University College London; Market and Supply Chain Study for Precision- and Ultra-Precision Surfaces

Executive Summary

The National Facility for Ultra Precision Surfaces (UPS) was established at OpTIC in 2005 through a £4.2m EPSRC grant under the RCUK Basic Technology initiative. It is a partnership primarily between UCL and Glyndwr University. The Facility has grown through other grants, contract revenues, and some £2m investment from Glyndwr University. It is unique in the UK in regard to its advanced optical manufacturing and metrology expertise. Skills include opto-mechanical design; software and controls; numerical modelling; ultra-precision surface processing; metrology and data analysis; industrial robotics; and optical instrumentation systems. Research capability at the facility is focused on addressing two main global market challenges for the advanced optical manufacturing sector:

1. Automation - How to manufacture high precision complex optics faster and cheaper.

2. Quality & Precision - How to maintain and improve surface accuracy.

Over the past 2-3 years, activity has focused upon developing a volume manufacturing process targeted on the challenge of producing ca. 1,000 ultra-precision mirror segments over 7 years, valued at ca. €100m for the world's largest telescope, the European Southern Observatory's European Extremely Large Telescope (ESO E-ELT), planned to be built in Chile 2015-2022. UPS has completed the first segment for ESO acceptance and produced the only metrology system in the world capable of performing to ESO standards, being twice as accurate as those of its competitors; and the only polishing process in the world that successfully avoids edge degradation. UPS is now developing the process for licensed use by a manufacturing entity.

This process places UPS in a strategic position to play a pivotal role in proving and testing the scientific processes for optimum manufacture of high value, complex optics on a commodity scale. This is one of the largest challenges facing the global science base and optics manufacturing industry. With the size of global optical components market forecast to grow rapidly from $3.6 billion to $12.3 billion by 2019, manufacturers, end users and metrology service providers must find ways to automate off and on-machine production and metrology processes, to speed up production processes and increase surface precision down to nanometre and sub-nanometre scale. According to latest figures, the world economy is worth an estimated $30T, and optics and photonics accounts for $10T of this (Phil Stahl, NASA, and 2014 SPIE President; NASA Mirror Tech Days Conference; Albuquerque, Nov. 2014 – put as a ref). Measurement technology is key to a large part of this huge market. Indeed, the global optical component manufacturing market was worth $3.6 billion in 2012 and is anticipated to reach $12.3 billion by 2019 [ref]. Outside optics, surface quality is in many cases approaching or reaching "optical tolerances".

As a result of the ESO project, UPS has developed a suite of metrology, polishing and production work packages that will be of direct benefit to industry in addressing this technology gap. These technologies are unavailable elsewhere, and 16 key global industry players are in discussions with UPS to assist them in developing process solutions for multiple applications.

T project is to develop an industry led project to transfer the knowledge from the Basic Technology Initiative and ESO E-ELT mirror segment programme into commercial and big science applications. The project will work with key companies and science organisations (including Gooch & Housego, Hexagon Metrology, Dioptic, NPL, HIPER, UCL and Zeeko), to develop a series of platform technology demonstrators, constituting key pieces of the overall process jigsaw, that will be disseminated to the broader supply chain. These demonstrators will lay down the foundations for long-term contract research and applied science projects that will generate a sustainable income from UK and international research grants, and commercial activity through the University's commercial arm, Glyndwr Innovations Ltd.

On the successful completion of this 9-month project, we plan to launch a larger programme of activity that establishes Glyndwr as a National and International Centre for applied research, contract research, training and skills development for the advanced optical manufacturing industry. We have letters of support from both industry and academic partners indicating that they are seeking genuine long-term collaborations with Glyndwr to facilitate this ongoing technology transfer.

This project will output c.60 Industrial, Academic and Science Programme Engagements, 7 new demonstrator processes/services, 15 Enterprises Assisted, 12 Collaborative R&D projects scoped for follow on funding, £450k R&D funding, 3 Industry Workshopsand 10 Partnerships / Affiliations. Our partners indicate that it will support them in the creation over 80 new jobs and over £80m revenue generation.

The proposed development is a targeted output of the EPSRC funding that founded the Centre.