Institution: University of Wales, Trinity Saint David

Unit of Assessment: 15

Title of case study: Knowledge Transfer Centre in NDT

1. Summary of the impact

Following the 2005 inauguration of the joint Non-Destructive Testing Validation Centre with TWI Ltd at Port Talbot, UWTSD: Swansea Metropolitan established a Knowledge Transfer Centre (KTC) in 2008 with European Regional Development Funds (ERDF) and UWTSD funding. The role of the KTC is to support Welsh Manufacturing Industry in the conjunction of NDT with Composites Fabrication. With additional funding from the pan-Wales ASTUTE project, two Prince of Wales Innovation Scholarships, two EPSRC/Industry CASE studentships, one in NDT and the other in Composites, the Unit has assisted 46 companies across Wales, undertaken 32 collaborative industrial projects and has created 5 jobs. Investment induced has totalled £282,482 to date and the Unit has established itself as a leading NDT centre of expertise. Industrial engagement includes research and development with leading NDT companies such as TWI Ltd, Silverwing Ltd, Oceaneering Ltd, and manufacturing companies such as Calsonic Kansei Ltd, Tata Steel and United Aerospace Ltd.

2. Underpinning research

Underpinning research in ultrasonic time-of-flight NDT was supported by ERDF Grant KTC 1004 and was primarily concerned with improving lateral positioning and resolution of weld defects by using multiple transducers and advanced signal processing techniques. This underpinning research is evidenced in Section 3 by references 1-6. This work was initially sponsored by EPSRC and Silverwing Ltd. This work was further extended to encompass phased array, full matrix capture and virtual source ultrasonic imaging techniques sponsored by a Prince of Wales Innovation Scholarship in partnership with TWI Ltd. This work was led by Prof Donne, Prof Wells and Dr Peter Charlton from 2008 through to the present. Donne is Project Director of the KTC and Charlton is a Senior Research Fellow in NDT.

The key commercial benefits of the research to the industrial partners include:

- The demonstration that improvements in weld defect sizing can be achieved through the use of additional receiver transducers to provide lateral defect positioning when using the ultrasonic time-of-flight diffraction method along with finite difference time reversal and Kirchhoff migration algorithms;
- The ability to perform real-time full matrix capture and total focussing ultrasound imaging methods for a variety of NDT inspection applications;
- Development of improved defect imaging through the development and use of novel synthetic aperture focussing and virtual source aperture ultrasound imaging algorithms providing medical ultrasound imaging capabilities to the NDT sector.

Underpinning research in thermographic NDT, with associated computational modelling, is evidenced in Section 3 by references 7-9. This research is targeted at improving the efficiency of commercially available light-based medical devices, by applying a combination of thermography and computational modelling. This work has led to the development of a three-dimensional time-dependent radiative transport code for low energy photons with thermal transport and photochemistry included, based on 3D Monte Carlo and Boundary Element Methods using an unstructured mesh. This model is used to optimise the device's radiant energy for darker skin types, thus extending the overseas market opportunities. This work was led by Prof Donne.

3. References to the research

1. Mosey S, Charlton P and Wells I "Resolution Enhancement of Ultrasonic B-mode images" Insight(British Journal of NDT), Vol 55, No2, Feb 2013
2. Wells I, Charlton P C, Mosey S & Donne K E "Background noise removal in ultrasonic B-scan images using iterative statistical techniques*",* International Journal of Quality, Reliability in Engineering (Wiley), Vol 24, pp 873-879, June 2008
3. Sinker P, Charlton P & Donne K E "Focusing of ultrasonic data for lateral defect positioning in time-of-flight diffraction" BINDT 2009 International Conference, Blackpool, 15-17 Sept 2009
4. Sutcliffe M, Weston M, Cooper I, Charlton P , Donne K, Wright B: *"Full matrix capture with time efficient auto-focusing of unknown geometry through dual-layered media"*, Insight (British Journal of NDT), Vol 55, No 6 , June 2013,
5. M. Sutcliffe,P Charlton, M. Weston, B. Dutton and K. Donne. *'Real-time full matrix capture for ultrasonic non-destructive testing with acceleration of post-processing through graphic hardware'* NDT&E International Vol. 51, October 2012.
6. M. Sutcliffe, P Charlton, M. Weston, B. Dutton and K. Donne *'Virtual source aperture imaging for non-destructive testing'*, Insight (British Journal of NDT) Vol. 54 No 7 July 2012.
7. Ash C, Donne K, Daniel G, Town G, Clement M, Valentine R. 'Mathematical modelling of the optimum pulse structure for safe and effective photo epilation using broadband pulsed light'. J Appl Clin Med Phys 2012; 13:5:3702. doi: 10.1120/jacmp.v13i5.3702
8. Donne K E, Marotin A, Al-Hussany A and Daniel G M "*Modified Boundary Element Method to Model Radiative Transport in Biological Tissue"*
International Journal of Engineering Simulation , vol12, No 1, (March 2011)
9. Donne, K.E., Thomas, R.A., Clement R.M. (September 2004) "*Thermographic methods in Laser-Tissue interaction",* World Congress in NDT, Montreal

Evidence of quality: Applied research into Composites Manufacturing was underpinned by ERDF Grant KTC 1001 (£305,000) and EPSRC PhD CASE studentship with United Aerospace Ltd, where the PhD student was recently successful (viva 1 Nov 2013). This work has led to an ERDF Collaborative Industrial Research Project (project ENDURO) to support local companies in the design, test and analysis of composite off-road transport. Start date 26 Nov 2008 through to 31 March 2009. CIRP Project Enduro: £121,928.19. Start date 1 May 2013.

Underpinning research in ultrasonic time-of-flight NDT was supported by ERDF Grant KTC 1004. £439,904. Start date 1 September 2010 through to 31 August 2013. UWTSD contribution to the £27M pan-Wales ASTUTE project was in NDT and our income from that project is £255,685.

4. Details of the impact

Impact and benefit to the industry and the Welsh economy from the Faculty's Knowledge Transfer Activities.

The Knowledge Transfer activity in the area of NDT and Composites Manufacture over the eligible period is aggregated in the following table:

Impact measure	***Achievement***
Enterprises assisted:	46
Collaborative industrial projects transferring NDT/ manufacturing expertise:	32
Jobs created:	5
New or improved products, processes or services launched:	12
Investment induced:	£282,482

A wide variety of project work was undertaken with companies ranging from small organizations employing less than ten people to large, multi-national operations. Examples include:

- **Crown Foods** – work was undertaken with the company to optimise coating weight on the sealing ring area of can ends. Experimental work at the local manufacturing plant, combined with resources from the company's R&D centre enabled the determination of optimum coating weight to reduce leaks in cans.
- **Tata Steel** – work was undertaken to improve the effectiveness and reliability of iron ore transportation in the ore stock area of the works. This work included introducing a degree of automation, which significantly improved plant reliability, reduced downtime and improved associated health and safety for operators and maintenance personnel. The project paid for itself within twelve months.
- **Rikoset** – testing work was undertaken to assist the company in the development of high-performance shin-guards for sports men and women. These shin-guards are lighter, stronger and provide more protection than is provided by currently available products. They may also be customised to meet the needs of individuals.
- **Team Precision Piping** – this project involved ultrasonic testing of pipe assemblies for the automotive industry, which revealed significant deficiencies in the manufacturing process, particularly in the brazed joints produced. This enabled the company to make major improvements in quality.
- **Silverwing Ltd** – development of NDT analysis software to improve the capability of the company's ultrasonic testing system helped to develop new product ranges and new market opportunities overseas.
- **Ford Motor Company** – a variety of projects was undertaken with the company's South Wales engine plant. These projects focussed on aspects of process and product quality improvement, such as the reduction of corrosion-related problems in components supplied to Indian assembly plants.
- **Aeristech Ltd** – accurate 3D measurement work was undertaken to assist the company with product development.
- **United Aerospace Ltd** – this project was funded by an EPSRC CASE studentship and investigated the post-moulding machining of fibre-reinforced composite materials. A variety of NDT techniques were employed to evaluate cut-edge quality and machining conditions. This led to the identification of optimum tooling selection, supported by the development of a software application for companies to use in process planning. The student working on this project was successfully examined on 1st November 2013.
- **TWI Ltd** – Two projects have been supported by a Prince of Wales Innovation Scholarship. The first is focussed heavily on the use of pulsed and lock-in infra-red thermography to identify sub-surface damage to fibre-reinforced composites in the aerospace industry, caused by impact. This project has improved the capability of TWI in applying thermography-based NDT to aerospace related composite materials. The second project is concerned with the development of a new real-time full matrix capture ultrasonic system for detecting buried defects, leading to a new commercial product.

5. Sources to corroborate the impact

i) KTC/CIRP references : Welsh Government Project Officer

ii) POWIS PhD studentships with TWI: Manager TWI Ltd, Port Talbot

iii) POWIS PhD studentship with Cyden Ltd, Chief Scientific Officer

iv) EPSRC CASE studentship with Silverwing Ltd. Development Manager

v) EPSRC CASE studentship with United Aerospace Ltd. Managing Director