

<p><b>Institution: University of the West of Scotland</b></p>
<p><b>Unit of Assessment: 11</b></p>
<p><b>Title of case study:</b> Centre for Enabling Technology Generates Economic Impact on a Worldwide Scale</p>
<p><b>1. Summary of the impact</b> (indicative maximum 100 words)          The Scottish Centre for Enabling Technologies (SCET) operates as a core element of UWS's Knowledge Exchange Strategy. Formed in 2008 to redress the effects of increasing offshoring in the UK IT industry (high-valued jobs being sourced outside the UK), SCET has assisted over <b>175</b> companies with short-term project interventions in creative technologies (database, web and mobile applications) since its formation. SCET's activities have been evaluated, and economic impact has been shown to exceed <b>£80m</b>. Companies report increased investment in innovation by <b>£4.6m</b>, <b>200</b> new products or processes introduced, almost <b>500</b> new jobs created, <b>940</b> jobs safeguarded and <b>9</b> new companies formed.</p>
<p><b>2. Underpinning research</b> (indicative maximum 500 words)          The Institute of Creative Technologies and Applied Computing (ICTAC) in the School of Computing has a major focus on the commercial applications of technology, in line with the Institution's own strategy on supporting the local economies of our 4 regional campuses, and this manifests itself in a wide range of applied research projects with companies. These were predominantly funded by a range of KTP, SCORE (Scottish Government SME Collaborative Research) and other proof of concept/principle funds.</p> <p>Research by Gray and Connolly (Director of the ICTAC at UWS) (2005-2008) (PAPER1), highlighted the challenges to the software and creative technologies industries of the practice of increasing offshoring of software development in the early 2000s, and identified major threats to the industry going forward.</p> <p>Gray and Connolly argued against the perceived wisdom in the government of the era that basic coding jobs were commodities due to the large number of surplus graduates being produced by India and China, and that the industry should thus focus instead on high-end activities such as project management, domain knowledge expertise and technical architecture. To do so would, they argued, skew the entire shape of the industry to such a degree that there would be insufficient employees at the lower levels to feed the sector with experienced staff in the future. They predicted that interventions would lead to a shift in the industry's hierarchical structure, which would make it unsustainable.</p> <p>The research identified that confusion and uncertainty persisted within government, business and education as to what skills would be required to make the UK IT industry globally competitive, and how these skills could be developed and taught in a timely manner using the UK education system. Key findings from the research were:</p> <ol style="list-style-type: none"> <li>1. That future skills required by the UK IT industry would present a major lifestyle change for many parts of the IT workforce;</li> <li>2. That government needed to take a holistic strategy for the UK IT sector to position itself for future competitive advantage, or risk losing a prized high technology industry to developing countries;</li> <li>3. That Higher Education Institutions would play a major role in developing the supply of skills needed for the UK to compete globally, and that there was a clear need for government policy and business to inform educational directions.</li> </ol> <p>Other research helped underpin a number of key interactions with industry, particularly web-based component architectures. For example, Connolly and Beeby (PAPER 2) proposed and developed a dynamic component-based architecture using a variant of the Model View Controller (MVC) and Model-View-ViewModel (MVVM) patterns, which we termed MVDVM (Model-View-DynamicView</p>

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Model). This proposed architecture was evaluated in a number of live industry projects (KTP CC Technology; KTP Invec Solutions) and was shown to have better performance than existing models. Research by Connolly et al. (PAPERS 3 and 4) proposed a novel transaction model for disconnected architectures that was subsequently implemented in industry (KTP Invec Solutions) to provide significant transaction throughput and reduce abort rates.

### Key Researchers for SCET

Professor Thomas M Connolly, Director of SCET; Director of ICTAC (all grants)

Dr Fraser Clark (KTPs with VMS, GMI; various SFC projects)

Dr Richard Beeby (KTPs with CC Technology, Cooper Software, Invec Solutions; SFC projects)

Dr Graeme McRobbie (KTPs with UK Whitegoods)

Dr John Nixon (KTPs with UK Whitegoods)

Dr Thomas Hainey (various SFC projects)

Professor Malcolm Crowe (transaction model research)

### 3. References to the research (indicative maximum of six references)

PAPER 1: Gray, W and Connolly, T.M. (2008). The Impact of offshoring in the IT Workforce within the UK, *International Journal of Information Technology and Management*, Vol 7, Issue 4, pp. 356-373

PAPER 2: Baillie, G., Allan, D., Armour, B., Milne, R., Connolly, T.M. and Beeby, R. (2011). A Model-View-DynamicViewModel and its Performance in a Web-based Component Architecture. *Twenty-Third International Conference on Software Engineering and Knowledge Engineering (SEKE 2011)*, July 7-9, 2011, Miami

PAPER 3: Lessner, T., Laux, F., Connolly, T. M., Crowe, M., (2011). Transactional Composition and Currency Control in Disconnected Computing, *International Journal on Advances in Software*, Vol 2, No 3 and 4, pp. 442-460

PAPER 4: Lessner, T., Laux, F., Connolly, T., Branki, C. and Crowe, M.K. (2011). An Optimistic Transaction Model for a Disconnected Integration Architecture, *3<sup>rd</sup> International Conference on Advances in Databases, Knowledge, and Data Applications (DBKDA 2011)*, January 23-28, 2011, St. Maarten, The Netherlands Antilles.

PAPER 5: Connolly, T.M., Boyle, E. A., MacArthur, E., Hainey, T. and Boyle, J. M. (2012). A systematic literature review of the empirical evidence on computer games and serious games, *Computers & Education*. 59, 661 – 686.

PAPER 6: Connolly, T.M., MacPhail, A., Scott, D.W. (2010). Developing a Web-based MIS System for Occupational Health, *6<sup>th</sup> International Conference on Web Information Systems and Technologies (WEBIST)*, 7 - 10 April, 2010 Valencia, Spain.

### Grants

#### Scottish Government/Scottish Enterprise

- Scottish Centre for Enabling Technologies (SCET), funded through the SEEKIT programme (2008-2012), £1,108,514

#### KTP (Technology Strategy Board)

- VMS Ltd, 2006-2008, £68,743
- Gas Measurement Instruments Ltd, 2009-2011, £74,898
- Occupational Health Records Platform (for Sterling Healthcare, 2007-2009), £111,463
- Web2.0/SaaS business platform (for UK Whitegoods, 2010-2012), £156,086
- Grant Management Technology Platform (for CC Technology Ltd, 2010-2012), £128,873
- MiView Business Intelligence Platform (for Cooper Software Ltd, 2010-2011), £128,873

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- VIPER 2 Technology Platform (for Invec Solutions Ltd, 2010-2011), £128,480
- Mobile B2B/B2C Platform (for UK Whitegoods, 2012-2014), £122,545
- Physical Properties Database Software (PPDS) (for TUV SUD, started Oct 2013), £81,323

**Scottish Funding Council**

- 28 company Innovation projects (£163,000) (2012-2013)

**R&D projects**

- Variety of company R&D projects, £454,410

**4. Details of the impact** (indicative maximum 750 words)

The key findings of the research in the publication “The Impact of offshoring in the IT Workforce within the UK” identified an urgent need for business, government and HE to work in parallel to develop and support the industry, strengthening it against the threat of increasing offshoring.

As a direct consequence of these findings, UWS, working with Glasgow School of Art and Glasgow University, designed and led an intervention – the Scottish Centre for Enabling Technology – to facilitate cooperation in R&D and knowledge exchange related to enabling technologies for content and knowledge management. In particular, it was designed to stimulate contact with SMEs and start-up companies that had the potential to benefit from productive knowledge and technology transfer, and were willing to innovate to help achieve a competitive edge.

The project was pitched to Scottish Government on the basis of the issues emerging from the research and also attracted support from Scottish Enterprise. As noted by Scottish Enterprise: “*His [Connolly's] paper on offshoring in the computing sector was also pivotal in attracting support to a sector that was in danger of being systematically weakened by low cost programming sourced outside the UK, and particularly Scotland.*” This research focus was strengthened by other publications derived from projects working directly with industry, principally on implementing web-based component architectures in service-oriented commercial entities, as evidenced by the statement from CC Technology: “*We were initially attracted to working with UWS because of underpinning research performed by Professor Connolly and his team at the University on database systems, component architectures and offshoring.*”

The project initially ran from 2008 to 2010, being the only SEEKIT project to have an expansion of funding and targets during the initial project period, and then going on to receive a further project time extension to the end of 2011. During the funding period, over 150 companies were assisted directly through the provision of University expertise to develop proof of concept demonstrators, and SCET’s activities were evaluated as part of the final reporting process. The economic impact has been shown to exceed **£80m**. Companies report increased investment in innovation by **£4.6m**, **200** new products or processes introduced, almost **500** new jobs created, **940** jobs safeguarded and **9** new companies formed.

Since the end of the external funding period, UWS has continued to invest in SCET infrastructure and staffing as the Centre continues to play a central role of its Knowledge Exchange strategy. Today SCET continues to employ 4 externally facing researchers on a sustainable basis. Since the end of the formal funding period, SCET has continued to attract funding directly from Scottish Enterprise and the Scottish Funding Council to underpin company projects and has completed a further 50+ projects.

SCET provides an initial entry point to the HE sector, addressing the first major gap in the links between business, government and HEIs. Following initial project delivery, companies are encouraged to maintain on-going relationships with the University and these incremental relationships have led to successful follow-on projects funded through R&D Tax Credits, direct investment SFC or SE follow-on funds and/or KTP funds.

As an example, initial work with a local SME - Invec Technologies - led from a SCORE funded project to a KTP project and then to a direct investment of more than £0.5m for UWS to help develop their web-enabled product and workflow tracking back-end systems. As a direct result of

**Impact case study (REF3b)**

Invec's high-end systems, it was acquired during our collaboration by US-based multinational Celestica. UWS was then quickly hired to help the underpinning R&D to redesign the Invec systems for the US, Canada, Mexico, the Czech Republic and Thailand. Figures supplied to UWS by Celestica indicate that the UWS supported system development increased turnover on a per country basis to the tune of **\$40m**. In addition, the system also "*had a strategic impact on Celestica, significantly changing the way the company operates its worldwide service operations*".

For CC Technology, a new platform was developed through a KTP project that allowed the company to expand and diversify its provision. From an economic perspective, the company estimated that "*annual sales turnover increased by about £250,000 and annual exporting sales increased by about £100,000 during the two-year project, and contributed to our winning of a very prestigious and valuable contract in India. We have estimated that over the next three years, the KTP project will increase our pre-tax profits by £750,000*". The project has also had a strategic impact on CC Technology, significantly changing the way the company handles its software development processes leading to a more efficient and effective software products.

SCET is now a key part of the core UWS KE Strategy. It has been praised as a highly successful SEEKIT project, and has had a significant impact during a major economic downturn both in economic terms (increased turnover and direct investment) and human terms (jobs created and protected). Much of these inputs and many of the impacts have been directed towards the developing creative industries in Scotland.

**5. Sources to corroborate the impact** (indicative maximum of 10 references)

Final Report for the Scottish Government/Scottish Funded SEEKIT Project

Final Report for the KTP projects for Crawford Scientific, Sterling Healthcare, CC Technology, and Invec/Celestica, UK Whitegoods

SFC CASE STUDY (KE REPORT 2012)

Corroborating statement from Scottish Enterprise

Corroborating statement from Celestica

Corroborating statement from Crawford Scientific

Corroborating statement from CC Technology