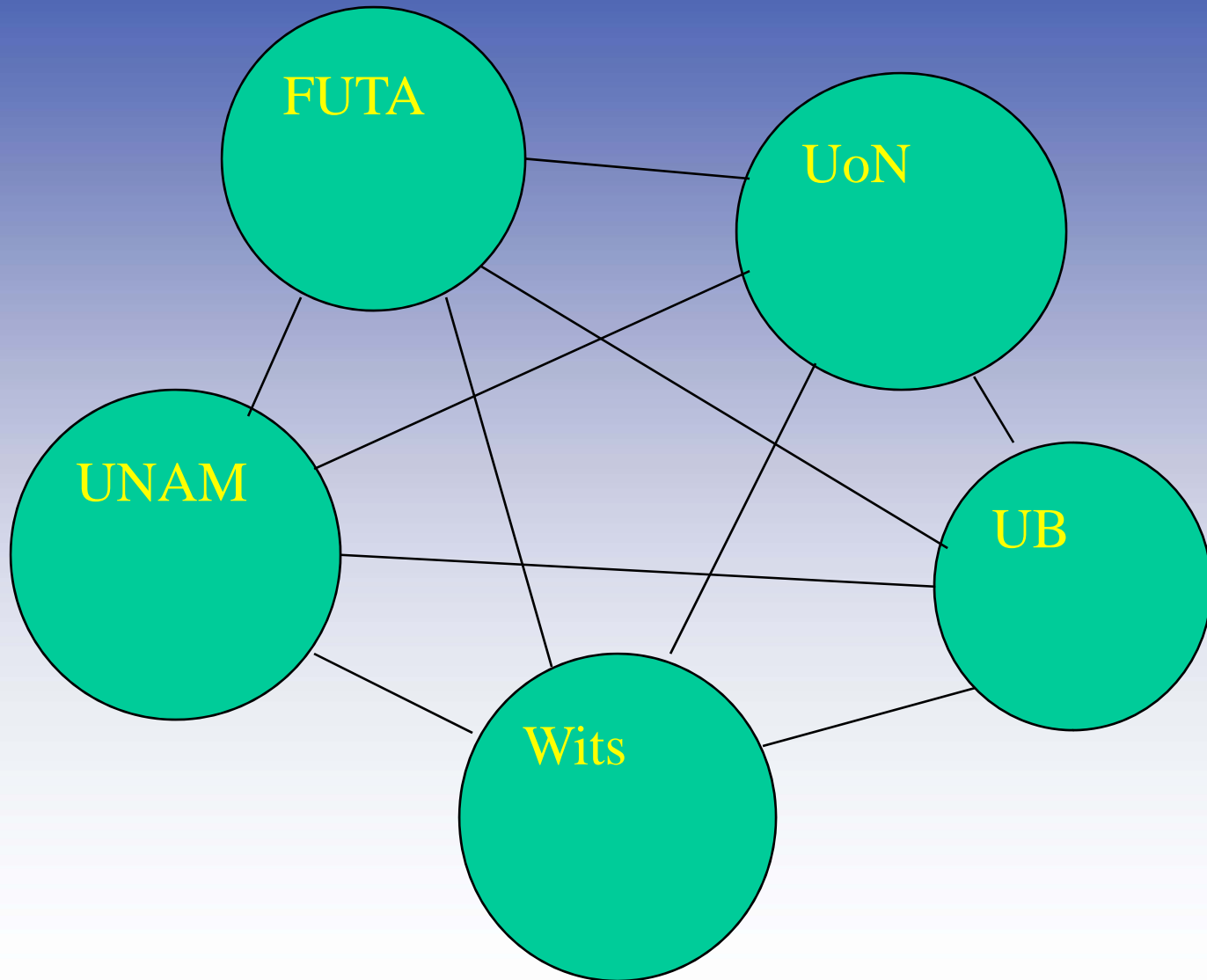


Effects of AMSEN

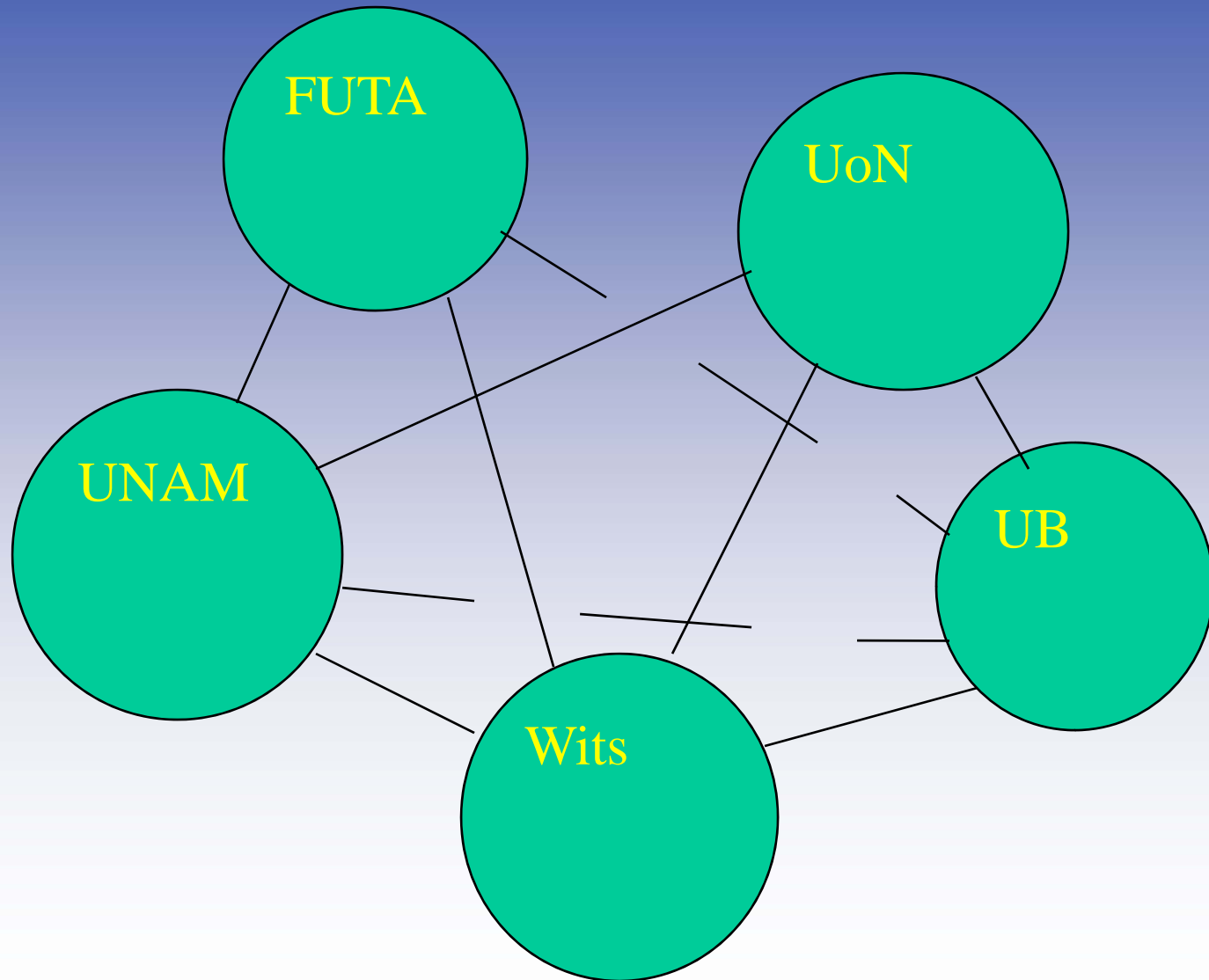
- Students being trained, undertaking research & presenting their work
- Better networking & collaboration between Nodes
- Staff being promoted & one student made a staff member
- Students encouraged to behave professionally
- Better networking & collaboration within own university
- Better networking & collaboration with other universities in same country (other students share AMSEN benefits)
- Exposure to other university cultures
- O. Olaniran received a PhD award from Nigeria to study at TUT, South Africa: supervised by Dr Olubambi & Prof. I. Sigalas.
- Other students being attracted (funded from elsewhere): from Kenya (started MSc 2010); From Ghana (started MSc in 2011)



Networking in AMSEN: ideal



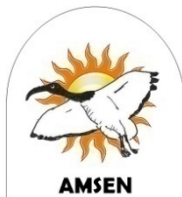
Networking in AMSEN: actual



Advantages of Networking: Workshops

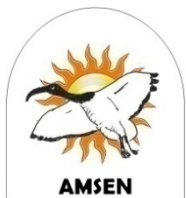
- Face:face share more ideas, inspire each other & share needs
- Practice presenting in a supportive but critical environment, listening, chairing, formal meetings & formal social events
- Discipline-specific: new knowledge/skills
- Increased access to external events → ↑ exposure
- Encourage professional outlook

- N.B.: Discipline-specific conference attendance is vital: students meet more experts → valuable feedback



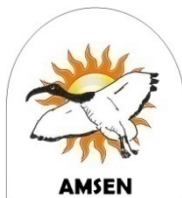
Short-term future...

- Improve Networking with FUTA
- Expose students to different environments to help their future careers, e.g. B. Odera joined Material Science International for phase diagram reviews
- Other workshops: Thermo-Calc, AFM, FUTA's XRD (Kenya?)
- Attempt rebates for successful students? Incentives?
- Look for other scholarships and running costs (e.g. Mr Olaniran) and new student at UNAM



Medium-term future...

- Upgrade MSc students to PhD where possible
- Further increase exposure to and encourage working with institutes and industry
- Complete current projects / students + recruit more
- Encourage more conference publications, leading on to journal publications
- Try to use TWAS and SIDA for the other interested countries, e.g. Zambia and Ethiopia
- Liaise with other Networks, e.g. MSSEESSA (Materials Science and Solar Energy Network for Eastern and Southern Africa)



Long-term future...

- Current students will ensure the networking continues
- Work with USA universities on course development?
- Mini-sabbaticals (~2–3 months) for graduated students after they have returned home
- Sustainability – how to carry on...
 - Governments
 - Other foundations? MacArthur?
 - Industry
 - EU
- Work with the African Materials Research Society

