Institution: Plymouth University

Unit of Assessment: 34

Title of case study: Operating Systems: Harvesting Data

1. Summary of the impact (indicative maximum 100 words)

i-DAT has developed an open infrastructure for 'harvesting' and visualising data to support collaborative interdisciplinary projects in environmental, social and cultural contexts. Framed as a series of 'Operating Systems' this research contributes to the strategic activities of not-for-profit, public, private and community sectors, including Arts Council England, Plymouth City Council, UNESCO Biosphere and World Heritage Sites. Through i-DAT's National Portfolio Organisation status, this research delivers significant audience numbers and new work and contributes to and can be measured against impacts in relation to civil society, cultural life, policy making, public services and, to a lesser extent, economic prosperity.

2. Underpinning research (indicative maximum 500 words)

i-DAT's underpinning research concerns are making 'data' generated by human, ecological, economic and societal activity tangible and readily available to the public, artists, engineers and scientists for artistic expression with a cultural and / or a social impact. It involves designing and constructing networked sensors and software platforms that focus on the significance that harvesting, processing and the manifestation of data can play in contemporary culture.

This practice-based approach engages pragmatically with people, communities and institutions through collaborative and participatory design methods and has been supported by a range of grant funding. The team led by Prof Mike Phillips, with B Aga (Director of Operations), Gianni Corino (Associate Professor) and Dr Simon Lock (Lecturer) explores the use of digital technologies to evaluate and measure the impact of human activity by building real-time models that incorporate quantitative and qualitative metrics. Professor Chris Speed worked for Phillips at i-DAT on the original Arch-OS development team prior to moving to the University of Edinburgh. The collaboration is maintained through the co-editorship of *Ubiquity, the Journal of Pervasive Media* and the underpinning Operating Systems research continues to provide a platform for Speed's current research. Phillips was approached by Thomas and Malcolm (Curtin Gallery) to bid for the commission to further develop the Operating Research to the Woods Bagot architecture. Phillips led the research from Plymouth whilst Thomas and Malcolm managed organisational relationships with the funders from Perth.

The innovative 'Operating Systems' originate in the Arch-OS (2005) collaborative research project, which brought together architects, software engineers, artists and designers to create a real-time digital model of a building. This involved creating code to access closed industrial Building Energy Management Systems, developing new sensors and providing an open access platform to the data for further commissions. The research gave new insights into the social, cultural and ecological possibilities of coupling real-time data with physical objects and spaces and is evident through the design and construction 'random' lift button's, a vision system to track building inhabitants, responsive robotic architecture, 3D audio system, experimental database design for streaming data to social networks and methods for visualising and sonifying the ecological footprint of a building.

Further iterations were developed in collaboration with international Architectural practices, engineers and Architecture Schools, leading to the 'i-500' public art commission which was opened in 2010 ($230,000 AU) for Curtin University's new research building in Perth, WA. This research has subsequently been embedded in the EPSRC eViz project for the visualisation for carbon reduction) project (£1.8m) as a strategy for behavioural change.

The elements of the Arch-OS system, consolidated in a single platform in 2010, have been

developed in a modular fashion each with a specific context and opportunities for new art works and audience engagement as for example: **S-OS** (2008-) [Social operating system] S-OS uses a range of analytical tools to explore the comparison of quantitative and qualitative data providing a platform for increased audience engagement, participation, and feedback at cultural and public events. Partners include Plymouth City Council, Cornwall Mining Heritage and Cheltenham Festivals.
Dome-OS (2009 -) The research has established new production processes, designed, coded, constructed, commissioned and curated software and hardware to visualise complex real-time data sets. Taking advantage of the Plymouth University's Immersive Vision Theatre the research has been a catalyst for interdisciplinary collaborations within international FullDome community.
Bio-OS (2010 -) [Biological operating system] This harvests data from the body using specially developed biosensors, mobile phones, and real-time feeds to enable social gaming, performance, and medical collaborations and involves collaborations with commissioned artists, IBM and Deriford Hospital in Plymouth, and the Charity Rosetta Life.
Eco-OS (2010 -) [Ecological operating system] This collects environmental data through remote networked sensors ('ecoids') developed in-house by the research team. It has been used in funded projects with UNESCO Biosphere and World Heritage sites and provided a platform for an interdisciplinary dialogue between schools, the public, artists and scientists.

A series of exhibitions have applied the data capture and visualisation/sonification process developed through the research to scientific imaging narratives. Most notable among these are Phillips's 'Exposure' Exhibition at UCLA Art Sci Centre (http://artsci.ucla.edu/?q=events/mike-phillips-lecture-exhibition-opening), his 'spectre ['spɛktə/]' at the Schauraum Wien, and his 'A Mote it is…' for Art in the Age of Nano Technology at the John Curtin Gallery, University of Technology, Perth (http://www.i-dat.org/a-mote-it-is-update/).

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

Thomas, P. Malcolm, C. Phillips, M. i-500 Project. The project applied the Arch-OS kernel from the Operating Systems research to a Public Artwork commission following an open competition (incorporating Arch-OS), artwork installation for the Curtin University Minerals and Chemistry Research and Education Building. Commission by Curtin University of Technology, John Curtin Gallery and Woods Bagot Architects. AU$230,000.00. 02/2010.

Phillips, M., Speed, C., (2010). La reificazione dei dati. *REM, Ricerche su Educazione e Media*, 2 (2), pp.245-258. International peer-reviewed journal. The paper locates this practice-based research in networked objects and data harvesting within a cultural discourse around 'place', 'space' and 'temporal' concerns pertinent to the emergence of the 'Internet of Things'.

Phillips, M., Speed, C. (2012) 'Ubiquity: A paranoid manifesto'*. Ubiquity. The Journal of Pervasive Media*, 1:1. 3-6. Editorial manifesto statement for new international peer reviewed journal for creative and transdisciplinary practitioners. This journal emerged through the collaboration of the editors on the Arch-OS project and its contribution to the emergence of the Internet of Things.

Phillips, M. (2012): There is no dome?, *Digital Creativity*, 23:1, 48-57. International peer-reviewed journal at the intersection of the creative arts and digital technologies. The paper is a component of the FullDome special issue 23:1 of Digital Creativity, guest edited by Phillips in collaboration with Nick Lambert from Birkbeck, University of London. It frames the international research initiative around the liberation of FullDome environments from the hegemony of the Planetarium.

Phillips, M. (2011) 'Human Geography*.* in Ascott, R., Girao, M., ed. *Presence in the Mindfield: Art, Identity and the Technology of Transformation.* Lisbon, Portugal: Artshare-Universidade de Aveiro, pp. 226-230. ISBN 978-972-789-356-0. The paper explores a new pornography of the body through its exposure to the crowd through new imaging technologies. It articulates the emergence of Bio-OS and the development of the Bio-OS tools through several artist commissions and a series of 'Data Labs'.

Phillips, M, Aga, B., Hazelden, K.(2008) "The Play Algorithm - A(n):= [r = 1,2,…..N]". In Deiz del

Corral, A. (ed), HOMO LUDENS LUDENS, Locating play in contemporary culture and society. LABoral Centro de Arte y Creación Industrial. Gijón, Asturias, Spain: pp 244-248. This paper articulates the data capture and algorithmic approach developed through the Arch-OS project and applies it to an urban play and learning context.

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

This research provides a platform for artists, technologists and scientists to develop new research and creative work. Its intention is to foster new relationships and collaborations with a range of stakeholders, disciplines and communities and has a wide variety of impacts.

In 2012 i-DAT (http://www.i-dat.org) secured Arts Council National Portfolio Organization status on the basis of this research, following a highly competitive national application process. The research consistently delivers well above ACE expectations as evidenced in the significant increase in audience numbers. Since 2008-2011 this research supported 215 artists with 4059 participants and an audience of 24178. This was generated through 608 exhibition days, 57 new commissions and 702 days of employment for artists and 319 training sessions. As an indicator of cultural impact i-DAT's audience figures have increased from 5000 in 2011/12 to 1478,380 in 2012/13. Of this 1473,167 are online, and 5,213 offline. 882 CYP workshops and collaborations have been delivered.

Prof Phillips research is actively contributing to Policy Making through his involvement with Arts Council England's cultural strategy, the regional Arts Council England SW Digital Reference Group, the TSB Internet of Things Special Interest Group and the AHRC Internet of Things Advisory Board. Strong relationships established with Arts organisations, artists, SME's, Councils and the third sector on the back of this research provides significant economic impact. This includes sponsorship from IBM for the Smarter Planet R&D studio at Plymouth University.

Bio-OS supported a collaboration (2011) with the E-Health and Health Informatics research group at Plymouth University Faculty of Health, Derriford Hospital and IBM Smarter Planet to design a prototype intelligent catheter ('iWee') to address costs to the NHS of treating catheter-induced infections.

S-OS Civil Society, Policy making and Public services impacts include a collaboration with Plymouth City Council (PCC) supporting the development of the city 'Visitors Plan' and ways to attract and support tourists. The research also assisted the PCC successful first stage TSB Future City Catapult (£50,000) and provided an information system to collect social network data and sentiment analysis for the British Art Show 7 (2011) and the Economic Impact report commissioned by PCC. This led to the Cheltenham Science Festival Keji (2012) installation and recently the NESTA Digital R&D award (£127,000 in cooperation with Cheltenham Festivals and Warwick University and supported by Facebook) for the Qualia Project, a real-time monitoring system to collate the economic, cultural and social impact of cultural events.

Eco-OS has contributed involved public engagement with schools through workshops and artists commissions. For example, Eco-OS provided the platform for the Confluence project (2011-12), funded by Leader 4 and Arts Council England, in collaboration with Beaford Arts, Appledore Arts, North Devon Biosphere Reserve, involving eight schools and four artists. According to Andrew Bell, Biosphere Reserve Coordinator, "A major benefit from the project was the trans-disciplinary working; which put the Biosphere Reserve scientific people in contact with technicians developing the sensors and the lead artists to explore and challenge ideas and concepts and provide new inspiration for portraying information (See source 5 below).

Dr Fish of the Centre for Rural Policy Research University of Exeter sees the Confluence Project as "part of the work enabling communities to orientate themselves towards the lived realities of environmental change and innovate within their changing circumstances." and "as much as the rational technocracies of policy and decision making might otherwise imply, environment processes need to be felt as much as understood." (See source 5 below). Extremely positive

responses from the participants and audiences support this insight: “A way of stimulating the mind to look at the environment through data capture. Wow!” and “Gorgeous use of data. Dreamy, one minute I was flying then swimming underwater” (See source 5 below). The research facilitated 3 Village Hall roadshows, 39 workshops with schools with a total of 1673 people. The Confluence project’s audience engagement contributed to a £750,000 award to the North Devon Biosphere (totalling £3 million with partnership contributions) from DEFRA for a Nature Improvement Area.

Dome-OS has established an international fulldome festival, FULLDOMEUK (http://www.fulldome.org.uk/) which is the catalyst for an international network that is informing policy making in the fulldome community (led by IMERSA, USA), initiating new licensing, distribution and production and display technologies and practices. i-DAT’s work with real-time data is creating new opportunities for creative workers in the field and supporting interdisciplinary collaborations for scientific visualisation. This research has been consolidated by the establishment of the European Mobile Dome Lab for International Media Artists funded by the EU Culture Programme, Strand 1.3.5, €200k (project # 545974), 09/2013, with University of Applied Arts Vienna (lead), NTLab - University of Athens (GR), Trans-Media-Akademie Hellerau (DE), Society for Arts and Technology (CA) - Université Laval (CA).

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

(1) i-DAT’s Arts Council National Portfolio Organisation status and mission are articulated here: (http://www.artscouncil.org.uk/funding/our-investment/funding-programmes/national-portfolio-funding-programme/). This describes the Arts Council England’s decision process and the selection criteria based on their recognition of the successful organisations documented impact. Achieving great art for everyone, A strategic framework for the arts’ describes the NPO’s mission and criteria (http://www.artscouncil.org.uk/publication_archive/strategic-framework-arts/) and ‘The relationship between the Arts Council and funded organisations’ (http://www.artscouncil.org.uk/advice-and-guidance/browse-advice-and-guidance/relationship-between-arts-council-and-funded-organisations).

(2) Statement from Arts Council England on impact of iDAT research.

(3) Statement from Plymouth City Council of the impact of the research. The resulting Visitors Plan is published at http://www.plymouth.gov.uk/plymouth_visitor_plan.pdf

(4) Statement from Cheltenham Festivals on impact of S-OS projects at Cheltenham Festival. Background information at http://www.keji.co.uk/, http://www.artsdigitalrnd.org.uk/content/first-funded-projects-digital-rd-programme-announced, and http://qualia.org.uk/

(5) The Confluence Project Brochure (http://confluence-project.org/) describing the impacts and outcomes of the project by North Devon Biosphere Reserve, Beaford Arts, and the Centre for Rural Policy Research University of Exeter.

(6) Statement from IMERSA (Immersive Media Entertainment, Research, Science & Art) on the FullDome UK Festival. Background details at http://www.fulldome.org.uk/

(7) Phillips special role as contributing presenter and facilitator in the Technology Strategy Board Special Interest Group “Roadmap for interdisciplinary research- Culture, creative and design and its workshops: http://bit.ly/17dmoJ6

(8) Statement from IBM Smarter Planet on the research and development collaboration with i-DAT, including establishing the Plymouth University ‘Smarter Planet Lab’.

(9) Statement from international consultant on UNESCO World Heritage Sites on the impact of i-DAT’s research on the heritage sites within the South West region.