Institution: University of Wolverhampton (UoW)

Unit of Assessment: UoA12:

a. Overview

The University has a strategy of developing and growing it's research environment through investment in the research infrastructure, careers and capacity and maximising impacts on industry, business, the professions and society through the transfer of its' intellectual capital beyond academic boundaries. This strategy involves increasing the number of UoAs and submitted staff to REF2014 and this is certainly true of this UoA12 submission with the number of category A staff submitted increasing from 8, in RAE2008, to 12 in the current submission. A policy is being followed of increasing the number of University Research Institutes and Research Centres engaged in high quality research so as to continue to develop a reputation for the exploitation of intellectual capital. For example, the University has a reputation for the exploitation of its' intellectual capital through programmes such as Knowledge Transfer Partnerships (KTPs) delivering more KTPs than most other HEIs in the UK and generating a substantial impact on wealth creation in the UK. This UoA12 submission alone includes the research income generated from 25 KTPs over the assessment period 2008-13.

This UoA is composed of staff from the Faculty of Science and Engineering (FSE). The Faculty's Engineering research is coordinated, via its Engineering and Computer Science Research Centre (ECSRC), into clusters or groups. The ones relevant to this submission are the Engineering Research Group (ERG), Midlands Simulation Centre (MidSim) and the Pervasive Computing Research Group (PCRG). With ERG providing the largest staff contingent. ERG, MidSim and PCRG work closely to provide joint collaborative support and with some submitted members in more than one group. ERG has a broad research brief, whereas MidSim concentrates mainly on simulation methods, in particular with the aerospace industry and making use of the Midlands Aerospace Alliance (MAA) network. PCRG undertakes research which involves gadget technologies, interaction of new systems with established computer hardware, software and interactive systems. Areas of interest include RFID, wireless sensor networks, massively mobile and parallel systems and mixed reality pervasive systems. There is increasing synergy between PCRG, ERG and MidSim and with many multidisciplinary research applications emerging, e.g. transportation, bioengineering and food technologies.

In addition the University has a Business Solutions Department (BSD) that supports the generation of external income, applied research and commercial engagement. The research in this submission is mainly applications-led and therefore the focus is primarily on applied research. This approach will continue for the future and certainly the next 5 years, however, the commitment by the University to grow its science and engineering base will see investment in equipment and staff that will also allow for an increase in research that is not applications driven.

b. Research strategy

In the 2008 Research Assessment Exercise the 'next five years' was projected to follow a route based primarily on Materials, Processes and Simulation; and Medical Engineering research and this has been the case. However, in the 2008 submission these activities formed two distinct groups. Since then there has been an ever increasing interdependence on ideas and techniques and hence increasing cross-group research partnership. For example although medical engineering research is still being carried out a broader interpretation is now considered as the research is concerned with providing engineered solutions with medical being considered an area of application rather than a separate research group, e.g. implant research using Direct Metal Laser Sintering and Melting (DMLSM) and the application of signal processing and analysis. This approach has worked well and has resulted in the generation of promising and in certain cases patentable ideas.

The primary strategic aim, pre and post 2008, has been to concentrate on applied research and end-user applications. Particular examples of the achievement of this aim, post 2008, has been a significant increased level of KTP activity, participation in UK government programmes such as the Advanced Technology Exploitation Programmes (ATEP); the Advanced West Midlands (AWM) funded 'Process Innovation for Rapid Product Development (RapidPD)'; EU programmes, either ERDF, such as 'New Technologies for Advanced Identification and Sensing (NTAILS)' or specific research projects such as the EC Competitiveness and Innovation Programme 'RFID from Farm

to Fork' and more recently an EU Marie Curie Industry Academia Partnerships and Pathways research project that provides a risk assessment system for manufacturing and construction companies. Further details are given below, in section 5d under finance. All of these programmes involve UK companies and/or EU company partners. Future strategic planning is to increase the level of activity, in particular EU funded programmes. To enable this a "Research Hub" has recently been opened on the City Campus of the University. This brings together the University Research Policy Unit and the Project Support Office. This facility has been designed to maximise contact and interaction between research students, staff researchers and the support services to make sure that research is as easy as possible to undertake in the University. It provides support for both established researchers and an environment to mentor and support younger researchers trying to establish a research career and especially a track record for funding. The Research Policy Unit (RPU) develops, implements and monitors the University research strategy. It works with the University International Centre to internationalise research and assists with the development of networks for Horizon 2020 or other European initiatives. The Project Support Office (PSO) provides expertise and support for the development and submission of research grants with an emphasis on European Funding. The PSO has recently enhanced opportunities to secure European funding by the opening of a Research Office in Brussels. There are also video-conferencing facilities to support international collaboration and EU funding bids.

A range of funding routes for both MPhil and PhD research students has been utilised, over the period 2008-13, i.e. EPSRC, NHS charity; student self-funded, University funded, the latter from making use of the HEFCE QR funding generated from the RAE2008 exercise or from the investment of £1M to fund PhD studentships across the University. In addition part-time students have been recruited from either industry or University technical staff. This is set to continue but now with more EU funded studentships. Good students are attracted by a vibrant, well-resourced unit that because of its concentration on applications-led research (including associated management systems) is carrying out projects that contribute significantly to wealth creation in the UK and International economies.

The University has formed a Faculty of Science and Engineering (FSE), operative from August 2013, and encompassing the STEM subjects. The new Faculty is composed of staff from the School of Technology (STECH) and most of the School of Applied Sciences (SAS). STECH and SAS ceased operation on inception of the FSE in August 2013. A strategic decision, by the University, is to expand the STEM subjects and this will result in an expansion of the Engineering research base, in particular post REF2014. A further outcome of the new faculty will be to develop degrees in Manufacturing, Medical and Chemical Engineering and, to underpin this, expansion of related research for these subjects. This will necessitate cross-faculty interdisciplinary and multidisciplinary working and the new faculty structure will make this more productive. This outcome will commence post REF2014 but planning and investment is already taking place.

c. People, including:

i. Staffing strategy and staff development

In 2009, the University began working towards achieving the standards of the **Research Concordat.** The Concordant plan given in the link highlights the steps being taken to achieve this [http://www.wlv.ac.uk/PDF/WLV-Concordat-action-plan-Feb-2012.pdf]. In May 2012, The University achieved the **European Commission HR Excellence in Research Award**, a process, incorporating the QAA Code of Practice for Research degree programmes and the Concordat to support the career development of researchers. As part of this work, the University organises an engaging and extensive staff development programme, which is available to all of the University's researchers. For example the programme includes: Academic Writing for Scholarly Publication**;** Qualitative Research Software**;** Pathways to Professorship and Readership; An introduction to teaching for PG and non-academic staff, Research strategy – Women in research; Examining a research degree**.** Introduction to research supervision at University of Wolverhampton; Supporting research students to the examination stage, including the viva voce; Toward timely completion: monitoring progress and supporting research students' skills development; Using an e-portfolio system to support you and your research. The University provides opportunities and guidance for promotion via research activities and since 2008, **Kibble** (2009), **Oduoza** (2010) and **Stanford** (2013) have been promoted to Professors (Oduoza and Stanford from Reader) and **Yahaioui** and

Ramaswamy to Readers.

Strategic appointments have been made in recruiting staff to support and enhance existing research strengths, for example: **Dr Lijuan Zhang**, a metallurgist from The Welding Institute (TWI), and previously the University of Cambridge, is a Senior Lecturer with knowledge of advanced Ni alloys and steels; her work complements materials developments taking place on our DMLS/M platforms. **Dr Palani Ramaswamy**, formerly of the University of Exeter, is a Reader and a signals processing analyst and engineer, who is carrying out pioneering research in the biometrics field, e.g. utilising EEG signals to control devices for disabled people. His work is seen to complement our activities in providing medical engineering solutions. In addition a Of the current Dean, **Professor Nduka Ekere**, has been appointed to FSE, with a strong background in Engineering research, e.g. modelling analysis of new solder materials in electronic components. His research strengthens the area of simulation analysis used to solve materials and processing operations. **Dr Emeka Amalu,** formerly of the University of Greenwich is a research fellow, specialising in Computer Aided Engineering (CAE) and Finite Element Analysis (FEA). He has employed these simulation methods to model and solve engineering problems associated with electronics interconnects, assembly, packaging technology and the rheological characterisation of soft solids. **Dr Nwabueze Emekwuru**, formerly of the University of Manchester, is a research fellow, specialising in Computational Fluid Dynamics (CFD) for heat transfer and atomised sprays. He is working in MidSim and collaborating with industrial partners on CFD/FEA research applications. **Dr Shufan Yang**, formerly of the University of Manchester, is a Lecturer and specialising in high performance computing and computational neuroscience. The main focus of her research is the development of methodologies to develop fully parallel high performance computing platform that scales to biological levels. Appointments such as these are seen to be supportive in teaching where taught programmes, whether undergraduate or postgraduate, are enhanced and driven by engineering research. In advertising these posts the importance of a strong and proven research background is emphasised and appointments only made when this is proven.

All staff are encouraged to prepare research proposals for external funding and are supported with the application process. To this end conference and networking opportunities are funded. New staff that can be classed as early career researchers (ECR) are given an extra time allowance and are expected, and supported, in applying for ECR grants. The University also has **Early Researcher Award Scheme (ERAS).** There are two elements to the scheme: (i) An individual research project that will yield outputs in terms of publications, further research and/or development of funding opportunities. (ii) A support programme to develop and enhance wider research-related skills through workshops, mentoring and progress reports. Where ECRs are engaged on PhD/MPhil supervision an experienced co-supervisor is always on the team.

ii. Research students

Research student administration is managed in FSE by a Student Management Board. This covers progression decisions, vetting of research student proposals, external examiner appointments and annual monitoring.

QR funding from income generated as result of RAE2008 has been used to fund 4 PhD studentships in areas considered strategically important, i.e. Additive Layer Manufacturing (ALM), Direct Metal Laser Sintering/melting (DMLS/M) and associated materials development; and simulation of processes and engineered structures. These studentships link to the two case studies and are seen to be mutually complementary to each case study with cross-over research. The University has also invested £1M to fund PhD studentships across the University and 2 PhD students have been recruited, to this Unit, from the central fund. Other studentships have been funded through EPSRC, charities and industry. There are also students, mainly industry-based who are part-time. The latter are able to give additional industrial relevance to our research. Part-time students, because of time constraints, often choose to undertake MPhils and over the current assessment period there have been 7 MPhils awarded, 5 of which were to part-time registered students. 14 PhDs were awarded over the period 2008-13, and this coupled with the number of MPhils awarded provides a good indication of completion success. For the current cohort at least 3 will complete PhDs in academic year 2013-4 and at least 4 should complete PhDs in academic year 2014-5.

The University offers generic training on what is necessary to successfully complete a research

degree. Some of these training sessions are common to the research staff development programme, e.g. Supporting research students to the examination stage, including the viva voce; Members of the unit also provide specific training on use of equipment relevant to a research programme and utilise study modules on taught Masters programmes to provide necessary knowledge and understanding. For example the Engineering department of FSE has MSc programmes in Rapid Product Development and Advanced Manufacturing, Polymer Engineering Design, Advanced Technology Management and Manufacturing Engineering. FSE also runs seminar sessions where research students present their work to their peers and academics. The presentation takes the form of that typically given at a conference. Research students are also funded to attend and present a paper for at least one international conference during their studies.

d. Income, infrastructure and facilities

A particular strength has been applied research to industry through Knowledge Technology Partnerships (KTPs). This has generated substantial funding (over 2008-13 in excess of £1.7M, including partner funding) with 25 KTPs contributing in the assessment period. Some of these feature in the two impact case studies, i.e. Powell and Harber in the DMLS/M Case Study and Advanced Chemical Etching Ltd and Burcas Ltd in the ADB Case Study. In the income table (REF4b) for years 2008-11 most of this funding is classified as BIS research council funding but a change in finance reporting rules in 2011 allocates most KTP funding as UK government (but not exclusively). Examples of KTPs (all started post 25/07/2008) are listed in Table 5.1 with the KTP number; the 'short' description gives some idea of the diversity and range of projects undertaken.

Table 5.1 Examples of KTPs contributing to this University UOA12 submission.

ID	'Short' Description	Company Name
7031	Develop underpinning theory, test capabilities, and simulated (FEA) configurations for Ultrasteel.	Hadley Industries plc
7033	Improve manufacturing to enable a manufacturing return to the UK from China.	Rubbermek Fittings Limited
7503	To investigate the existing metal bonding manual process and devise an automated replacement.	Burcas Limited
7619	Upgrade diesel fuel dispensing and monitoring equipment, using contactless automatic identification technology and radio telemetry.	MIS Fuel Monitoring Limited
7835	To develop a new technology quick assembly pipe fitting system for steel tube pipe-work.	CMT Engineering Limited
7874	To develop standardised analytical techniques to ensure optimally engineered tension levelling lines.	Bronx Engineering Limited
8014	Design utilising NPD techniques to develop a cantilever bath for the disabled and elderly.	Abacus Healthcare Services Limited
8207	To transfer the heat treatment of metal components from salt bath to vacuum furnace.	Timken UK Limited
8230	Develop a process for the controlled etching of aluminium for heat exchangers for aerospace.	Advanced Chemical Etching Limited
8519	To introduce new design methods to make product development advances in lighting products.	Integrated System Technologies Limited
8715	To develop the core technology for a high security electronic padlock system that requires no keys	Henry Squire & Sons Limited
8791	Design, develop and manufacture hardware, software and load cells for hydraulic equipment.	Phoenix Calibration Limited

A major source of grant funding has been through RDA sources. This is of particular relevance to the impact case studies, for example:

(i) The award of the £1M AWM funded PIRPD (Process Innovation for Rapid Product Development – ref CRWT 7003) project. The programme, known as 'RAPIDPD', ran from June 07 to September 10 and resulted in the acquisition of the EOS M270 DMLS/M machine and associated support. The grant income has been submitted by the University to HESA as 'Enterprise' income and not research income. This preferred approach earns funding for the University in the form of HEIF support to support

industry. More detail on this project is given in the impact case study (REF 3B) concerned with Direct Metal Laser Sintering and Melting (DMLS/M).

(ii) The DTI Advanced Technology Exploitation Programmes (ATEP1 and 2), concerned with Affordable Diffusion bonding and Advanced Surface Cooler technology development.

(iii) An MoD contract MoD on the "Development of Innovative Energy Absorbing Light Weight Armour".

Contracts (i) and (ii) generated income (UK Government) of around £132,000 and this has been included in REF Table 4b. More detail on these projects is given in the impact case study (REF 3B) concerned with Affordable Diffusion Bonding (ADB).

Some project funding began towards the end of the census period for RAE2008, i.e. ERDF project grants concerned with applied research support and technology transfer to industry, but around £400,000 of this income was post January 2008 (and as for the PIRPD project above preferentially submitted by the University to HESA as 'Enterprise' funding). Several KTPs were subsequently awarded from contacts made during these ERDF projects. Smaller project grants were obtained from EPSRC and charities but overall grant income has primarily been concerned with applied research on industrial engineering projects.

The EC funded project 'Farm to Fork' (led by **Newman**) generated income around £880,000 and was also submitted to HESA as 'Enterprise' funding in order to maximise HEIF funding to the University.

The University has been awarded, in September 2012, a 1€ million EU Marie Curie Industry Academia Partnerships and Pathways research project. **Oduoza** led the consortium grant bid and is the project coordinator. PhD students will also be trained during the course of the project. The University will work closely with the University of West Bohemia and Thyme Software throughout the venture. Project duration is 4 years and the project task is "Development of a Risk Management Software System for SMEs in the Construction and Manufacturing Sectors". This project will add to the number of visiting scholars. This project generated £256,000 of income funding in year 2012-3.

Facilities:

The research environment is vibrant and has a strong relationship with companies and other institutions those that may eventually develop and deploy the results of research. The quality of the research undertaken relies on the continual enhancement of the research equipment infrastructure which includes:

An EOS M270 Xtended direct metal laser sintering/melting (DMLS/M) machine,
An EOS M250 DMLS machine
A DTM2500+ Selective Laser sintering (SLS) Machine for rapid prototyping polymers.
An extensive range of Zwick-Röell mechanical test equipment
A non-contacting high precision video extensometer
A Zeiss EVO50 environmental scanning electron microscope with Oxford Instruments' WAVE/LINK x-ray spectrometers
Olympus LEXT laser scanning confocal microscope
A nano-particle mechanical alloying powder metallurgy facility
A high temperature furnace and environmental test chamber
3-axis, 4-axis and 5-axis machining centres, cryogenic machining capability
Vacuum casting and injection moulding for polymer products.
Finite Element Analysis (FEA) with Ansys, Abaqus, and MAC systems available.
Two 16 processor Beowulf clusters and one specialist high performance GPU processor (Supermicro GPU SuperBlade).

FSE (STECH), to support infrastructure, has also invested in test measurement equipment, useful for services to industry as well as research partner building, e.g. over 2011-13 ~£70K in microscopy, metallography, mechanical test and bio-signal analysis; and since RAE2008 invested £114k in equipment to support mobile systems, RFID and pervasive computing.

This equipment in the main supports manufacturing and materials engineering, simulation of processes and structures, services to industry, such as consultancy and rapid manufactured or prototype products. The income generated in part is used to support research. Students on taught Masters and Undergraduate degrees also access the equipment, e.g. for research projects.

The University has a **Business Solutions Department (BSD)** that supports the generation of

external income, applied research and commercial engagement. Under a director of this department there are dedicated Business Development Managers who work closely with their respective schools and can assist with a range of activities from strategy setting, bid writing, business relationship building, development of new products, through to mentoring and coaching. http://www.wlv.ac.uk/staff/services/business_solutions_department.aspx. An example of support is the way BSD manages, with academics, several highly successful part-funded projects including Knowledge Transfer Partnerships (KTPs) and Knowledge Exchange & Enterprise Networks (KEENs). KEEN is a new business improvement programme, part-funded by the European Regional Development Fund (ERDF), designed to help West Midlands based SMEs increase their profitability and growth.

Intellectual property (IP) policy and management. The University includes IP and related issues in its staff development activities to raise awareness among staff and students of the opportunities presented by the development of IP and provide information and assistance for the purposes of capturing and exploiting those opportunities. The University, its Research Institutes, Research Centres and its Schools also provides the infrastructure, environment and other support to encourage and enable ideas to be developed to a point where they may be commercially exploited. There is also IT Futures (ITFC) the University of Wolverhampton's Technology & Digital Media service provider based at the Telford Innovation campus providing consultancy, development services, research and partnerships. An integral part of ITFC is the **NTAILS** centre, which facilitates collaboration between the University and West Midlands businesses such as tourism and manufacturing looking to adopt new technologies. This can include free business assistance in the adoption of these technologies, equipment loan, graduate placements, free to attend technology seminars and links to academic research (http://www.it-futures.com/ntails/).

e. Collaboration or contribution to the discipline or research base

In the 2008 Research Assessment Exercise research was projected to follow a route based primarily on Materials, Processes and Simulation; and Medical Engineering research. Although a divide between the two groups has naturally vanished collaboration can still be sub-divided to evaluate the respective contributions to the research base.

Materials, Processes and Simulation

The reputation of both the work and the academics has grown significantly with international research scholars residing within the Department of Engineering for significant periods from institutions in New Zealand (6 months), Korea (1 year), Germany (a researcher, Professor A E Tekkaya, from the University of Dortmund, between March to May 2008, to undertake research into simulation of Additive Layer Manufacturing) and China (Professor Guoning Tang, the Vice President of Hunan University of Science and Technology, completed a sabbatical year, between March 2010 to February 2011, to conduct research on mineral granular mechanics in vibration ball milling machines). The New Zealand and Korean visits are described in the DMLS/M case study. These visiting researchers were working (and continue to do so) primarily with Stanford and Kibble. These interactions and the reciprocal visits have resulted in publications relating to microstructural control in the development of preforms for superplastic forming using the DMLS/M process (**Kibble – output 1)**; the simulation of the DMLS/M thermal system including the incremental powder build-up and thermal inertia (**Stanford – output 2**); and influence of DMLS/M processing parameters on behavioural characteristics of the resultant solid (**Stanford – outputs 3-4**). This work cross-links and complements research into materials development (**Zhang – output 1**); process simulation (**Spence – outputs 1-3**; **Yahiaoui - outputs 1-3**); knowledge management process simulation (**Oduoza – output 2**); thermal analysis simulation (**Emekwuru – output 3)**; and process prediction modelling (**Ekere output 1; Amalu output 4**).

In addition to visiting scholars other international collaborations are:

Visiting Professor, University of Applied Sciences, Dresden Germany [2008 – to Date] **(Ekere)**
Visiting professor at Harbin Institute of Technology, China [March 2010 –.to date] **(Zhang)**

Medical Engineering

The medical engineering research has developed with research being undertaken in implant development (**Stanford – output 3**) which links with activities being undertaken as a research partnership into using titanium alloys in the additive layer manufacturing process for maxillofacial implants (**Stanford, Impact Case Study 1 and output 4**). EEG brain signals analysis and processing (**Ramaswamy outputs 1-4**). **Ramaswamy** is also collaborating with C. S. Syan, of the University of West Indies, Trinidad on 'Autonomous vehicle control with brain-computer interface'

research. Funded by University of West Indies, 2009. Currently the work is on-going.

Industrial collaborations:

Stanford and EOS GmbH: Stanford, with other Department staff, has made Wolverhampton an internationally leading centre for rapid manufacturing. This is recognised by machine manufacturers and hence for the last four years EOS GmbH have supported the Department promoting our activities worldwide; providing the latest versions of the underlying software, gifting powders, other consumables, and support. The success of the collaboration has resulted in the Department being asked to host two international rapid manufacturing conferences and being the recipients of the first titanium ready Direct Laser Metal Sintering EOS 270 machine in Europe.

Members of national/international committees:

EPSRC Peer Review College: **Ekere** (2005-2009, 2009 to Date); **Oduoza** (Dates?); **Ramaswamy** (2011-to date); United Kingdom National Chairman Society of Chemical Industry, Electrochemical Technology Group [September 2006 – 2010] **(Oduoza);** Committee member of the BSI for the setting of UK standards relating to ALM Technology and for the characterisation of nano-powders 2011. **(Stanford);** Panel member of EOS Global e-Manufacturing forum for ALM Technology 2008. **(Stanford);** Member, Steering Committee Foresight Vehicle Programme (**Newman,** 2008-). Member Executive Board, RFID in Europe **(Newman**, 2011-).

Conference contributions:

One element of staff development relates to conference attendance and the fuller participation - every submitted person is/has been involved in some form of conference management – the list below demonstrates how these activities develop international standing.

International conference organisation: Convenor, Electrochem International Conference, 14–15 September, 2010 **(Oduoza)**; RSC and SCI, supported by the International Society of Electrochemistry (ISE); Co-organizer of 1st and 2nd UK-China Steel research forum held at the University of Leicester 18-20 July 2010 and the University of Science and Technology of Wuhan, China 6th-9th April 2012 **(Zhang)**.

Programme / Technical committee member of the following conferences: Flexible Automation and Intelligent Manufacturing (FAIM,; Sweden 2008; UK 2009; USA 2010, China 2011) **(Oduoza);** Royal Society of Chemistry, Society of Chemical Industry (SCI) (2008,2009 and 2010) (**Oduoza);** World Multi-Conference on Systematics, Cybernetics and Informatics **(**WMSCI 2008), **Oduoza).** International Conference on Biomedical Engineering, Malaysia (ICoBE-2012), 2012 (**Ramaswamy)**; IEEE Symposium on Industrial Electronics & Applications, Indonesia, September 2012 (**Ramaswamy)**; 4th Computer Science and Electronic Engineering Conference, September 2012, UK (**Ramaswamy)**.

Invited Session Chair: 11th International Thermoplastic Elastomers Conference TPE 2008, Prague, Czech Republic, 12-13 November 2008) and The 12th International Thermoplastic Elastomers Conference TPE 2009, Frankfurt, Germany, 11-12 November 2009. **(Both Kibble).**

Invited presentations or Keynote/Guest speaker: Engineering Integrity Society and The Institute of Mechanical Engineers (IMechE). Title: *Nickel Bronze – Tungsten Composite Produced by Direct Metal Laser Sintering/Melting (DMLS/M).* 9 March 2010 **(K Kibble and M Stanford**); An invitation to present at the Titanium Information Group annual conference: Technology Developments in Titanium at the National Metals Technology Centre (NAMTEC), *Laser Sintering and Super Plasticity of Titanium* 7th April 2011, Rotherham, UK **(Kibble and Stanford**); Keynote paper:*Tool Condition Monitoring - Where to from here?*, The Seventh International Conference on Condition Monitoring and Machinery Failure Prevention Technologies, 22-24 June 2010, Ettington Chase, Stratford-upon-Avon, England **(Stanford).**

Journal Editorial Board:

Associate editor: International Journal of Artificial Life Research [2008-]. (**Ramaswamy)**

Editorial board member: ISRN Signal Processing Journal [2010-]; International Journal of Cognitive Biometrics [2010]; International Journal of Cognitive Performance Support [2010]; International Journal of Biomedical Engineering and Consumer Health Informatics [2008-]. (**Ramaswamy)**

Fellowship of Professional bodies

N Ekere Fellow of the Institute of Engineering Technology (FIET), CEng;
K Kibble Fellow of the Chartered Quality Institute (FCQI), CEng
C F Oduoza Fellow of the Institution of Chemical Engineers, CEng, CChem