Institution: LJMU – General Engineering Research Institute

Unit of Assessment: UoA 15

a. Overview

The General Engineering Research Institute (GERI) is a world-class centre for research in the fields of manufacturing and measurement technology. The Institute encompasses a range of research activities which include work of a speculative and fundamental nature; but it would be fair to say that a particular focus is placed upon applicability, developing innovative new approaches and technologies for the solution of "real-world" problems in industry and medicine.

The Institute is constituted as an independent centrally resourced unit within the University's Faculty of Technology and the Environment. It is led by a Director, Prof David Burton, who is responsible for the leadership, managerial operation and long term strategic development of the Institute. Prof Burton reports to the Dean of Faculty and GERI is represented on all appropriate internal Faculty committees. In this way the Institute, whilst free to pursue its own research agenda, is fully integrated into the management of the university as a whole.

GERI can trace its history back over 40 years to what were originally two research groups; one in advanced manufacturing and one in optical metrology. These amalgamated to form a single research body in 1996 and were granted Research Institute status by the university in 2002. As a consequence of its history GERI has always been interested in the interplay between manufacturing and measurement. It offers a unique skill and knowledge portfolio that links these two areas and this enables it to tackle challenging interdisciplinary research problems.

At present the Institute has 14 staff; 12 researchers, a full time dedicated technician and a full time administrator. The dedicated technician is supplemented by central Faculty resources. In addition there are three emeritus professors still professionally active within the Institute.

Since RAE2008 the Institute has benefited from over £3m of infra-structure and capital investment. It took occupation of its new, purpose built, office and meeting accommodation in 2012. In the same year £1.6m was spent to completely reconfigure and refurbish its laboratories, bringing them together on one continuous site for the first time. In addition, as well as considerable expansion in our cell mechanics space and capability, we have added a new laser micro-machining laboratory.

New capital equipment purchased since 2008 has included; a Bruker 3D white light interference microscope, a Zeiss scanning confocal microscope, a Bridgeport 5-axis machining centre, 8 lasers for the new laser micro-machining laboratory, including 3 fibre lasers: a 5W Fianium pS laser, a 20W nS SPI laser and a 400W CW laser from JK Lasers.

Five new staff from outside GERI have been appointed in this assessment period and three of our PDR's have joined the staff and are submitted for the first time; this personnel growth is reflected in our increased submission size.

Today the Institute can be described as consisting of two teams; the Optics and Measurement Group (OMG) and the Advanced Manufacturing Group (AMG). But these titles only reflect the origin of the teams' disciplines rather than the way the teams themselves operate. In reality, GERI staff move between teams and most projects involve contributions from both sides. Much of our activity is uniquely catalysed by the interplay between measurement and processing technologies and this occupation of the interstices between traditional disciplines is one of our trademarks, a key enabler in our success and a pivotal element in shaping our strategy both past, present and future.

b. Research Strategy

Review of the Delivery of the 2008 Strategy

We will begin this examination of strategy within GERI by carrying out a brief self-evaluation of our performance over 2008-13 against the strategic targets we set ourselves in RAE2008:

RAE2008 Goal 1: Intelligent 3D Surface Measurement.

Through EPSRC Grant EP/D077702/1, we successfully developed the world's first intelligent and fastest 3D measurement system. This was used in clinical trials for a medical application in radiotherapy. We went on to further develop this system with an NIHR funded programme. Research outputs from this included a total of 15 papers, 3 PhD's and one book. The work went on to have major impact within the medical physics and clinical spheres and led to further EPSRC support via the grants EP/F013698/1 and EP/H024913/1.

RAE2008 Goal 2: Cell Mechanics – the Next Steps.

We have considerably developed and expanded our collaboration with the biological research community – further details below. We have developed new models in cell mechanics, based on

our metrology skill-base, which have underpinned new understanding of how the mechanical strength of cells varies under conditions of disease and therapeutic irradiation.
A highlight of this work was the development of a new nonlinear model for the analysis of atomic force microscopy (AFM) force curves. This was key in helping us to determine, for the first time, two significant points, firstly that prostate cancer cells are mechanically weaker than their normal counterparts and secondly that prostate cancer cells respond in a more nonlinear fashion to compressive forces than do normal cells. Our recent work in this area has also highlighted that therapeutic levels of ionising radiation affect the mechanical strength of cells. This is a world first and we are currently investigating the consequences of such findings with a multidisciplinary team of researchers from the medical and academic communities. Since 2008 our work in this area has expanded and to date has generated 13 papers and 7 PhD's.
RAE2008 Goal 3: 3D Nano-Metrology.
We have made major strides in the area of detecting nano-scale faults in structures. In particular through EPSRC Project EP/G004358/1, which involved the design of new techniques for processing acoustic and x-ray images of electronic components to extract 3D information in a novel way. Work in this area to date has produced 23 papers and 2 PhDs.
RAE2008 Goal 4: Fluid Delivery in Grinding.
Through EPSRC Project GR/S82350/01, via both experimental and modelling techniques, we probed the physics behind fluid delivery in grinding, including new regimes such as Minimum Quantity Lubrication. This work generated new insights into this economically and environmentally important area. Findings from this work continue to be employed by industry. Outputs from this work included; 4 Invited / Plenary papers, 9 Journal papers, 8 Conference papers and 4 PhD's. A high proportion of the publications are cooperative with overseas collaborators. Outcomes are described in 4 recent leading books in the area of abrasives technology and are also featured in training course materials in abrasives machining. This is the area of one of our impact case studies.
RAE2008 Goal 5: High Efficiency Grinding.
Within EPSRC project GR/R68795/01, improved high efficiency grinding was investigated for surface grinding through; (a) increasing workspeed on deep creep feed grinding into the HEDG region, (b) the introduction of vibration assisted grinding. With the support of TSB funding (Grant DB133H) a prototype of a new generation vibrational HEDG machine tool has been developed. This opened up a new paradigm of high efficiency grinding operation. Outputs from this development included 10 papers and 2 PhD students.
RAE2008 Goal 6: Developments in Microwave Technology
This area is included for the sake of completeness, but this team transferred to another department within the university and this work is now reported in another UoA.

The Strategy Going Forward.
Much of GERI's research focuses on problems that arise in industrial practice, operating largely on the technological push and pull exerted by world-class manufacturers. The use of the phrase "push and pull" conveys the fact that this relationship is two-way; GERI undertakes research, some of which provides solutions to problems in industry, but at the same time industry's identification of key strategic problems informs the research agenda of the Institute.
The European Regional Development Fund (ERDF) project, known as "The GERI Research Outreach Project", forms a key element in our strategy. This project seeks to engage a wide spectrum of industrial partners ranging from Tier-One manufacturers to regional SME's. It provides us with funding to enhance engagement via: promotional activities, pilot and feasibility studies and the provision of additional dedicated personnel resources.
This activity has helped us to identify the key technology areas in which we should be active to enable us to maintain a strong industrial base to our research. These key areas form the basis of our investment strategy in terms of both people and facilities. They are identified below and are mapped against our two core teams, Optical & Measurement (OMG) and Advanced Manufacturing Technology (AMT) and also the staff members that are submitted to this exercise;
REF2014 Goal 1: OMG - High speed optical metrology, Burton, Lilley**,Murphy**
Macro inspection for surface form in manufacturing and 3D microscopy and analysis in support of bio-medical applications.
REF2014 Goal 2: OMG - New fusions of microscopy techniques, Burton, Lilley**, Murphy**, Harvey, Zhang**

To support industrial uptake of nano and micro technologies in manufacturing – including ultra-sound and holographic microscopy techniques. Utilising new results and techniques we have developed in the area of 3D-macro-interferometry in the microscopy application area.

REF2014 Goal 3: AMG - Laser micro-machining. Sharp*, French*

Applications of laser machining and micro-machining require a continuing and underlying research activity. Specific applications here are the machining of Carbon Fibre composites, particularly for repair applications, chemically assisted machining of ceramics and high band gap semiconductors, and the manufacture of electromagnetic and acoustic meta-materials

REF2014 Goal 4: AMG – Laser surface processing. Sharp*, French* Murphy**

The laser has been recognised as a tool for surface processing and functionalisation, and the advent of new laser types (e.g. fibre lasers) and the review of existing laser types (e.g. TEA CO_2 lasers) provide the opportunity to develop novel surface processes, including laser induced micro-plasma processing. Texturing applications aim to improve the following areas; adhesion bonding in ceramic and carbon fibre composite applications, the control of cell behaviour on laser textured surfaces, textured surfaces to control wetting and (unwanted) deposition of products, and engineering applications of laser cleaning.

REF2014 Goal 5: AMG – Functional surfaces. Chen*, Morgan, Batako**, Opoz*, Sharp*, French*, Murphy**

Development of functional structural surface manufacturing aims to improve functional surface performance by introducing novel manufacturing technologies, including micro-machining, grinding, EDM, rolling, laser processing, micro-finishing and vibro-mass finishing. The research will provide significant benefits in areas such as: energy efficiency, tissue engineering, and optical functionality.

REF2014 Goal 6: AMG – High efficiency grinding. Chen*, Morgan, Batako**, Opoz*, Sharp*, French*

Developments in High efficiency grinding technology utilising state of art techniques created by GERI in order to evolve a new generation of grinding technologies that provide much higher material removal rate with lower energy consumption and reduced environmental impact. The enabling techniques developed by GERI include HEDG, fluid delivery optimisation, vibration assisted grinding, thermal analyses, minimum quantity lubrication and laser assisted grinding.

Staff identified with a single asterisk have been recruited from outside GERI since RAE2008 specifically to support these strategic areas, whilst staff identified with a double asterisk are those that have been mentored through GERI's staff development system, commencing as PhD students and PDRA's. The latter have been developed specifically for the purpose of fulfilling this strategy and they are now fully independent researchers within GERI.

This strategy is a step in realising GERI's vision to be a world-class centre of excellence for research into metrology and surface processes, supporting both manufacturing and medical practice. Impact paths for these plans are established due to the fact that they are largely industry driven by our ERDF Outreach project.

c. People

GERI, like any vibrant research unit, is simultaneously working towards long term strategic goals and yet is also a place of constant change. This paradox of long term aims and constant renewal to meet the demands of those aims is at the heart of our staffing policy.

We have a kernel of well-established team members – three of this current submission were among the five category A staff submitted last time. Four of the staff submitted here for the first time are products of our own internal development programme – which is detailed below. The remaining four staff submitted this time have been recruited over the assessment period from outside GERI with our strategic aims in mind. Thus, we continue the policy we described in 2008 of having a healthy mix of home-grown talent and new blood.

These developments have not only expanded our activities and enabled us to include new strategic technologies, driven by our contacts with industry through our ERDF Outreach Project, it has also significantly lowered our average age. In RAE2008 the average age of category A staff submitted by GERI was 57.6, whilst this time it is 50.1.

c. I. Staffing strategy and staff development

GERI's People Development Programme – Post-Docs and ECR's

GERI recognises that it is vitally important to its future that it nurtures the best of its own young talent. To this end PDRA's and ECR's are encouraged to take a full and active role within the

Institute. The success of this programme is testified to by the fact that four of the eleven staff submitted this time are products of this mentoring programme. In addition to the annual exercise of running the GERI Annual Research Symposium (GARS) described below, several other initiatives are in place within GERI to develop this important group of staff:

- Colleagues in this category are encouraged to develop new ideas, take a role in grant application writing and as advisors and mentors to PhD students. More mature members of this group are given priority as members of PhD supervisor teams – sitting alongside more experienced colleagues.
- Steps are taken, via line manager monitoring, to ensure that all PDRA's and ECR's take full advantage of a wide range of networking and training opportunities that the university offers, such as grant writing workshops, "research cafe" events etc.
- These staff are encouraged to apply for ECR internal support grants from the University – three of those submitted here have received such grants and have benefited greatly using them to build external networks of personal contacts with organisations such as Fraunhofer IFAM and the Irish Composites Centre and with these collaborators then to go on and develop successful first grant applications.
- All staff in this area are encouraged to take on some limited teaching duties; as a development opportunity, to enrich their CV's and enhance their employability. Such commitments are kept very modest in size, being of the order of 100 hours per year.

In every respect PDRA's are extended all the same mentoring and guidance training opportunities as ECR's who are staff members. So for example all PDRA's in GERI undergo an annual PDPR (annual staff performance review) as part of the normal process and have the same access to internal training and budgets for external training as established staff. In the field of staff development and opportunity there is no distinction made between PDRA's and permanent staff colleagues in this area. For example one of GERI's PDRA's was recently awarded an ECR Development Grant by the University.

GERI's People Development Programme – Established Staff

Colleagues well established in their careers are far better able to select and design their own development programmes. All full time staff are allocated a budget for conference/course attendance. In addition funding can be applied for to support particular training needs for groups of staff, for example during the course of this assessment period groups of staff have attended courses on specific skills such as; Labview programming, IDL Programming, 5-Axes Machining and aspects of H&S.

Visiting Staff Members from Overseas

During this assessment period the Institute has played host to a large number of visiting scholars for extended periods of collaborative working and experience. These include: Prof Takazo Yamada of Nihon University, Japan, Prof Sergey Dovgalets of the Vinetsa Technical University, Ukraine, Profs Valerie Kuzin and Alexey Vereschaka from the Moscow State University of Technology, Dr Ahmed Al-Roubaiy from Babylon University of Technology, Dr Quinghua Ly from Hubei University of Technology, China, Dr Ashardi Abas from the University Pendidikan Sultan Idris, Malaysia, Prof Yogesh Bhalerao from Maharashtra Academy of Engineering, India, Prof Y C Chan from the City University of Hong Kong, Dr Michal Lattner Purkyne of the University Czech Republic and Dr Zhang Lei of Shandong University, China.

Evidence of Equality and Diversity

GERI is an extremely cosmopolitan place with colleagues from a number of different cultural and ethnic backgrounds. During this assessment period the Institute has had the benefit of staff, including PDRA's, and PhD students from; UK, France, Italy, Poland, Turkey, Ukraine, Republic of Georgia, Russia, Republic of Togo, China, India, Jordan, Saudi Arabia, Libya, Iraq, Iran, Malaysia, Thailand, USA and Chile. The Institute is happy to report that this day-to-day internationalism enriches the life of staff and students alike and all sections of this very diverse community work together well.

Historically gender is more of an issue for the Institute. Whilst the Institute makes every effort to welcome female students and staff, the fact is that females are very under-represented. Given the low numbers of women in the engineering disciplines at undergraduate level, this of course is not very surprising. However, the move by GERI's optical metrologists into research in support of

mechano-biology has done something to redress the balance and GERI graduated three female PhD students during this assessment period, one of which went on to spend a period of one year with us as a PDRA. We plan to build on these early successes.

c. II. Research students

GERI's People Development Programme – PhD Students

GERI gets most of its PhD students by external application or recommendation by former students, associates or collaborators. Of the 28 students passing through the Institute during this assessment period 39% were home/EU and 61% were overseas. In addition to our own students, at any one time there will be 3-5 visiting students from overseas collaborating institutions working in the Institute for periods of between one and six months. These visiting students underpin some of our collaborations and add to the international and intellectual environment of the Institute.

Typically students are allocated a supervisory team made up of three members. At least two of these will be drawn from within the Institute, with the third often drawn from a collaborating partner, such as an industry, or overseas collaborating university, or research centre. In addition to the supervisory team, further "special advisors" may be formally linked to the student's project at registration time if it is deemed appropriate.

All students attend the University's induction programme and are appointed a mentor from among the Post-doc staff or younger colleagues to assist them whilst settling in. Having been provided with a project brief and an initial reading list, students are then encouraged, under guidance and supervision, to develop their own work programme. Once approved by the supervisory team this programme forms the basis of the student's application to register for a higher degree.

Thanks to the provision of a new dedicated building – see infrastructure below – GERI staff and students are located in a single two story building with staff offices adjacent to student open-plan accommodation. This means that supervisors and students are in daily contact. These informal meetings and discussions are supplemented by a formal rota of meetings between students and their supervisory team. These meetings will occur approximately every three weeks for any particular student and it is at these that progress is officially monitored and targets are set. On top of this system students and their supervisors complete an Annual Progress Review which is forwarded to the Faculty Research Degrees Committee for external monitoring. All of this works well and the average time to completion of a GERI PhD student is just over 4 years with no students withdrawing or failing to complete.

As well as technical supervision, PhD students are given training in communication skills. The Institute runs a weekly seminar programme and all students are required, as part of their programme of studies, to attend and deliver these seminars. A student can typically expect to deliver 3 to 4 such seminars over the course of their studies.

Additionally GERI runs a more formal annual research symposium, GARS, at which students are required to submit papers either for poster or oral presentation. GARS has been run since 2005 and 2013 saw the 8th GARS event take place at which 13 papers and 8 posters were presented. We believe this event is unique in that it is entirely organised and run by GERI's PDRA and ECR community, from engaging a prestigious external speaker to deliver a keynote address, through calling for and selecting papers, to arranging the venue and refreshments. The yearly running of GARS is a major personal development opportunity for these staff.

This training programme in presentation skills is very effective, with GERI students often being complimented on how well they present material at conferences etc. and frequently winning prizes for best presentation – for example GERI student Ahmed Ahtaiba won Best Paper Presentation at WEC 2011 and another student, Siew Yan Goh, won Best Paper at the 10th Int'l Conference on Manufacturing Research, ICMR2012, Birmingham 2012.

d. Income, infrastructure and facilities

GERI is fortunate to have benefited from a consistent long-term investment process by the university and has very well equipped laboratories. Moreover during this assessment period there have been particularly significant developments;

- The construction of a new 2 story building to provide dedicated office and meeting accommodation for GERI. This means that all of our staff and students are now located in close proximity to each other.

- The relocation of our Advanced Manufacturing Laboratory, so as to bring all of our laboratories within one continuous space, instead of being distributed in different parts of the university's Byrom Street site.
- The allocation of an additional 271 sq-metres of laboratory space.
- The complete and extensive refurbishment of our laboratories.

This package represents a total research investment of £2.6M, with 60% of this coming from the university and 40% from ERDF as part of the "GERI Research Outreach Project".
In total the Institute has 339 sq-metres of office and meeting space and 798 sq-metres of dedicated laboratory space. The main laboratories are comprised of the following:
An Advanced Optical Metrology Laboratory – 283 sq-metres; equipped with stabilised dark room facilities, two standard dark rooms, project prototyping and rig building bays, five large optical surface tables, a range of lasers, optical equipment, cameras, sensors and detectors. A Wyko white light interferometer, a Uniscan laser measuring station, a Comet FeinFocus Tiger X-ray Inspection Station, a high speed, super resolution "pixel shifting" CCD camera system, as well as appropriate modern computing and image processing facilities.
A Cell Metrology Laboratory – 54 sq metres; equipped with an Asylum Research molecular force probe atomic force microscope (MFP-3D), Zeiss laser scanning confocal microscope (LSM510), Zeiss Axiovert microscope, and a custom, in-house designed and built single optical fibre-based laser trapping system for cell manipulation**.** This cell metrology suite also has a dedicated, fully equipped cell culture laboratory located immediately adjacent to it.
An Advanced Manufacturing Laboratory – 284 sq metres; equipped with a number of state-of-the-art machine tools, such as; Modified J&S Dominator Grinder, Ultramat Cylindrical Grinder, J&S SAAM Universal Grinder, Bridgeport 5-Axis Machine Centre, Low-temperature Precision Grinder, a mass finishing unit with vibratory feeder, as well as extensive process monitoring facilities for the in-process measurement of force, power, vibration, acoustic emission, temperature and size. This laboratory also has a small dedicated local metrology facility in an ante-room equipped with Talysurf, Talyrond, Laser size measurement, comparator etc. Note this is in addition to the leading edge surface metrology equipment available in the optical measurement laboratory and the cell metrology laboratory. This extremely wide spectrum of metrology equipment, available to support all strands of GERI's research, is one of the benefits of our range of complementary interests.
A Laser Surface Micro-Machining and Processing Laboratory – 80 sq-metres; equipped with three optical benches, a range of lasers including a 20W 100pS IR Fibre laser, an 8W 532nm DPSS NdYVO4 nS pulsed laser, a 20W nS pulsed 1064nm fibre laser, 350W pulsed YAG laser, and a 400W CW fibre laser. Precision CNC tables and galvanometric scanning heads provide high speed flexible beam delivery. Analysis equipment within the laboratory includes optical microscopy and a contact angle goniometer.
In addition to these major laboratories the Institute has a number of smaller rooms with particular uses; for example a dedicated quiet study space open to staff and students who wish to work in silence, this also doubles as the Institute's library where PhD theses, text books, trade catalogues and equipment manuals are stored. There are also three small laboratories which can be used in a "hot desking" manner, for short term feasibility studies, or commercially confidential activities.
The Institute is well positioned to maintain this level of facility. For example, if the opportunity arises to carry out an interesting research project with a local company as a collaborator, but there was a need to purchase a new piece of capital equipment to facilitate that project, then the Institute has an earmarked £600k capital budget for this purpose.

Information on Research Funding Portfolio and Future Plans
As previously stated, GERI draws much research inspiration from its collaboration with industry and this collaboration involves both technology push and technology pull. To support this it is essential that GERI seeks a mixed funding portfolio, from RC based funding through to commercial exploitation. Over the assessment period EPSRC funding and EU funding has been secured supporting basic research activity, TSB-funded collaborative R&D projects with industry as well as purely industrially funded activities have supported key programs in the AMG and in the latter months of the assessment period this has now led to financial support for the active commercial exploitation of HEDG technology.
The other vital aspect of funding is to assist in outreach and interaction with industry. The ERDF project is a pivotal aspect here and allows us to employ a dedicated liaison engineer to develop

relationships between our academic team and North West Industry. GERI keeps an open mind on such "structural" and regeneration targeted funding and is examining several opportunities to engage in the Advanced Manufacturing Supply Chain Initiative and related funding. Such schemes provide promising additional routes to impact for our research.
A new initiative for funding of a multi-partner Advanced Manufacturing Centre by ERDF is under preparation. As well as our own process-orientated research this is planned to bring in teams from other institutions in the region to contribute expertise in complementary aspects of manufacturing. As part of this initiative we intend to apply for funding to create an Industrial Grinding Academy based on our expertise and relationship with established training providers in the topic area. We see such training activities as offering industry a "complete package" of advanced support in this technology and further enhancing our reputation in this area.
Future plans also embrace the Horizon 2020 programme and GERI is gearing up for a number of applications in this area with discussions on-going with three consortia at present.
TSB will continue to be an important source of funding and the AMG-based laser group has been pursuing a strategy in the area of laser machining of carbon fibre composite structures, particularly with reference to MRO activity (maintenance, repair and overhaul). This includes a future bid with GKN and the National Composites Centre that will take the current TRL2-3 level work on fibre laser machining and develop it to TRL5-7 level ready for exploitation.

e. Collaboration and contribution to the discipline or research base

GERI makes a wide, energetic and significant input to the development of our discipline areas. Examples of our contributions over this assessment period are:

- During the assessment period the staff submitted in this UoA have published 121 Journal Papers, 101 International Conference Papers and 6 books. In addition they have produced 15 keynote or invited papers.
- GERI hosted the 6th International Conference on Precision Machining in 2011. This was attended by 110 delegates from 20 countries. Sponsors included the IET and Rolls Royce. Proceedings available at www.scientific.net.
- Along with Christie Hospital and UCLan, GERI organised and hosted the first international meeting of the ECSON Network of excellence in technology in radiotherapy. This was attended by 44 representatives from all the member states of the EU, see www.ecson.org
- Members of GERI in this submission have sat on the Organising Committee or Programme Committee of 22 international conferences, edited "special editions" of journals, are on the editorial board of 7 journals and have acted as panel members and reviewers for EPSRC.
- Submitted staff acted as external PhD examiners for 16 Universities and 19 Candidates
- GERI has formal collaborative arrangements with; the Moscow State Technical Univ. (resulting in two long term visiting professors, 3 joint journal publications and 3 conference papers) and the Shanghai Univ. of Science and Technology (resulting in a "shadow version" being constructed of our AMT Laboratory to aid collaboration, an $5m investment by USST). The Institute also has ERASMUS exchange agreements with: Purkyne Univ., Czech Rep., Royal Inst. of Technology KTH, Sweden and Miskolc Univ., Hungary.
- Submitted staff have carried out consultancies for a number of companies and institutions, including: Jaguar Land Rover, Getrag-Ford, Biomer Technology, Digital Projection, JP Imaging Ltd., CAE Services Ltd., Rolls-Royce, Woodrow Scientific, Inovaris, Double R Controls Ltd., Neuteq Europe Ltd. and Performance Springs Ltd.
- Members of the Institute were awarded the following distinctions and honours during the assessment period: the Faculty Medal of J.E.Purkyne University, Czech Rep., 2011 for 'Outstanding contributions to Manufacturing Research'; Visiting Professor Fuzhou University, China; Visiting Professor Xi'an University of Science and Technology, China; Presidency of the UK Association of Laser Users; Membership of the Photonics Leadership Group (DBIS); Assessor for the Finnish Academy of Sciences; Chair of the National Workshop on Laser Machining of Carbon Fibre; Academic Fellowship of the CQME (Chongqing Machinery and Electric Company) European Innovation Centre; the award of three conference paper prizes; appointment as a forensics expert in tool failure.