Institution: University of East London

Unit of Assessment: UOA15

a. Context

Research conducted within UEL's School of Engineering is fundamentally applied in nature. It focuses primarily on **communications, control and electric power design** (CCEP research group); **sustainable** engineering design, materials (bio-engineering); and manufacturing (DMEM research group). Areas of specialism are sustainable design and manufacture, Earthquake engineering, signal processing, structural engineering, geotechnical engineering, coastal engineering, telecommunications, electrical power and control engineering.

The potential non-academic impacts of our work in these areas are realised primarily in industry contexts; current industry partners in and users of our research include Control Techniques Dynamics (CTD), Delphi Diesel, and Ford Motor Co. We share our research findings with these partners throughour transfer of expert skills and advice and exchange of skilled people through internships, secondments, and joint industry-academia appointments. Despite its small size, the Unit has worked hard to foster productive and mutually beneficial relationships with these sorts of research user, and now works with five UK and international industrial partners on the development of innovative control techniques (Delphi Diesel, UK); innovative electric machine design (CTD, UK); novel active power filters (EVBU, Slovakia); reliable bio-engineering of hip and wrist prosthesis (Osteotec, UK); and novel algorithms for analysing recorded seismic events (Canterbury Seismic Instruments (CSI) Ltd, New Zealand).

The benefits we deliver to these partners range from facilitating their development of new products and delivery of new or improved services, to direct financial gains resulting from these enhanced capacities. Through these partnerships we are, moreover, able to deliver benefits to and enhance the health, safety and wellbeing of a much wider cross-section of the general public, and to effect tangential benefits such as reductions in environmental damage.

b. Approach to impact

Industry links are central both to ensuring the utility of our research to a non-academic audience and to maximising its beneficial potential. Since 2008 we have taken a multi-faceted approach to instituting and maintaining those links, and to making extra-academic impact an integral part of our research agenda. During that period, we have successfully established new relationships with companies both in the UK (e.g. Delphi Diesel, Control Techniques Dynamics, OsteotecLtd) and abroad (e.g. EVPU, Slovakia; CSI Ltd, New Zealand). The following activities have constituted important facets of the approach we have taken to initiating and supporting such relationships.

Our pathway to forging new links with partners in the UK or, in particular, abroad, often includes our **transmission of knowledge via other HEIs**. For example, Chanerley's development of software for use in the correction and analysis of seismic data, which provides useful information allowing improvements of the designs of seismic resistant structures, has been published by CSI Ltd, a spin out of the University of Christchurch (see UEL15-01).Where appropriate, we also contribute to **cross-disciplinary** (e.g. civil and electronic engineering) **research and cross-institutional partnerships** (e.g. Chanerley's collaborative work with Bristol University) as a means of expanding the range both of the benefits we can offer to our current partners, and of the potential beneficiaries of our work. Recent examples of such work include research on broadband power line communication, which embraces two sub-categories of electrical engineering (Communications and Power Engineering). Since July 2013, Abdalla has been the lead Partner of a €1.71 million FP7 project in partnership with twelve European organisations including TU-Delft University and DCA.

The fact that work within the Unit is **commissioned by and / or developed in collaboration with industrial organisations** constitutes another important pathways for our transfer of expertise and communication of research findings to industry partners. Between 2008 and 2010, for example,

Hosny worked with a Slovakian company, EVPU, on a commission to develop novel, fast acting compensating algorithms for power active filters to reduce higher harmonics pollution and reactive power. Between 2008 and 2011 Saidpour worked in conjunction with Osteotec (UK) Ltd (US) to transform the design construction of hip and wrist prostheses, which has led to the developments of new fracture fixation implants; these developments have improved the patient care and quality of life with significant societal benefits. The Unit has, over the years, also enjoyed a productive relationship with the Ford Motor Company. We particularly promote engagement with commissioned and/or collaborative research since these sorts of project not only allow us to help our partners address specific questions or problems, but also help us remain aware of and responsive to the changing landscape of broader industry needs.

As well as sending our staff and research students out to industry, we also foster and maintain our links with industry partners by **advising on their continued professional development**. Since 2008, for example, Hosny and Dodds (Emeritus Professor) have provided academic supervision for PhD research work being undertaken by two employees of Delphi Diesel, a UK-based engines manufacturing firm based in London, one of whom recently completed his PhD work successfully and moved to the USA as a consultant engineer. In addition, the Unit uses **CASE studentships to leverage new and consolidate existing links with industry partners**. UEL has a long history of collaboration with the Ford Motor Company and Abdalla, for example, is continuing with this legacy and is currently supervising an industrial EPSRC/CASE award with Ford, exploring symbiotic simulation of the Ford Engine manufacture; this is underpinning the developing of a strategic partnership with Ford Motor. The company is also currently is sponsoring jointly with EPSRC a PhD student based within it. Since 2008 the School has had the EPSRC/CASE awards, including the current award. These sorts of CASE Award studentships exemplify this particular strand of our approach to fostering and developing industrial links that benefit our industry partners, in this instance by optimising and enhancing the overall performance of the engine production line.

We also capitalise on the possibilities that our **alumni networks** offer to develop productive and sustainable industry relationships: thus for example ourlong-term relationship with Control Techniques Dynamics (CTD), an electrical machines manufacturing firm based in the UK whose main clients are in the field of aerospace and military industries, arose from the fact that its director of research and development graduated from UEL and completed his PhD work (on FPGA design methodology for permanent magnet synchronous motors) within the Unit. Perryman, Dodds and Sooriyakumar's (2009) design of algorithms and software for designing efficient drives has since been implemented by CTD. The research findings have allowed CTD to control the thermal management of its rotor-mounted permanent magnetic brushless motor, resulting in higher efficiency, better performance, a more compact size and lower costs.(see UEL15-02). These sorts of industry relationship are either initiated or consolidated by our production of external **joint funding applications** with industry partners, including in the case of our CTD partnership. Thus, in 2008, Hosny and Perryman (now retired) were awarded £60,000 jointly from EPSRC/CTD to support their work with the company. Joint application are an important element of our two-way dialogue with industry, since they ensure that our research reflects and is designed to meet the specific needs of the external partners with whom we work.

As well as working with individual commercial organisations, the Unit ensures the impacts of its research findings on broader industry sectors by **providing expert advice and sharing specialist knowledge with relevant advisory and regulatory bodies**. Recent examples of this include Lota's contribution (2009) to the standardisation of the software defined radio (SDR) cognitive architectures at the European Telecommunications Standards Institute (ETSI), a body recognized by the European Union as a European Standards Organization.

To ensure that our research agenda continues to reflect and respond to industry need, the Unit instituted an **industrial advisory board** (IAB) in 2008. Its 11 members include representatives of electrical and civil engineering firms such as CW Contractors, National Grid, Visteon, Kelvin Hughes, DLR, Ford Motor Company, Echelon Ltd, Bulgin Components Ltd, Atkins Ltd, and Canary Wharf Ltd. These board, which meets once per semester, is tasked both with feeding into the on-going development of the Unit's research strategy to ensure its focus on non-academic impact, and

with assisting in our regular evaluation of the strength of our industry impacts as a means of improving these. We also take advantage of the support offered centrally at UEL. This includes paid secondments and time in lieu of teaching to new and existing academic staff researchers to foster and encourage these activities.

c. Strategy and plans

We recognise that we are still at the start of our impact 'journey'. However, we have ambitious plans to maximise the impacts our research in future and intend to build on the solid foundations we have in key areas, particularly our development of productive relationships with industry partners. These plans may be summarised with reference to the following strategic targets:

Industrial consortia: we are in the process of establishing industrial consortia for general engineering with the objectives of establishing local and national industries collaboration for the benefits of industrialists and academics. Activities arising from those consortia will include joint research and consultancy, and the provision of graduate and continuing education programmes for practicing engineers. This will help us ensure that the research we deliver remains relevant to the changing needs of industry users, and will contribute to best practice in relevant areas. The provision of CPD training through consortia will likewise ensure the better focus of our training and development offering on end-users in industry. It will also provide a forum supporting the translation and industrial application – and thereby the ultimate impact – of less obviously applied research.

Maintaining existing links with industry partners and develop new relationships: We intend to particularly focus on consolidating existing partnerships and developing new ones to apply our growing research expertise in the field of communications and product design. This will be achieved via the creation of three new industrial research partnerships (such as EPSRC case awards, EPSRC/TSB grants in conjunction with industry and Royal Academy of Engineering industrial research fellowships) between 2013 and 2020. Our first priority here is to actively pursue Lota's collaborative application on radio frequency analogue to digital converters in conjunction with **UCL and Cambridge Silicon radios** for future EPSRC/TSB grant funding. However, we also plan to use our research in communications/ power to institute collaborations with national grid and local area grid networks, and to share the results of our power line communication investigation with energy utility companies to help ensure the sustainability of the power supply

Realising the full potential of current projects: We will actively pursue the realisation of future impacts of Chanerley's collaborative, cross-institutional research on seismic analysis, which will include the dissemination of new wavelet transform software through Canterbury Seismic Instruments Ltd.

Consultancy and contract research: We plan to see at least 50% of the Unit's researchers engaging in consultancy and / or contract research by 2020.

d. Relationship to case studies

Both case studies exemplify the Unit's emphasis on **fostering and maintaining links with partners across a range of industry sectors**. The case study based on Chanerley's work on correcting and analysing seismic data (UEL15-01) provides an example of our **use of cross-disciplinary and cross-institutional research to maximise the audiences for and beneficiaries of our work**. The current interest from CSI Ltd. in purchasing a commercial version of the algorithm has also informed the emphasis in our strategy and plans for the future on ensuring that these and other potential impacts of current research projects are followed through and fully realised over the coming years. The UEL team's work with CTD/Emmerson (UEL15-02), which led to their adoption of new design and manufacture processes allowing them to maintain their market share in difficult economic conditions, arose partly from our capacity to capitalise on the opportunities provided by our **alumni network.** The case study also describes the impacts of work supported by **joint funding**.